EXAMINING THE REGISTRATION FOR AND UNREALIZED BENEFITS FROM BC'S FAIR PHARMACARE PLAN

by

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Abstract

Background: Fair PharmaCare is a catastrophic public drug plan which is available to all the residents of British Columbia. Coverage is determined by income-based deductibles and therefore requires households to self register and consent to allowing the Canada Revenue Agency to release their income information to the BC Ministry of Health. In the absence of registration, households are assigned the highest deductible of $10,000. In 2019, the government reduced and eliminated deductibles and the family maximum for lower income households. It remains unclear why many households are not registered and whether they could derive additional benefit from registering.

Methods: This thesis used administrative data to examine the association between household level, area-based, and needs-based characteristics and time until registration using survival analysis. Interrupted time series analysis was performed to evaluate the impacts of the 2019 policy change on registration rates, as well as the association between registration, drug utilization, and drug expenditures. Simulation methods were used to estimate the unrealized benefits from households not registering.

Results: We found a strong association between needs-based factors and registration for Fair PharmaCare. The 2019 policy change that lowered deductibles and coinsurance for lower income households did not result in a change in Fair PharmaCare registration rates, suggesting that there are other factors impacting registration amongst the population not registered for Fair PharmaCare. In the year of registration for Fair PharmaCare, a significant increase in drug expenditures and drug utilization was observed, followed by decreasing drug expenditures and a sustained level of drug utilization over time. If full registration for Fair PharmaCare occurred, we estimated there would be only small changes to private payer savings per household and a very small increase to the PharmaCare budget.

Conclusion: Households register for Fair PharmaCare when the need arises, and until the need arises, even if deductibles and coinsurance are lowered, further registration does not appear to occur. The province would not face large expenditures if the full population were to register in Fair PharmaCare. However, the incentive to register amongst those not yet registered is likely small as most households have minimal drug expenditures.

Lay Summary

Fair PharmaCare is the catastrophic public drug plan available to all BC residents. As the program uses income-based deductibles to determine coverage, it requires households to self register. Many households are not registered in the program. On January 1, 2019 the BC government reduced Fair PharmaCare's deductibles and copayments for lower income households. This thesis investigated the factors associated with registration, the impact of the policy change on registration rates, the association between registration, drug expenditures and drug utilization, and finally it estimated the potential benefits left unrealized due to lack of registration. Overall, we observed that households register for Fair PharmaCare when the need arises, and until then, registration will likely not significantly improve population level access to medicines and health outcomes. However, focusing efforts on increasing registration amongst households with poorer health will provide a concentrated benefit to this group at a nominal cost against the PharmaCare budget.

Preface

The work presented in this manuscript was written and performed by Candice Chiu under the supervision of Dr. Michael Law. With guidance from Dr. Law, Candice constructed the research questions, developed and executed the data analysis, and wrote the findings. The members of the thesis committee, Dr. Kimberlyn McGrail and Dr. Mary De Vera provided feedback on the results and manuscript. Other members from the UBC Centre for Health Services and Policy Research (CHSPR) including Yan (Lucy) Cheng (Statistician) and Heather Morgan (Research Coordinator) provided support and feedback around the data analysis and manuscript respectively.

The four studies that comprise this thesis were conducted as part of Dr. Law's broader research program: "Improving Access to Medicines in Canada and Abroad". Ethics approval was obtained from The University of British Columbia's Behavioural Research Ethics Board under certificate number H21-01125.

None of the work contained within this dissertation are taken directly from previously published or collaborative articles. All inferences, opinions, and conclusions drawn from this work are those of the author, Candice Chiu, and do not reflect the opinions or policies of the Data Steward(s) at Population Data BC.

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List of Abbreviations

ACF	Autocorrelation function
ADGs	Aggregated Diagnostic Groups
ANOVA	Analysis of Variance
BC	British Columbia
CADTH	Canadian Agency for Drugs and Technologies in Health
CCHS	Canadian Community Health Survey
CI	Confidence Interval
CIHI	Canadian Institute for Health Information
cITS	Controlled Interrupted Time Series
Cox PH	Cox Proportional Hazards
CRA	Canada Revenue Agency
CRNA	Cost-related nonadherence
FHA	Fraser Health Authority
HH	Household
HR	Hazard Ratio
IFHP	Interim Federal Health Program
IFHP	Interim Federal Health program
IHA	Interior Health Authority
INESS	L'Institut national d'excellence en sante et en services sociaux
ITS	Interrupted Time Series
LRT	Likelihood Ratio Test
MSP	Medical Services Plan
NHA	Northern Health Authority
OECD	Organization for Economic Cooperation and Development

PACF	Partial autocorrelation function
pCPA	pan-Canadian Pharmaceutical Alliance
SDRP	Social Development and Poverty Reduction
SES	Socioeconomic status
SRE	Secure Research Environment
VCHA	Vancouver Coastal Health Authority
VIHA	Vancouver Island Health Authority

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I would like to thank the incredible research community at CHSPR for always being an inspiration to work alongside, especially through opportunities to learn about their research work. I would like to thank all the professors and mentors who have equipped me with the necessary research and life skills, particularly Dr. David Whitehurst who introduced me to the world of health services research and taught me all my foundational skills.

To all the friends and my support group for always being a listening ear to the hills and valleys of my research, keeping me accountable to completing this thesis and encouraging me throughout this degree. To my family, thank you for your unconditional love, patience and understanding which allowed me to pursue this degree and research work. None of this would have been possible without all the individuals mentioned above.

Dedication

This thesis is dedicated to the Canadian Healthcare System.

Chapter 1 – Introduction

1.1 Access to Prescription Medicines in Canada

While the Canada Health Act mandates that all insurance plans covering hospital and physician services be publicly administered, comprehensive, universal, portable, and accessible, these rules do not cover prescription drugs.[1, 2] This remains the case today despite at least five commissioned reports on pharmacare over the past 50 years. All of these, from the 1964 Royal Commission on Health Services report to the 2019 Achieving Pharmacare for All report, recommend that some form of universal pharmacare be adopted in Canada.[2, 3] Indeed, there is currently no national standard for prescription drug coverage, and each province is left to decide who, what, how, and if it will cover prescription drugs. In the absence of a national approach, prescription drug coverage in Canada is made up of a patchwork of public and private drug plans that leave people facing a number of cost-related barriers to accessing the prescription medications that are medically necessary for their health.[3, 4]

1.2 Drug Expenditures in Canada

In 2019, Canada spent $34.3 billion on prescription medicines, which was a 2.7% increase from 2018.[5] This represented 15.2% of total health spending, the second highest category of healthcare costs in the country.[3, 6] The average annual rate of increase over the last 30 years for prescription drug costs, at 8.1%, outpaces other health services.[3, 7] However, it is also worth noting that the average annual growth rate of drug expenditures has been declining recently, from 8% between 2000 and 2009 to 2% between 2010 and 2019.[6] Overall, Canada's prescription drug spending is comparatively high: out of the Organization for Economic Cooperation and Development (OECD) countries, it's total per capita expenditure on pharmaceuticals is 43% higher than the average and is only surpassed by the United States and Switzerland.[8]

In response to this level of spending, there have been many initiatives to reduce costs. The most prominent recent initiative has been the creation of the pan-Canadian Pharmaceutical Alliance (pCPA),

which negotiates drug prices on behalf of public payors in Canada.[9] As of March 31, 2020, the pCPA realized $2.58 billion in annual savings through collective negotiations with both brand name and generic manufacturers.[5, 9, 10] These negotiations fit into the Canadian drug review and approval process after Health Canada has authorized drugs for sale based on safety, efficacy and quality, and Canadian Agency for Drugs and Technologies in Health (CADTH) and L'Institut national d'excellence en sante et en services sociaux (INESS) have reviewed and recommended whether a drug should be reimbursed based on clinical and cost-effectiveness.[9] However, these reimbursement recommendations and collective negotiations are only applicable to public drug plans, each of which can still decide independently what drugs they will cover.[9]

In response to growing expenditures, public drug plans in Canada have also employed cost-sharing mechanisms to transfer costs to patients. In particular, coinsurance and deductibles are very common. Coinsurance is a cost-shifting mechanism where the insurer pays the stated percentage of total drug costs and the beneficiary pays the remainder.[11] In contrast, a deductible is a cost-shifting mechanism where the beneficiary has to spend over the deductible amount before they will be covered by the insurance plan.[11] The drawback of these mechanisms is that they may lead to cost-related nonadherence (CRNA), with many Canadians being unable to afford their prescription drugs.[12, 13]

1.3 The Patchwork of Drug Plans Across Canada

While some population groups such as registered First Nations, members of the Canadian forces, veterans, resettled refugees, and refugee claimants are covered under federal drug plans, most public drug plans are administered at the provincial or territorial level. Typically, these programs provide targeted coverage for particular groups (such as seniors and those with particular diseases) and those with lower incomes who have high drug costs relative to their household income.[3, 14] Catastrophic drug coverage is a form of insurance that is designed to protect individuals from facing drug expenses that would cause them undue financial hardship or threaten their financial security.[15, 16] According to the World Health

Organization, catastrophic health expenditures are those that are unaffordable unless a household cuts down on basic necessities such as food, clothing, or children's education.[15] This is why the majority of catastrophic drug plans will only provide coverage after drug expenditures exceeds a certain percentage of household income. Beyond public coverage, the costs of prescription drugs are covered through private insurance, and out-of-pocket payments.[3] According to the Canadian Institute for Health Information (CIHI), in 2019, approximately 43.6% of total drug expenditures in Canada were financed by public drug plans, 36.9% by private insurance and 19.9% paid for out-of-pocket.[5, 8]

1.4 Variations in Public Drug Plans

As public drug insurance is administered provincially, depending on where in the country an individual lives, their bill for prescription drugs may be drastically different. For illustrative purposes, in a study by Clement et al., it was found that a patient older than 65 years old with annual net income of about $55,600 would pay less than $100 for a 3-month dispensation of 20mg/d of citalopram, 5mg/d of aripiprazole and 7.5 mg/d of zopiclone under a public drug plan in Alberta, Saskatchewan, Ontario, Newfoundland, and PEI, but would pay $300 in BC, and $390, the full cost of the drugs, in Manitoba.[17] Oral oncology medication is another example of how public coverage varies drastically across the country – in provinces like BC, Alberta, Saskatchewan, Manitoba, and Quebec, oral chemotherapy drugs are fully covered, whereas in provinces like Ontario if you are between the ages of 25 and 65 and not on social assistance, you would be subject to the deductibles of the province's catastrophic Trillium Drug Program plan (approximately 4% of household income) prior to receiving coverage.[18, 19]

Table 1.1 shows the provincial drug coverage programs for the general adult population in each province in Canada. The majority of provinces offer catastrophic drug plans with some element of a deductible, copayment, or premium.[8, 20] Not only is the coverage different, but the total cost of the prescription regardless of payer is also drastically different; in the same example from Clement et al., set in 2018, the total cost of the same prescription ranges from $350 to $700 across different provinces.[17] This scenario

demonstrates there are differing financial barriers and differing cost of medications that patients face that are dependent on where in the country they live.

Table 1.1 Provincial drug coverage for the general population below 65

Province	Patient Eligibility	Coverage Details
British Columbia	No restrictions	Catastrophic coverage with income-based deductibles up to 3% of household income and 30% coinsurance between deductible and family maximum.[11]
Alberta	No restrictions	Voluntary coverage with premiums of $63.50 for an individual and $118 for a family. $50 annual deductible and 30% co-payment up to a maximum of $25.[21]
Saskatchewan	No restrictions	Catastrophic coverage with semi-annual income-based deductibles at 3.4% of household income and 35% co-payment after.[22]
Manitoba	No restrictions	Catastrophic coverage with income-based deductibles between $100 and 7.28% of household income.[23]
Ontario	No restrictions	Catastrophic coverage with income-based deductibles at ~4% of household income with up to $2 fixed copayment for each drug filled during the year.[24]
Quebec	Restricted to those not eligible for private insurance	Mandatory coverage with premiums between $0 to $710 per person. $22.25 monthly deductible per person and 35% coinsurance.[25]
Newfoundland and Labrador	No restrictions	Catastrophic coverage with deductibles ranging from 5-10% of household income.[26]
Nova Scotia	No restrictions	Catastrophic coverage with income-based deductibles up to 20% of household income and 20% coinsurance.[27]
New Brunswick	No restrictions	Voluntary coverage with annual premiums between n$200 to $2,000 and 30% copayments to a maximum of $5 to $30 per eligible prescription, depending on income.[28]
Prince Edward Island	No restrictions	Catastrophic coverage with income-based deductibles between 3% and 12% of household income.[29]

Adapted from Brandt et al.[8]

1.5 Variation in Private Drug Plans

Approximately 59.4% of Canadians have access to a private drug plan.[30] Private drug plans can be purchased directly from insurance companies, but are far more commonly provided through employers. There is currently a limited body of publicly available research on private drug insurance coverage in Canada and how it varies across employment industries and regions. However, private plans are often more generous than public plans for the general adult population, as most public coverage is generally catastrophic in nature. Past research from Ontario has found that those with private insurance have better access to medicines and are more likely to take the medications that they are prescribed than those without when individuals were compared using propensity score stratification techniques.[31]

1.6 Who in Canada is falling through the cracks?

The Canadian Community Health Survey (CCHS) is a cross-sectional survey that collects information related to health status, health care utilization and health determinants for the Canadian.[32] According to the published results of the 2016 CCHS, 19.5% of Canadians and 17.2% of Canadians with multiple chronic conditions reported having no drug insurance that covered all or part of the cost of their prescription medications.[33] There are limitations in these statistics as past studies have shown that self reported data tends to over-report the number of uninsured and under-report the number who are publicly insured.[16, 34, 35] These numbers may also be subject to recall and social desirability bias.[33, 36] However, even with these caveats, they suggest that a significant portion of the Canadian population does not have coverage for prescription drug costs they incur.

A closer look at who is reporting private, public, and no insurance that covers part of drug costs can help to show who is under or uninsured in Canada. The first area of coverage is private drug plans. Employees who work full-time, earn over $30,000 and are over the age of 25 are more likely to have access to private insurance coverage than part time workers, those earning lower wages, and those under age 25.[8] Nearly three in five (59.4%) respondents from the 2016 CCHS survey reported having private insurance that

covered all or part of the cost of their prescription medications, and the prevalence of having private insurance was positively associated with household income.[30] People aged 18-24 had slightly lower rates of insurance coverage, and people aged 65 years or more were far less likely to have private insurance coverage.[30] This means that the remainder of the population, those who are between 18-24 or over 65 years of age, working part time, and with lower household income are more likely to be either uninsured or underinsured, and thus relying on public coverage.

Second, many Canadians report being covered by a public drug plan. About one in six respondents (16.5%) reported being on a government plan that covered all or part of the cost of their prescription medications.[36] In a study that used national CCHS data for 2015 and 2016, and Ontario data across five years between 2005 and 2016, it was found that individuals with lower household income and lower educational attainment had higher odds of reporting public drug coverage.[35] Differences in drug insurance coverage was also found in self-reported health status, where those in poorer health states were more likely to report having public drug coverage.[35] Those in lower SES and older adults were more likely to report having no drug insurance.[35]

Finally, a large number of Canadians report no drug coverage that aids in the cost of their prescription drugs. Nearly one in five (19.4%) reported not having a plan that covered all or part of the cost of their prescription medications.[4, 8, 36] This suggests that those who are self-reporting that they have no drug insurance might be eligible for public drug insurance in their respective province, but are not registered for the plan, are unaware of the benefits of the plan they are enrolled in, or are not able to realize any benefits from the plans due to the cost-shifting mechanisms such as deductibles that have been implemented by governments. As such, it is important to develop an understanding of the impacts of not having drug insurance and why individuals may not have drug insurance that is covering all or part of their drug costs.

1.7 The State of Cost-Related Nonadherence in Canada

CRNA is the act of taking less medication than prescribed due to cost barriers.[36] CRNA is problematic because it leads to worsened health outcomes such as premature deaths for common conditions, as well as increased overall healthcare utilization and expenditures such as additional doctor visits, ER visits, and hospital admissions.[2, 4, 12, 36, 37] Canada's adult population suffers from a higher percentage of CRNA at a population weighted average of 10.2% in comparison to other comparable high-income countries with universal health insurance.[38] Out of comparable countries with universal public systems including Australia, New Zealand, Sweden, and the United Kingdom, the population weighted average of CRNA was 3.6%.[38] For comparable countries with social insurance systems including France, Germany, Netherlands and Switzerland, the population weighted average of CRNA was 3.8%.[38] Another recent systematic review that included sixteen studies of varying quality performed specifically on Canadian participants found that estimates of overall prevalence of CRNA ranged from 5.1% to 10.2%.[39] Included in the systematic review was a study using responses from the 2016 CCHS survey which found that 5.5% of Canadians reported being unable to afford 1 or more drugs in the prior year.[36] This study also found that BC had the highest rate of CRNA in Canada at 8.1%.[36] BC is one out of several provinces including Saskatchewan, Manitoba, and Newfoundland and Labrador that provides a catastrophic public drug plan using income-based deductibles, which leaves substantial room for out-of-pocket payments by households.[3, 4, 7, 8, 40, 41]

1.8 Predictors of Medication Cost-Related Nonadherence

A number of research studies have sought to understand potential predictors of CRNA. Some factors identified from a systematic review of the prevalence, predictors, and clinical impact of CRNA in Canada include high out-of-pocket spending, low income or financial flexibility, lack of drug insurance, younger age, and poorer health.[39] The self-reported results of respondents who had at least two or more chronic conditions in the 2016 CCHS were consistent with the findings of this systematic review, showing that

CRNA is more common in younger adults, people without employer or association drug insurance plans, those with poorer health status, people with more chronic conditions, and those who have higher out-of-pocket prescription costs.[33]

Despite having drug insurance plans, individuals may still have to pay out-of-pocket drug costs as insurers use a number of cost-shifting mechanisms such as deductibles and copayments that transfer costs to patients in an attempt to manage rising expenditures on prescription medications.[42, 43] Imposing patient charges through cost-shifting mechanisms can also lead to increased CRNA.[2, 36, 44] A systematic review synthesizing associations among cost-sharing features of prescription drug benefits and the use of prescription drugs between 1985 and 2006 found that increased cost sharing was associated with lower rates of drug treatment, worse adherence among existing users, and more frequent discontinuation of therapy.[44] The 2016 CCHS found that those with a government plan had 1.95 times higher odds and those with no plan had 3.26 times higher odds of reporting CRNA than those with an employer benefit plan.[33, 35]

Based on the examination of public drug plans across Canada described in Section 1.4, it is plausible that those relying on a government plan are more likely than those with private plans to experience CRNA, since the majority of public plans are catastrophic plans with some form of deductibles, copayments, and more tightly managed formularies.[7, 8, 20] Meanwhile, on the private insurance side, in 2020, 88% of plans used a generic substitution policy, 87% used prior authorization, 70% had coinsurance, 34% had capped dispensing fees, 23% had deductibles, 23% had managed formularies, and 20% had plan maximums.[45] These results are roughly consistent with an earlier study on cost control mechanisms in private insurance plans from 2010 which showed that among employees with private benefits, 12% of plans included deductibles, 79% included co-payments, and 19% included multi-tiered managed formularies.[12] This suggests that those relying predominantly on public drug plans may be facing more cost barriers than those relying predominantly on private drug plans.

1.9 Brief Overview of BC's Public Drug Plans

There are ten targeted needs-based public drug plans and one catastrophic drug plan available for the general public in BC.[11] The table below shows a list of all the public drug plans in BC, as described on the Government of BC Ministry of Health webpage.[11]

Table 1.2 List of public drug plans in BC

Name of Public Drug Plan	Description
Fair PharmaCare (Plan I & Plan J)	Income-based drug plan covering all eligible prescription drugs, dispensing fees and some medical supplies. Self registration is required.
First Nations Health Benefits (Plan W)	Provides 100% coverage of eligible prescription costs, funded by the First Nations Health Authority.
Recipients of Income Assistance (Plan C)	Provides 100% coverage of eligible prescription costs for BC residents receiving benefits and income assistance through the Ministry of Social Development and Poverty Reduction (SDPR). Registration is completed by SDPR.
Psychiatric Medications (Plan G)	Provides coverage over certain psychiatric medications, available to BC residents who demonstrate clinical and financial need. Registration is completed by physician on an annual basis.
Residential Care (Plan B)	Covers full cost of eligible prescription drugs for permanent residents of licensed residential care facilities. Registration is automatic upon becoming a permanent resident of a Plan B facility.
Cystic Fibrosis (Plan D)	Provides coverage of digestive enzymes and other products listed on the cystic fibrosis formulary for individuals registered with a provincial cystic fibrosis clinic. Registration completed by cystic fibrosis clinic.
Children in the At Home Program (Plan F)	Provides 100% coverage of eligible prescriptions for children and teens with a severe disability or complex health care needs. Registration is completed by the At Home Program of the Ministry of Children and Family Development.
BC Palliative Care Drug Plan (Plan P)	Provides 100% coverage of eligible costs for medications used in palliative care. Registration is completed by physicians or nurse practitioners.
Assurance Plan (Plan Z)	Provides 100% coverage over Mifegymiso, Paxlovid and Medical Assistance in Dying medications.
Smoking Cessation (Plan S)	Provides 100% coverage over certain smoking cessation prescription drugs.
British Columbia Centre for Excellence in HIV/AIDS (Plan X)	Provides coverage over antiretroviral drugs for HIV-positive individuals.

The income-based catastrophic public drug plan in BC is called Fair PharmaCare. It is available to everyone eligible for provincial insurance, but requires additional self-registration due to privacy laws restricting the BC Ministry of Health from freely accessing individuals' CRA verified income information.[11] Currently, individuals can register for Fair PharmaCare online on the BC government website, by phone, or by mailing in a paper form.[11] The key information required is net income from the previous two years and consent for Health Insurance BC to perform an income check with the Canadian Revenue Agency.[11] As income information is required from two years prior, the BC government website indicates that additional income verification steps may be needed for individuals who are new residents to Canada, British Columbians who have been living and working overseas, people turning 19, and people who were exempt from filing a Canadian tax return.[11] The registration website that is currently in use was deployed in March 2019 to improve user experience and replaced the website that had previously been used since 2003.

1.10 The Problem of Cost-Related Nonadherence in BC

Based on the understanding of potential predictors of CRNA discussed previously and the registration method for BC's Fair PharmaCare plan, we developed the conceptual framework shown below to understand why BC has the highest rate of CRNA in Canada.

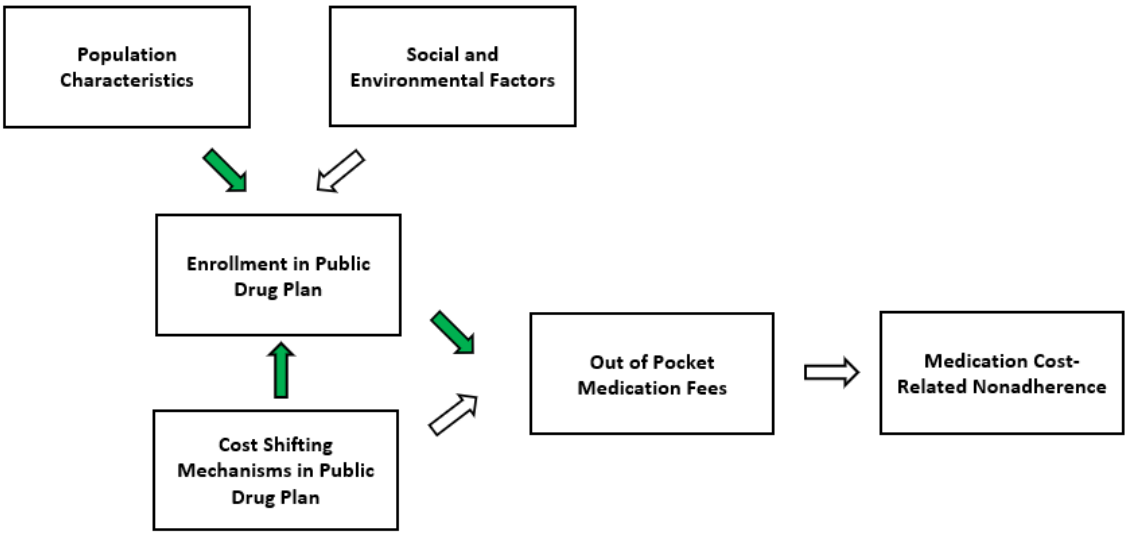


Figure 1.1 Conceptual framework

The white arrows in the conceptual framework show the relationships that have already been established in past research or are concurrently being assessed in ongoing studies. In Section 1.7 we discussed the existing literature around the relationship between cost shifting mechanisms, out of pocket fees and CRNA. We also discussed the relationship between population characteristics, social and environmental factors, out-of-pocket fees and CRNA in this section. The green arrows represent the gaps in literature that will be explored in this study.

1.11 BC Fair PharmaCare – Introduction of Income-Based Deductibles in 2003

In order to meet budgetary constraints during a period of uncontrolled growth in government spending on pharmaceuticals and concern of perceptions around the existing program's fairness and equity, an income-based Fair PharmaCare plan was introduced in 2003 to replace the prior age-based PharmaCare plan.[46, 47] As shown in Tables 1.3 and 1.4 below, the plan involves varying levels of deductibles, coinsurance, and family maximums based on household income.[11] Notably, the generosity of the program varies based on whether the household has a member that was born prior to 1940. The

deductibles in BC are similar to those in other Canadian provinces which range between 0% to 5% of household income for those with incomes below $40,000.[3, 4, 8, 20]

Table 1.3 Comparative of the design of British Columbia's income-based Fair PharmaCare Regular assistance plan – Plan I: from April 1 2003 – December 31 2018 versus January 1 2019 onwards

Regular assistance before change coverage scheme from Apr 1, 2003 – Dec 31, 2018	**Regular assistance after change coverage scheme from Jan 1, 2019 onwards**
$0-$15,000 0% deductible 30% coinsurance 2% family maximum	< $13,750 0% deductible 0% coinsurance 0% family maximum
$15,000.01-$30,000 2% deductible 30% coinsurance 3% family maximum	$13,750.01-$30,000 0% deductible 30% coinsurance 0.7% to 2.8% family maximum
$30,000.01-$45,000 3% deductible 30% coinsurance 4% family maximum	$30,000.01-$45,000 2.2%-3.1% deductible 30% coinsurance 3% to 4% family maximum
>$45,000 3% deductible 30% coinsurance 4% family maximum	>$45,000 3% deductible 30% coinsurance 4% family maximum

Information described in the table above is based on communications from the Ministry of Health [11, 48]

Table 1.4 Comparative of the design of British Columbia's income-based Fair PharmaCare Enhanced assistance plan (for those born prior to 1940 – Plan J): from April 1 2003 – December 31 2018 versus January 1 2019 onwards

Enhanced assistance before change coverage scheme from Apr 1, 2003 – Dec 31, 2018	Enhanced assistance after change coverage scheme from Jan 1, 2019 onwards
$0-$14,000 0% deductible 25% coinsurance 1.25% family maximum	$0-$14,000 0% deductible 0% coinsurance 0% family maximum
$14,000.01-$33,000 0% deductible 25% coinsurance 1.25% family maximum	$14,000.01-$33,000 0% deductible 25% coinsurance 1.1% -1.2% family maximum
$33,000.01-$50,000 1% deductible 25% coinsurance 2% family maximum	$33,000.01-$50,000 0.9% to 1.1% deductible 25% coinsurance ~2% family maximum
>$50,000 2% deductible 25% coinsurance 3% family maximum	>$50,000 2% deductible 25% coinsurance 3% family maximum

Information described in the table above is based on communications from the Ministry of Health [11, 48]

Results from a prior study indicated that these income-based deductibles led to a decrease in public spending, but did not lead to a statistically significant difference in drug utilization, or health care resource utilization amongst older adults born prior to 1940.[40] A related study with a focus on lower-income adults, found that the deductible implemented at the $15,000 income level led to a reduction of 7.2% in overall drug use and costs, but changing the deductible from 2% to 3% at the $30,000 threshold did not result in a statistically significant change in drug expenditures.[41] Research which included analysis stratified by drugs for specific diseases such as antihypertensive prescriptions reported that the removal of deductibles increased the odds of filling the prescription.[49] Overall, initial access to medications was not altered by the implementation of the 2003 policy change, regardless of age and income.[46]

In an assessment of the impact on the distribution of financial burden performed by Hanley et al., who asked the question of whether the public subsidy and private payments became more closely related to income after the introduction of Fair PharmaCare, it was found that the overall move to Fair PharmaCare

resulted in larger but slightly less regressive private payments and smaller but slightly more progressive public subsidies.[50] In other words, access to medicines was maintained, while government spending decreased due to an increase in alignment between levels of private and public expenditures with the distribution of income.[50]

1.12 Barriers to Registration in BC's Fair PharmaCare plan

After the income-based Fair PharmaCare plan in BC was introduced in 2003, a study was performed to understand whether there were underlying differences in the population characteristics of those who were and were not registered in Fair PharmaCare. Within this study's cohort (which excluded households with members aged 65 or older, social assistance recipients, and/or members likely to receive prescription drug insurance through another publicly funded program), 40% of households who were eligible for Fair PharmaCare were not registered in Fair PharmaCare in 2003.[51] It found that households residing in areas with relatively high concentrations of recent immigrants had slightly lower adjusted odds of registering for Fair PharmaCare, and that there was ethnic variation in registration rates.[51] Households with at least one child had a lower adjusted odds of enrollment than households without children, and households with a single parent had a higher adjusted odds of enrollment than households without a single parent.[51] Area-level income did not result in a statistical difference in the odds of enrollment.[51] As expected, the odds of enrollment increased in line with drug expenditure and poorer health status, as measured by total Aggregated Diagnostic Groups (ADGs).[51]

Although those who are not registered in Fair PharmaCare could be covered by a private plan and not necessarily uninsured, there are similarities between the population characteristics of those who were not enrolled in Fair PharmaCare in the Leong et al. study and the population characteristics of those who self-reported not having any form of drug insurance in the CCHS.[51] A study based on two national (2015, 2016) and six Ontario (2005, 2008, 2013-2016) cycles of the CCHS data found that individuals with

higher household income had higher odds of reporting some form of drug coverage.[35] Further, those who have lower income, poorer health and are older in age were more likely to be covered by a public drug plan, while those with higher income, very good health and of working age were more likely to be covered by private plans.[35] Several studies in the United States have also shown that the registration requirements of public health insurance plans can act as a greater barrier to access in certain subgroups which may differ based on physical and mental health, ethnicity, education levels, and sex.[52, 53] These studies suggest that there is a relationship between population characteristics and enrollment in public drug plans that needs to be further studied.

1.13 BC Fair PharmaCare – 2019 Policy Change to Deductibles and Copayments

In January 2019, the BC government introduced a new $105 million three-year plan to reduce deductibles and copayments for lower income individuals in the province.[54] The 2019/20 BC Ministry of Health service plan stated that this new Fair PharmaCare policy was expected to reduce deductibles and co-payments for 240,000 families with household net incomes under $45,000.[55] As shown in Tables 1.3 and 1.4, this new policy eliminated the copayments for families with household incomes lower than $13,750 – Plan I ($14,000 – Plan J), eliminated deductibles and reduced copayments for households with incomes between $13,750 and $30,000 – Plan I ($14,000 and $33,000 – Plan J), and reduced deductibles and copayments for families with household incomes between $30,000 and $45,000 – Plan I ($33,000 and $50,000 – Plan J). The plan remained unchanged for families with household incomes over $45,000 – Plan I ($50,000 – Plan J).[54] In 2020, Health Minister Adrian Dix reported that the expansion of the Fair PharmaCare program increased the number of new beneficiaries from 63,600 between January 1 2018 and March 31 2018 to 151,900 during the same time period in 2019.[56] This suggests that the policy change enabled more individuals to claim PharmaCare paid subsidies to cover their drug expenditures. Although the government expects that their new policy will bring increased benefit to 240,000 BC

families,[56] it is unclear whether the policy change motivated more households to register for Fair PharmaCare and whether being registered has led to improved access to medicines.

1.14 The Gap in Literature

There has been a wealth of research and knowledge translation related to design of drug formularies, cost sharing instruments, and eligibility for public drug plans in BC. Households registered for public drug plans that leave them paying all or a portion of drug costs contribute towards the inequity in access to prescription medications and CRNA. Beyond this, there are also households that are eligible for existing public drug plans but not registering for them and not realizing the benefits that they could be as a result.

A study of 2003 Fair PharmaCare registration rates in BC suggested that 40% of the eligible population was not enrolled.[51] There have been no studies published since that time which have examined either the characteristics of those who are eligible for public drug plans but not enrolled, or how their drug expenditure and utilization patterns changed after enrollment. There have also been no assessments of the policy change in 2019 eliminating or reducing deductibles and copayments for certain segments of the population. It is important to understand who is not enrolling so the BC government can better target their communications and policies towards these individuals, if in fact people are missing out on benefits for which they are eligible.

Finally, there is currently no research that exists to estimate how much money is being foregone from the population that is eligible for Fair PharmaCare but not enrolled. Administrative data cannot differentiate the additional out-of-pocket expenditures vs. private insurance costs resulting from not being enrolled. It is, however, possible to estimate the potential overall cost savings to individuals and private insurers if individuals who are not currently enrolled became enrolled. Quantifying the unrealized benefits from Fair PharmaCare will help educate and raise awareness of the public on how much they could collectively be

saving if they made full use of the public drug plan that the province offers, and allow the Ministry of Health to budget for these potential increases in public spending.

1.15 Research Objectives

The aims of this research were to assess the following questions in regard to registration in Fair PharmaCare:

Chapter 2:

1) Objective 1: Obtain an understanding of the association between population characteristics and time until enrollment in Fair PharmaCare.

Chapter 3:

2) Objective 2: Assess the impact of the 2019 Fair PharmaCare change that reduced and eliminated deductibles and copayments on registration rates.

Chapter 4:

3) Objective 3: Assess the association between enrolling in Fair PharmaCare, drug expenditures, and drug utilization.

Chapter 5:

4) Objective 4: Simulate the cost savings that private payers would realize from full enrollment of all households in Fair PharmaCare.

1.16 Data Sources

Information for analysis was obtained through three BC-based administrative population datasets which were linked using anonymized identifiers. These are: 1) the BC PharmaCare Plan Eligibility Fact Table;

2) the BC PharmaNet prescription drug claims database; and 3) the BC MSP Consolidation File. Data was requested from Population Data BC for the period January 1, 2013 to March 31, 2021. Data linkage was performed by programmers at Population Data BC, who provided de-identified data linked using a project specific study ID to the research team.[57] All datasets were then analyzed and accessed within the secure research environment (SRE) established by Population Data BC. All three sources of data are frequently used in health services research and as such are valid and reliable.[58]

BC PharmaCare Plan Eligibility Fact Table

This dataset identifies to which pharmacare plan each household is assigned. All pharmacare plans in BC are included in this dataset, except for Plan B. Plan B was identified from PharmaNet records which had an indicator for what plan dispensations were made from. Any records within the dataset that were associated with Plan I or Plan J were then mapped to the appropriate deductible and family maximum for each household according to the Fair PharmaCare policy. When individuals register for Fair PharmaCare, they are required to grant permission for PharmaCare to verify their family income with the Canada Revenue Agency (CRA).[11] As such, this dataset provided us with validated household income bands for all individuals who were registered for Fair PharmaCare. Individuals who did not register and consent to releasing their income information from the CRA are automatically categorized into the plan with the highest deductible and family maximum of $10,000.[11]

BC PharmaNet

This data system was created in 1996 to act as a comprehensive database that captures all outpatient drug dispensing information across the province regardless of the coverage that the individual receives.[57] It does not include data on drugs dispensed during in-patient hospital visits.[57]

MSP Consolidation File

This dataset provided information on the demographic characteristics and provincial insurance (MSP) status of individuals in our study population.[57] The Consolidation File provided basic information on

age, sex, geographical information and registration data derived from the MSP registration and Premium Billing files and augmented by other sources in order to provide a complete registry of all individuals in the province who are eligible to and/or receive health care services.[57] This was used to conduct a descriptive analysis of the population by their enrollment status in Fair PharmaCare.

Health Canada Drug Product Database

This is a publicly available dataset maintained by the Government of Canada. It provided product information on drugs that are authorized for sale by Health Canada.[59]

1.17 Study Cohort

The overall cohort consisted of all households that were registered in MSP at any point between January 1, 2013 and March 31, 2021. Households that were registered in Plan W at any point in time were excluded as this plan is funded by the federal government and not the BC Ministry of Health.

To assign a dominant PharmaCare plan to households, we first assessed enrollment at the end of each year at the individual level. If an individual was enrolled in multiple plans at the end of the year, only the most comprehensive plan was considered. Based on the descriptions of plans from Table 1.2, the following hierarchy was applied in order of comprehensiveness of the plan: Plan C, Plan B, Plan P, Plan I/J. If an individual was only registered in a plan for one day, we did not consider them to be in this plan. We merged these individual plan registration figures to household identifiers to determine household level registration status.

Households with more than one individual could also have individuals registered in different plans at the end of the year. We applied the same hierarchy based on comprehensiveness of the plan to assign the dominant plan to the household. Only single households enrolled in Plan B or Plan P were considered to be enrolled in a comprehensive plan, as households with more than one individual would still benefit from enrollment in Fair PharmaCare. Single households enrolled in Plan P were unlikely to benefit from

registering in Fair PharmaCare as they are near the end of life. Households of all sizes with at least one individual enrolled in Plan C were considered to be enrolled in Plan C, as it would be expected that if one individual in the household is eligible for social assistance, the entire household would be as well, and therefore the household would not benefit from enrollment in Fair PharmaCare. As such, in this study, single households enrolled in Plan B and Plan P, and households of any size with at least one individual enrolled in Plan C were considered to be enrolled in another relatively comprehensive public drug plan. Households enrolled in the other public drug plans in BC were expected to still potentially benefit from enrollment in Fair PharmaCare, and as such were not considered to be enrolled in Fair PharmaCare or another comprehensive plan. The same approach as described above was also performed at the month level, as the unit of time in Objective 2's analysis is in one-month increments.

1.18 Thesis Outline

This thesis is composed of six chapters. This first chapter provided background information on the research topic around the current patchwork of drug insurance coverage in Canada in relation to CRNA, particularly around the development of British Columbia's catastrophic public drug plan for the general public and registration rates. The second chapter examines the first research objective of understanding the associations between population characteristics and registration for Fair PharmaCare. The third chapter examines the second research objective around the impacts of the 2019 policy change reducing deductibles and copayments for lower income households on registration rates. The fourth chapter outlines how registration in Fair PharmaCare impacts drug expenditures and utilization across time. The fifth chapter simulates the potential cost savings to private payers and the budgetary impacts of registration in Fair PharmaCare amongst the population that is not currently registered. Finally, the concluding sixth chapter summarizes the findings of this thesis, presents recommendations for future research, and discusses policy implications.

Chapter 2 – Examining the Association between Population Characteristics and Time until Enrollment in Fair PharmaCare

2.1 Background

2.1.1 Drug Coverage in Canada

In Canada, prescription medications are covered through a mix of public and private funding.[8] Canada is the only developed country that has a universal healthcare system, but no universal coverage of prescription medications.[3, 8] The public and private plans that do exist often require payment of a deductible or copayment to obtain prescription drugs.[3, 60-62] This has led to problems of accessibility to medications for some individuals, for many reasons including financial barriers.[33, 39, 60, 61] A systematic review looking at studies on cost-related nonadherence (CRNA) in Canada published between 1992 to 2019 found that the overall prevalence of CRNA ranged between 5.1 to 10.2%.[39] Results directly from the 2016 CCHS, a cross sectional survey administered to 28,091 Canadians found that 5.5% of all Canadians, representing 8.2% of those with at least one prescription dispensed, self-reported being unable to afford one or more drugs in the prior year.[36] This survey also showed that those with a government drug insurance plan had 1.95 times higher odds, and those with no plan had 3.26 times higher odds of reporting CRNA than those with an employer benefit plan.[35] This indicates that those without any form of drug insurance are more likely to forego medications due to cost related barriers. Aside from lack of drug insurance, studies have also consistently found that high out-of-pocket spending, low income or financial flexibility, younger age, and poorer health are commonly associated with CRNA.[33, 36, 39, 61]

As described in Section 1.4, public drug coverage also varies significantly across the country, as there are no national standards for public drug insurance. Likewise, rates of CRNA also vary across the country, with the results from the 2016 CCHS indicating that BC has the highest prevalence of CRNA in Canada at 8.1%.[36] This study focuses on public drug coverage in British Columbia.

2.1.2 BC Fair PharmaCare

There are ten targeted needs-based public drug plans in BC, and one catastrophic drug plan, Fair PharmaCare. Of the needs-based plans, there are three that are relatively comprehensive and do not require individuals to register on their own. These are: Plan B for permanent residents of licensed residential care facilities; Plan C for recipients of BC Income Assistance; and Plan P for those receiving palliative care at home.[11] The catastrophic plan, Fair PharmaCare, is universally available to all BC residents that are eligible for health insurance (MSP).[11] Fair PharmaCare was introduced in 2003, when it replaced the prior age-based public drug plan.[50] Coverage is determined at the household level according to income-based deductibles and family maximums.[11] As such, Fair PharmaCare requires consent from households to allow the Canada Revenue Agency (CRA) to release their income information to the BC Ministry of Health for the purposes of assigning the appropriate Fair PharmaCare deductible and family maximum.

Registration for Fair PharmaCare occurs on an opt-in basis rather than an opt-out basis. The BC government reported that at the end of March 2020, 1,270,903 households were registered for Fair PharmaCare.[63] There are 40 income categories within Plan I, the Fair PharmaCare plan for households without individuals born prior to 1940, and 38 income categories within Plan J, the Fair PharmaCare plan for households with individuals born prior to 1940.[11] Based on which income category a household falls into, the applicable deductible and family maximums are assigned to households. In the absence of registration, households who are enrolled in MSP are automatically assigned the highest deductible and family maximum of $10,000, under the assumption that the household falls into the highest income category.[11] Fair PharmaCare is the first payer in the Province of British Columbia which means that prescription fills are first applied against the household's Fair PharmaCare deductible and family maximum, and anything not covered by Fair PharmaCare will then be applied against any private insurance options or be paid out-of-pocket by the individual household. As such, even if an individual has

private drug insurance, the household could still potentially benefit from registering for Fair PharmaCare if drug costs are high.

2.1.3 Factors Associated with Registration

As only 1,270,903 households are registered for Fair PharmaCare, it is apparent that a number of households are not yet registered.[63] According to the Government of BC website, based on the registration process, there are a few groups that face additional barriers to registration: new residents to Canada, British Columbians who have been living and working overseas, people turning 19 and people who were exempt from filing a Canadian tax return.[11] Households that did not file a tax return in the prior year will have to call Health Insurance BC for further instructions on what documents can be provided. New residents may be eligible for the Interim Federal Health program (IFHP) which temporarily covers some prescription drugs for resettled refugees, protected persons in Canada, Refugee claimants, victims of human trafficking, and detainees.[11] New residents may also need to attain a notarized affidavit, which may be an additional burden.[11] When a child turns 19, they are required to register themselves for their own Fair PharmaCare plan, since they are no longer considered dependent children unless they are in a full-time educational program and are 24 years of age or younger.[11]

According to a past study performed specifically on registration rates in the BC Fair PharmaCare program in 2003, household level predictors resulting in higher registration included those without children, and households with a single parent.[51] One area-based predictor resulting in higher registration rates was households not in areas with relatively high concentrations of recent immigrants.[51] Needs-based predictors resulting in higher registration rates included higher drug expenditure and poorer health status.[51] Studies performed in the United States where registration is also required for enrollment into some Medicaid programs also show that barriers to registration differ based on physical and mental health, ethnicity, education levels and sex.[52, 53]

It has now been over 15 years since the publication of the prior study based on 2003 data,[51] and significant changes in the insurance landscape have occurred including the reduction and elimination of deductibles and copayments for some lower-income households in 2019.[11, 56] This prior study also excluded households over the age of 65 as this group was born prior to 1940 and automatically registered into Plan J as a part of the Fair PharmaCare initiation process. The prior study did not incorporate an element of time, as it was a multivariate logistic regression that reported adjusted odds ratios for each explanatory variable. As such, the analysis was unable to capture registration trends of households that did not register immediately after the onset of an explanatory variable. Finally, the prior study was conducted in the initial year of the implementation of Fair PharmaCare, and both the dissemination of information about the plan and registration process have changed since then.

This study will provide updated and expanded information relevant to Fair PharmaCare registration. It will focus on how household-level, area-based and needs-based characteristics are associated with the length of time it takes for a household to register for Fair PharmaCare. This will provide an understanding of whether particular households are more likely to register for Fair PharmaCare, and if there are any characteristics that lead to a higher probability of registration at any given point in time.

2.2 Methods

2.2.1 Study Context/Study Design

This study was designed to test the null hypothesis that there is no difference in hazard of registration between household-level characteristics, needs-based characteristics, and area-based characteristics. The study design selected was a retrospective observational cohort study using administrative data. We followed a cohort of households across the study period to observe the relationship between the stated characteristics and the length of time that elapses before a household registered for Fair PharmaCare.

2.2.2 Data Sources

This study used the same data sources as those described in Section 1.16. This specific objective used the MSP Consolidation File, PharmaCare Eligibility Fact Table, and PharmaNet.

2.2.3 Study Cohort/Study Period

Overall Cohort

A sub cohort was created from the overall cohort described in Section 1.17, which included all households that were registered in MSP and not registered in Plan W in any year between January 1, 2013 and March 31, 2021. Households were included if they were not registered in Fair PharmaCare or another relatively comprehensive public drug plan (Plan B, C or P, as described in Section 1.17) in the first year of the study, 2013. Households already registered in Fair PharmaCare in the first year of the study, 2013, were excluded because it would not be possible to test the length of time to registration in Fair PharmaCare given that there was no prior year information available.

The unit of observation for this study was individual households, as registration for Fair PharmaCare occurs at the household level, and deductibles and copayments are determined by household income.

Censoring

Registration was defined as becoming enrolled in Plan I or Plan J, the two Fair PharmaCare plans. Households were right censored when they enrolled in another relatively comprehensive public drug plan, as there would be little additional benefit for the household to enroll in Fair PharmaCare. Households were also right censored when they were no longer present in the MSP Consolidation File. This is typically indicative of a household moving away from British Columbia, or the death of the last individual within the household.

Study period

The study period for this objective was January, 1 2013 to December, 31 2020. This study period was selected as it is the data that was available at the time the analysis was conducted. The unit of analysis was an individual household, and time varying covariates were calculated in one-year increments of time, as deductibles and coinsurance are calculated annually.

2.2.4 Study Variables of Interest

Outcome variable of interest

The outcome of interest was registration, which is defined as being enrolled in Plan I or Plan J.

Needs-based predictors

The drug expenditure variables were used as indicators of need for medications. The age category variable was also classified as a needs-based predictor because age is associated with a greater need for healthcare, and those that are 60 and over typically have a greater need.[64] These variables are defined in Table 2.1 below.

Table 2.1 Needs-based variable definitions

Variable	Definition
Baseline accepted drug expenditure category ($0, $1-$100, $101 – $499, $500 – $1,000, >$1,000)	Total drug expenditures that are accepted by pharmacare for the households in the first year that the household appears in the cohort. This is derived from PharmaNet. Accepted drug expenditures are those that are eligible for reimbursement from Fair PharmaCare and count towards the household's deductibles/family maximums. They include accepted ingredient costs, professional fees and special fees.
Year-over-year change in accepted drug expenditure categories ($0, $1-$100, $101 – $499, $500 – $1,000, >$1,000)	Total drug expenditures that are accepted by pharmacare for the household were aggregated across the year and placed into accepted drug expenditure categories. This is a time varying covariate.
Age category (household contains an individual greater than 60 years old)	This was derived from the MSP Consolidation File by identifying households that had individuals over 60. This is a time varying covariate.

The year-over-year change and age category variables are time varying, meaning that they can have a different value in each year of analysis. A one-year interval was selected because the period of the Fair PharmaCare deductible is evaluated on an annual calendar basis.

Area-based predictors

Health authority and neighbourhood income decile were obtained from the MSP Consolidation File and were coded based on the household's registered postal code (Table 2.2). Households that had invalid or missing health authority or neighbourhood income decile variables were removed from the cohort. Invalid parameters included those where individuals within the same household had different values for these variables.

Table 2.2 Area-based variable definitions

Variable	Definition
Health authority	Health authority that household resides within, as provided by MSP Consolidation File. There are five geographic health authorities in BC.
Neighbourhood income deciles	Neighbourhood income deciles were provided by the MSP Consolidation File. The postal code associated with the household in the MSP Consolidation File was mapped to the average household income (adjusted for household size) in the area in the nearest census year. A census is completed every 5 years and the nearest Census is defined as 2 years before a Census year, the Census year itself, plus the two years following a Census year.[57] Statistics Canada collates average household income across Census Dissemination Areas which are small, relatively stable geographic units comprising of around 400 to 700 persons. These dissemination areas are then sorted by income and aggregated into 1,000 strata, which are then collapsed to deciles.[65, 66]

Household-level predictors:

Variables describing household composition were derived based on information available in the MSP Consolidation File (Table 2.3). These variables are based on sex, birth year, and the fact that members of households share a common MSP ID.

Table 2.3 Household-level variable definitions

Variable	Definition
Household contains a single parent	Coded as a household with a child and only one adult (over 18) that is 10 years or older than the child.
Household contains a female	Coded as a household with at least one individual that is a female.
Household size	Count of number of individuals within that household.
Household contains a child	Identified whether the household contained an individual below 18.

2.2.5 Statistical Analysis

Survival analysis is used to measure the length of time that passes until a particular event of interest occurs.[67] The survival function is represented as $S(t) = P(T>t)$, the probability of survival beyond time T. The event of interest may or may not have occurred at the time of the statistical analysis, the subject may have been censored or may have been lost to follow up at the time of statistical analysis. Survival analysis was selected to conduct this study for two primary reasons: 1) longitudinal data was available and could be used, and 2) the time it takes a household to register may vary depending on household needs and area-based characteristics. This study was designed to test the null hypothesis that there is no difference in hazard of registration in each group within the covariates described in the previous section.

Registration status was measured on an annual basis within a multivariate cox proportional hazards (cox PH) model.

Kaplan Meier

A Kaplan Meier graph shows the proportion of subjects that have not yet experienced the event of interest at the specified points in time.[68] Kaplan Meier graphs were created for this study to describe overall survival as well as to describe survival across households from each of the five categories of baseline accepted drug expenditures. Kaplan Meier graphs were not created for time varying covariates as Kaplan Meiers are non-parametric and assume constant hazard across time. Kaplan Meier assumptions of independent events and non informative censoring were tested based on knowledge that the registration status of one household does not impact the registration status of another household, and that households leaving the cohort prior to registering for Fair PharmaCare are not more or less likely to register for Fair PharmaCare. Survival was calculated as the number of registrations that occurred each year out of the total number of households at risk (households not registered and not censored).

Cox Proportional Hazards Model

The Cox PH model measures survival time as a function of multiple variables, modelling the instantaneous hazard rate.[69] The hazard rate at time t is the instantaneous probability of experiencing an event at time t, given that the event has not yet occurred.[69, 70] Hazard ratios (HR) and 95% confidence intervals for each covariate were calculated from the semi-parametric multivariate Cox proportional hazards model to compare the hazards across groups within each covariate when holding all other covariates constant. All assumptions of the model were tested and addressed accordingly. Non-informative censoring and independence were tested based on study knowledge, proportional hazards were tested by checking Schoenfeld plots, and collinearity was tested by using Pearson correlation tests with a threshold of 0.8 applied. No issues were noted in any of the tests performed.

The analyses in this study were performed using SAS Version 9.4, and R Version 3.6.2.

2.3 Results

2.3.1 Cohort Characteristics

Our study included 2,655,042 households not initially registered that contributed a total of 9,206,593 years of data. Of these households, 860,712 registered for Fair PharmaCare, 128,048 enrolled into another relatively comprehensive public drug plan, 546,068 moved away from BC or died, and 15,049 were removed due to missing or invalid data (i.e., health authority and neighbourhood income deciles not captured in the Consolidation File) over the course of the study period.

Tables 2.4 shows the baseline characteristics of households based on registration status at the end of the study period. Household characteristics were fairly balanced across the group that did not register and the group that did eventually register, with some exceptions. A greater proportion of households that did not register during the study period had no accepted drug expenditures during the baseline year, and did not contain an individual 60 and over. In addition, a greater proportion of households that did not register during the study period did not contain a female and contained only one individual.

Table 2.4 Household characteristics stratified by registration status at time of censoring

	Not Registered (%)		Registered (%)		Total (%)	
Total Population	**1,794,330**		**860,712**		**2,655,042**	
Needs-based baseline characteristics						
Drug expenditures accepted by PharmaCare						
$0	963,825	53.7%	221,464	25.7%	1,185,289	44.6%
$1 - $100	447,125	24.9%	205,194	23.8%	652,319	24.6%
$101 - $499	298,814	16.7%	262,390	30.5%	561,204	21.1%
$500 - $1,000	52,078	2.9%	85,421	9.9%	137,499	5.2%
>$1,000	32,488	1.8%	86,243	10.0%	118,731	4.5%
Drug expenditure accepted by PharmaCare greater than $10,000 in a single year						
No	1,793,454	100.0%	854,535	99.3%	2,647,989	99.7%
Yes	876	0.0%	6,177	0.7%	7,053	0.3%
Year-over-year drug expenditure change greater than $100						
No	1,648,281	91.9%	713,463	82.9%	2,361,744	89.0%
Yes	146,049	8.1%	147,249	17.1%	293,298	11.1%
Single drug expenditure greater than $1,000						
No	1,790,932	99.8%	847,589	98.5%	2,638,521	99.4%
Yes	3,398	0.2%	13,123	1.5%	16,521	0.6%
Household contains individual aged 60 and over						
No	1,614,794	90.0%	588,932	68.4%	2,203,726	83.0%
Yes	179,536	10.0%	271,780	31.6%	451,316	17.0%
Area-based baseline characteristics						
Health authority						
IHA	260,653	14.5%	143,579	16.7%	404,232	15.2%
FHA	612,919	34.2%	319,330	37.1%	932,249	35.1%
VCH	534,909	29.8%	200,757	23.3%	735,666	27.7%
VIHA	281,361	15.7%	150,361	17.5%	431,722	16.3%
NHA	104,488	5.8%	46,685	5.4%	151,173	5.7%
Neighborhood income decile *(1=lowest; 10= highest)*						
1	216,231	12.1%	75,728	8.8%	291,959	11.0%
2	192,870	10.8%	80,645	9.4%	273,515	10.3%
3	193,778	10.8%	86,137	10.0%	279,915	10.5%
4	178,220	9.9%	86,290	10.0%	264,510	10.0%
5	183,032	10.2%	88,416	10.3%	271,448	10.2%
6	177,925	9.9%	89,698	10.4%	267,623	10.1%
7	166,008	9.3%	88,689	10.3%	254,697	9.6%
8	170,540	9.5%	94,630	11.0%	265,170	10.0%
9	157,887	8.8%	89,185	10.4%	247,072	9.3%
10	157,839	8.8%	81,294	9.4%	239,133	9.0%
Household-level baseline characteristics						
Household contains single parent						
No	1,714,566	95.6%	831,574	96.6%	2,546,140	95.9%
Yes	79,764	4.5%	29,138	3.4%	108,902	4.1%
Household contains a child						
No	1,392,067	77.6%	719,919	83.6%	2,111,986	79.6%
Yes	402,263	22.4%	140,793	16.4%	543,056	20.5%
Household contains female						
No	736,871	41.1%	238,259	27.7%	975,130	36.7%
Yes	1,057,459	58.9%	622,453	72.3%	1,679,912	63.3%
Household size						
1	1,289,597	71.9%	526,885	61.2%	1,816,482	68.4%
2	254,259	14.2%	210,037	24.4%	464,296	17.5%
3	117,065	6.5%	56,472	6.6%	173,537	6.5%
4+	133,409	7.4%	67,318	7.8%	200,727	7.6%

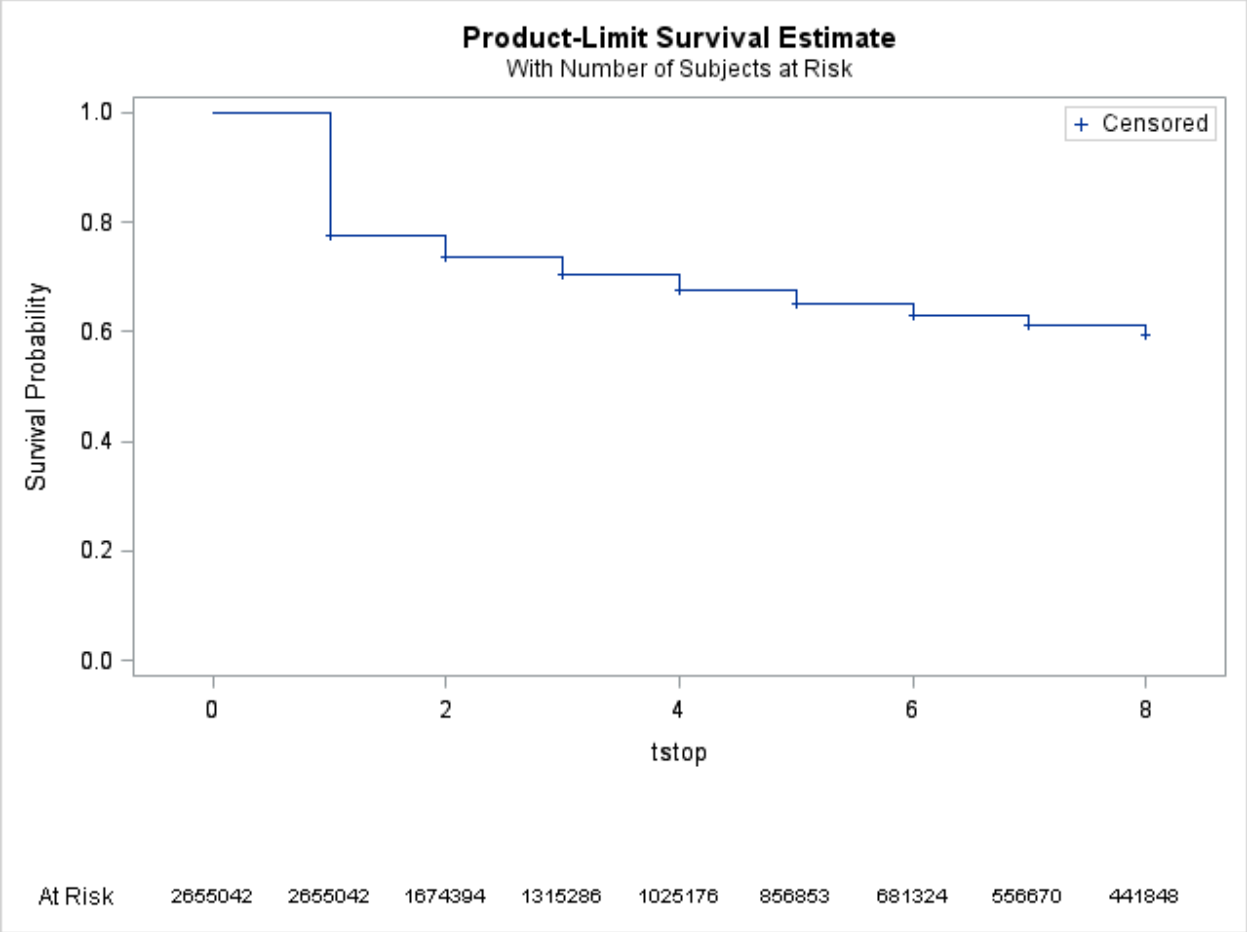
Legend: *IHA = Island Health Authority; FHA = Fraser Health Authority; VCH = Vancouver Coastal Health Authority; VIHA = Vancouver Island Health Authority; NHA = Northern Health Authority*

2.3.2 Overall Results

Kaplan Meier Results

Figures 2.1 and 2.2 display the Kaplan Meier graphs for the overall cohort as well as stratified by baseline accepted drug expenditure category. The 8-year survival probability of not registering for Fair PharmaCare was 59% in the overall cohort, and ranged from 17% to 74% for baseline accepted drug expenditure category 5 (>$1,000) to category 1 ($0), respectively.

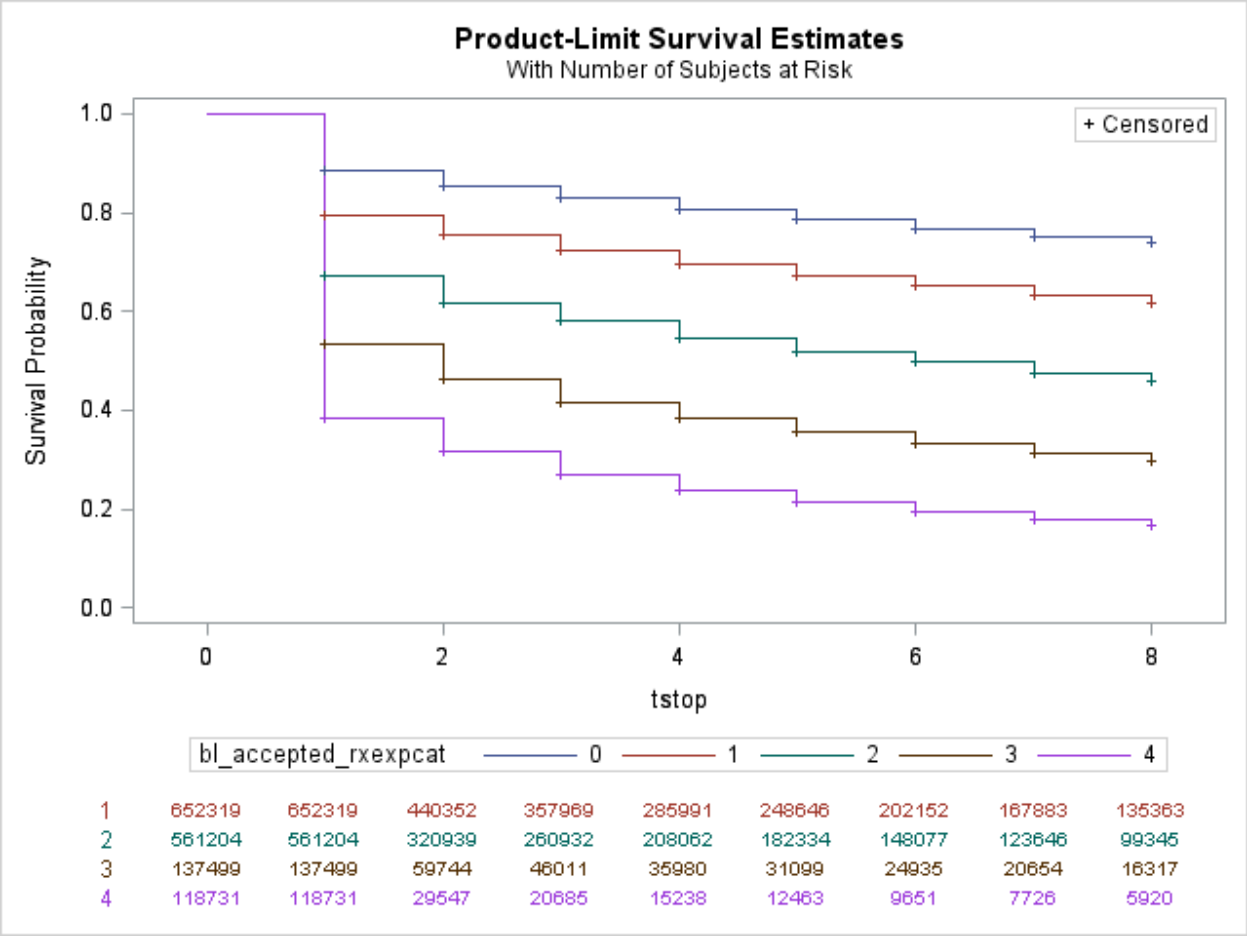
Overall, 32% of households in the cohort registered and 441,848 households remained at risk of registration after 8 years. Of households with baseline accepted drug expenditures of $0, 19% of registered (184,903 still at risk at study end), 31% of households with baseline accepted drug expenditures in the $1-$100 category registered (135,363 still at risk at study end), 47% of households with baseline accepted drug expenditures in the $101 - $499 category registered (99,345 still at risk at study end), 62% of households with baseline accepted drug expenditures in the $500 - $1,000 category registered (16,317 still at risk at study end), and 73% of households with baseline accepted drug expenditures in the greater than $1,000 category registered (5,920 still at risk at study end).



Legend: *tstop = number of years since the household entered the cohort*

Figure 2.1 Kaplan Meier graph showing survival curve for registration in Fair PharmaCare across all households in the cohort of interest

At baseline, 2,655,042 households were not registered in Fair PharmaCare or another relatively comprehensive public drug plan and were at risk of registration for Fair PharmaCare.



Legend: *tstop = number of years since the household entered the cohort; bl_accepted_rxexpcat = categorical variable for level of drug expenditures accepted by PharmaCare at baseline, in the year that the household entered the cohort. 0=$0, 1=$1-100, 2=$101-499, 3=$500-1,000, 4=>$1,000*

Figure 2.2 Kaplan Meier graph showing survival curve for registration in Fair PharmaCare stratified by baseline level of drug expenditures accepted by PharmaCare across all households in the cohort of interest

At baseline, 1,185,289 households with $0 baseline accepted drug expenditures and 118,731 households with more than $1,000 baseline accepted drug expenditures were not registered in Fair PharmaCare or another relatively comprehensive public drug plan and were at risk of registration for Fair PharmaCare.

Impact of variables of interest on registration – Cox PH model results

Table 2.5 Results from multivariate Cox PH model

	Hazard ratio	95% Confidence Interval	
Needs-based characteristics			
Baseline drug expenditures accepted by PharmaCare			
$0	reference		
$1 - $100	1.53	1.52	1.54
$101 - $499	2.14	2.12	2.15
$500 - $1,000	2.78	2.75	2.80
>$1,000	3.38	3.35	3.41
Year-over-year change in drug expenditures accepted by PharmaCare			
$0	reference		
$1 - $100	0.98	0.97	0.98
$101 - $499	1.05	1.04	1.06
$500 - $1,000	1.23	1.21	1.25
>$1,000	1.62	1.60	1.65
Household contains individual aged 60 and over			
No	reference		
Yes	1.73	1.73	1.74
Area-based characteristics			
Health authority			
VCH	reference		
FHA	1.21	1.21	1.22
IHA	1.14	1.14	1.15
NHA	1.03	1.02	1.04
VIHA	1.11	1.10	1.12
Neighbourhood income decile *(1=lowest; 10=highest)*			
1	reference		
2	1.10	1.09	1.11
3	1.14	1.13	1.15
4	1.17	1.16	1.18
5	1.18	1.17	1.19
6	1.19	1.18	1.20
7	1.21	1.20	1.23
8	1.22	1.21	1.23
9	1.21	1.20	1.23
10	1.15	1.14	1.16
Household-level characteristics			
Household contains single parent			
No	reference		
Yes	1.20	1.18	1.21
Household contains a child			
No	reference		
Yes	0.61	0.60	0.61
Household contains female			
No	reference		
Yes	1.25	1.25	1.26
Household size			
1	reference		
2	0.97	0.97	0.98
3	1.31	1.29	1.32
4+	1.35	1.33	1.36

Legend: *IHA = Island Health Authority; FHA = Fraser Health Authority; VCH = Vancouver Coastal Health Authority; VIHA = Vancouver Island Health Authority; NHA = Northern Health Authority*

Needs-based characteristics

The hazard of registering for Fair PharmaCare at a given point in time increased with baseline accepted drug expenditure category with hazard ratios ranging from 1.53 to 3.38 times that of households with no baseline accepted drug expenditures. The same trend existed for year-over-year change in accepted drug expenditures with hazard ratios ranging from 1.05 to 1.62 times that of households that had no year-over-year change in accepted drug expenditures.

Households containing an individual aged 60 and over had a hazard of registering for Fair PharmaCare at a given point in time that was 1.73 (95% CI: 1.73 – 1.74) times that of households that did not have an individual aged 60 and over.

Area-based characteristics

There are five geographic health authorities in British Columbia. After adjusting for the other variables, households residing in the Fraser Health Authority (HR 1.21, 95% CI: 1.21 – 1.22), Interior Health Authority (HR: 1.14, 95% CI: 1.14 - 1.15), Northern Health Authority (HR: 1.03, 95% CI: 1.02 - 1.04) and Vancouver Island Health Authority (HR: 1.11, 95% CI: 1.10 - 1.12) all had a greater hazard of registering for Fair PharmaCare as compared to households residing in the Vancouver Coastal Health Authority.

The multivariate cox model showed a gradient response where households living in dissemination areas with higher neighbourhood income deciles had a greater hazard of registration in Fair PharmaCare between neighbourhood income deciles 2-8. The dose effect tapered off for neighbourhood income deciles 9 and 10. The hazard of registering for Fair PharmaCare at a given point in time ranged from 1.10 times (95% CI: 1.09 – 1.11) for neighbourhood income decile 2 to 1.22 times (95% CI: 1.21 – 1.23) for neighbourhood income decile 8 as compared to households in dissemination areas with neighbourhood income decile 1.

Household-level characteristics

Households containing a single parent and households containing a female both had a hazard of registering for Fair PharmaCare at a given point in time that was greater than households with a single parent (HR: 1.20, 95% CI: 1.18 – 1.21) and households without a female (HR: 1.25, 95% CI: 1.25 – 1.26). Households with 3 or more individuals had a hazard of registering for Fair PharmaCare at a given point in time that was greater than that of a single household. The hazard ratios ranged from 1.31 (95% CI: 1.29 – 1.32) to 1.35 (95% CI: 1.33 – 1.36). Households with 2 individuals had a lower but similar hazard of registration as single households with a hazard ratio of 0.97 (95% CI: 0.97 – 0.98). Households containing a child had a hazard of registering for Fair PharmaCare at a given point in time that was 0.61 (95% CI: 0.60 – 0.61) times households that do not contain a child.

2.4 Discussion

2.4.1 Interpretation of Results

Registration in BC's Fair PharmaCare program is optional, but does allow households with high drug expenditures relative to their income to receive better coverage. We found that of households eligible but not yet registered, 32.4% registered during our study period of 2013-2020. Our results showed that needs-based factors were highly associated with registration, specifically baseline level of accepted drug expenditures. The higher the drug expenditures a household had at the time they entered the cohort, the greater their hazard of registering for Fair PharmaCare. This largely explains why the survival probability of not registering for Fair PharmaCare was high at the beginning of the study period: 78.6% of households not registered had baseline accepted drug expenditures below $100. Households that experienced a large change in drug expenditures were also more likely to register for Fair PharmaCare immediately. Further, this exhibited a dose-response relationship: the larger the change in drug expenditure year-over-year, the more likely they were to register for Fair PharmaCare at a given point in time.

Overall, this suggests that households register for Fair PharmaCare when they need it, or they become aware of it and register when they have a greater need for it.

Age category was also considered a proxy for needs due to the correlation between aging and need for medications,[64] and households with older adults had a higher hazard of registration. However, it is worth noting that a smaller cohort of households with older adults were part of this study, which is in part a result of the automatic enrollment of those aged 65 and over in 2003 when Fair PharmaCare was first implemented. As such, there was naturally a higher baseline registration rate in older adults, who were then excluded from our population as they were already registered at baseline. Households containing a female and with household size greater than one were more likely to register for Fair PharmaCare at a given point in time. Households living in dissemination areas with higher neighbourhood income deciles were more likely to register for Fair PharmaCare at a given point in time.

2.4.2 Discussion of Findings in Relation to Existing Literature

These findings are similar to those reported by Leong et al. in their study on Fair PharmaCare registration rates in 2003 when the new public drug plan was first introduced. That study found that in 2003 households containing at least one adult female, and single parent households were more likely to register for Fair PharmaCare; whereas households with at least one child were less likely to be registered for Fair PharmaCare.[51] The direction of these results were largely consistent with our study. Needs-based results were also similar, with Leong et al. showing that households with larger prescription drug expenditures and lower health status had greater odds of registering for Fair PharmaCare.[51] While the Leong et al. study showed no relationship between household income and registration,[51] our study showed a positive relationship between household income and registration. This may be due to household income being tied to private insurance, and private insurers mandating registration in more recent years – something that likely would not have yet been in place in the initial year of Fair PharmaCare roll out. Our study extends these prior findings by demonstrating that there was a positive association between age and

registration. Additionally, households with a higher year-over-year increase in drug expenditures were more likely to register.

2.4.3 Policy Implications

The results of this study suggest that people register for Fair PharmaCare when the need arises, or when they learn about the program due to accruing high drug expenditures. If there was a desire to improve overall registration into Fair PharmaCare, younger households, single households, households containing only males, and households containing children should be targeted. However, our model suggests that these groups are the least likely to actually receive benefits from the program. Although households with lower household income have a higher level of coverage, the results of this study show that they were less likely to register. This may be due to higher income being associated with higher levels of private insurance requiring plan enrollees to register for Fair PharmaCare. It could also be a signal that lower income households are missing out on benefits. As such, if there is a desire to improve overall registration into Fair PharmaCare, lower income households should also be targeted. It is worth noting that these households would also be subject to lower deductibles and coinsurance, and as such, given the same level of need for medications, would receive a greater benefit from registration than a higher income household.

2.4.4 Strengths and Limitations of the Study

A strength of our study is a large sample size, which is the entire population of BC at risk of registering for Fair PharmaCare over 8 years. As we are limited to utilizing the data available within the PharmaCare Eligibility Fact Table, BC PharmaNet, and MSP Consolidation File, there may be other important explanatory variables that may be confounding or modifying the true relationship between the population characteristics of interest and registration for Fair PharmaCare that we were unable to explore. Missing explanatory variables that could have significance would be knowledge of official languages, ethnic

origin, immigration status, highest level of education attained, and enrollment in a private drug plan. While neighbourhood income deciles were used to proxy household income, these may not be precise at the household level.[66]

Another limitation of this study is that we were not able to calculate the year-over-year change in accepted drug expenditures variable for households who registered for Fair PharmaCare in the first year that they appeared in the dataset, as prior year drug expenditure data was not available for these households. However, this does not change the overall results indicating that registration was strongly associated with needs-based factors, as this cohort would still contribute towards the baseline accepted drug expenditures variable which had the strongest association with registration.

2.5 Conclusion

Registration for Fair PharmaCare was most strongly associated with the needs-based factors of drug expenditure levels and age. Those eligible for BC Fair PharmaCare register for the public drug insurance plan when the need arises. The next strongest association observed was a household-level factor: larger household size. Overall, households living in areas with higher neighbourhood income deciles, households without children, households containing a female, households outside of the Vancouver Coastal Health Region, and single parent households were more likely to register. Given that households who need Fair PharmaCare are registering when there is an increase in need, efforts should continue to focus on ensuring that the population at need is receiving coverage for which they are eligible.

Chapter 3 – Examining the Impact of Reducing Deductibles and Copayments for Lower Income Households on Registration Rates

3.1 Introduction

3.1.1 The Role of Deductibles and Copayments in Drug Insurance

Two common cost shifting mechanisms used in both public and private plans are deductibles and copayments.[12, 41, 42, 71] Insurance plans with deductibles only cover expenditures incurred above the deductible limit.[41] A copayment is an amount that the beneficiary has to pay out-of-pocket every time a prescription is filled. This can be in the form of a fixed dollar amount, or in the form of coinsurance, which is a stated proportion of the drug expenditures.[3, 17, 72] These cost shifting mechanisms control healthcare expenditures, but some studies have found they can adversely affect adherence to medicines and resulting health outcomes.[71]

Despite this, these cost-sharing mechanisms are widely used in public drug plans in Canada. For example, several provincial drug coverage programs for the general population in British Columbia, Saskatchewan, Manitoba, Ontario, Nova Scotia, and Prince Edward Island offer catastrophic drug plans with income-based deductibles.[8] The public drug insurance plans for the general population in British Columbia, Alberta, Saskatchewan, Ontario, Quebec, Nova scotia, and New Brunswick also incorporate an element of copayments.[8]

In British Columbia, the Fair PharmaCare program provides a universal catastrophic drug plan to the general population. The income-based deductibles in the program plan range from 0% to 3% of household income.[11] Expenditures on medications below the deductible limit are paid in full by either private insurance plans or out-of-pocket charges. Beyond the deductible, Fair PharmaCare charges coinsurance of either 25% or 30% up to a family maximum of up to 4% of household income. On-formulary drug expenditures above the family maximum are paid in full by Fair PharmaCare.[11] In BC, PharmaCare is the first payer, so all claims are first adjudicated against the public insurance plan, and only amounts that are not paid by PharmaCare are billed to private insurers or to patients directly.

3.1.2 Impacts of Deductibles and Copayments

A number of studies have documented the impact of introducing cost shifting mechanisms, and income-based deductibles specifically, on drug utilization.[71] For example, the introduction of income-based deductibles in BC in 2003 led to a decrease in public spending, but did not change overall drug utilization or total drug spending once privately paid amounts were accounted for among adults aged 65 and above.[40] However, another study found that among lower income households making around $15,000, a deductible of 2% of household income reduced overall drug use and costs by 7.2%.[41] This highlights concerns around cost-related nonadherence, where individuals forego medications that they need because of cost. Prior survey results have found that BC has the highest rate of CRNA in Canada, and Canada has one of the highest rates of CRNA among comparable OECD countries.[36, 39, 60] BC also has the highest per capita out-of-pocket drug expenditures in Canada, which could partially explain the higher rate of CRNA.[73] As being enrolled in drug insurance programs is associated with lower rates of CRNA, it is important for us to understand the relationship between cost shifting mechanisms and enrollment in drug plans.

3.1.3 Who is not Enrolled in BC's Fair PharmaCare Program?

The last study conducted on Fair PharmaCare registration rates was published by Leong et al. and based on 2003 data.[51] This study indicated that in the inaugural year of the Fair PharmaCare program, approximately 60% of the population under 65 years old in British Columbia that was eligible for Fair PharmaCare registered.[51] The Ministry of Health also reported that the total number of households registered in Fair PharmaCare at the end of March was 1,259,176 in 2018, 1,273,462 in 2019 and 1,270,903 in 2020. This means that a large portion of the population is still not registered, despite Fair PharmaCare being available to everyone who is registered in MSP and there being no monetary cost to registration. The results presented in Chapter 2 showed that registration is most strongly associated with needs-based factors. Households with lower health needs (e.g., lower drug expenditures and younger age)

were less likely to be registered. Registration was also associated with household size, where single households were less likely to be registered; and neighbourhood income, where those living in areas with lower neighbourhood income deciles were less likely to be registered.

3.1.4 Overview of 2019 Fair PharmaCare Policy Change

The BC government introduced a policy change on January 1, 2019 which lowered deductibles and copayments for lower-income households. As shown in Table 1.3 and Table 1.4, the coinsurance was eliminated for households with incomes below $13,750 ($14,000 if the household contains an individual born prior to 1940), deductibles were eliminated and copayments were reduced for households with income between $13,750 and $30,000 ($14,000 - $33,000 if the household contains an individual born prior to 1940), and deductibles and copayments were reduced for households with income between $30,000 and $45,000 ($33,000 and $50,000 if the household contains an individual born prior to 1940).[48] The BC government anticipated that this policy change would lead to 240,000 additional beneficiaries receiving benefits from Fair PharmaCare.[48] What was unclear, however, was whether there would be new registrants that would be motivated to register due to the reduction of deductibles and copayments. If an increase to registration rates is observed, this may indicate that households foresee greater benefit in Fair PharmaCare following these changes.

Past research has not yet isolated the impacts of deductible and copayment levels on registration for public drug insurance plans. As such, the policy change in 2019 in BC presents a unique opportunity to study the impacts of reducing cost shifting mechanisms from a public insurance plan. Beyond BC, this work can also inform other provinces that utilize deductibles and coinsurance in their public drug plans. Therefore, this study will focus on the impacts of reducing cost shifting mechanisms on registration rates.

3.2 Methods

3.2.1 Data Sources

This study used the same data sources as those described in Section 1.16. This specific objective used the PharmaCare Eligibility Fact Table and the MSP Consolidation File.

3.2.2 Study Context/Study Design

We conducted a controlled interrupted time series (cITS) analysis for this study as it allows for the estimation of policy effects while controlling for secular trends.[74] Interrupted time series analysis is one of the strongest quasi-experimental approaches for evaluating the longitudinal effects of interventions.[74] The intervention of interest was the policy changes in Fair PharmaCare that reduced and/or eliminated deductibles and copayments from registrants with household income below $45,000 ($50,000 if the household contains an individual born before 1940). cITS measures both immediate level changes resulting from the policy change as well as longitudinal trend changes in registration rates. These are compared to the level and trend changes in a control group.[74] In this analysis, we used households living in higher income neighbourhoods as the control group. Any differential level or trend changes between the two groups serve as the estimated impacts of the policy change.

3.2.3 Study Cohort/Study Period

Overall Cohort

The overall cohort formed the denominator of the Fair PharmaCare registration rate, representing all households that were eligible for Fair PharmaCare and not another relatively comprehensive public drug plan. This cohort was created as described in Section 1.17, and included all households that were registered for MSP and not registered for Plan W at any point in time between January 1, 2013 to March 31, 2021. Additionally, households were excluded from the cohort during any time period that they were enrolled in another relatively comprehensive public drug plan, as described in Section 1.17, as we would

not expect them to have any additional incentive to register for Fair PharmaCare given that they are unlikely to derive further benefit beyond their current plan.

Control group

The Fair PharmaCare policy change in 2019 only changed the deductibles and copayments for households with incomes less than $45,000 ($50,000 if the household contains an individual born before 1940). As such, the control group was defined as households with household incomes above $45,000 ($50,000 if the household contained an individual born before 1940).[48] Validated income information for households who have not registered for Fair PharmaCare and consented to releasing their CRA information to the BC Ministry of Health was not available. Therefore, neighbourhood income deciles from the MSP Consolidation File were used as a proxy for household income. Neighbourhood income deciles were mapped to households by Population Data BC using the postal code conversion file from the closest census. A census is completed every five years and the nearest census was defined as two years before a census year, the census year itself, plus the two years following a census year.[57] Statistics Canada collated average household income across Census Dissemination Areas, which are small, relatively stable geographic units comprising of around 400 to 700 persons. These dissemination areas were then sorted by income and aggregated into 1,000 strata, which were then reduced to deciles.[65, 66]

In order to determine which neighbourhood income deciles were most likely to be associated with households that were not affected by the policy change, we examined the distribution of Fair PharmaCare plans across each neighbourhood income decile within the registered population. The results of this analysis validated the correlation between neighbourhood income deciles and validated household income, showing that the proportion of households affected by the policy change increased as neighbourhood income decile decreased. Based on this analysis, we selected the top two neighbourhood income deciles as the control group, as these deciles were the least likely to include households affected by the policy change: more than two-thirds of registered households living in these dissemination areas were not impacted by the policy change.

Table 3.1 Percentage of registered population impacted by the policy change

Neighbourhood Income Decile	Impacted by Policy Change	Not Impacted by Policy Change
1 (low)	59.5%	40.5%
2	53.7%	46.3%
3	49.7%	50.3%
4	46.5%	53.5%
5	42.5%	57.5%
6	39.2%	60.8%
7	36.2%	63.9%
8	33.3%	66.7%
9	31.1%	68.9%
10 (high)	28.0%	72.1%

Intervention group

We defined the intervention group using similar methods. We aimed to include households with incomes below $45,000/$50,000 as these households would have been most affected by the policy change. Using the same methods described above, we selected the two lowest neighbourhood income deciles, as more than 50% of the registered households living in dissemination areas with neighbourhood income deciles 1 and 2 were affected by the policy change.

Study period

Our study focused on data from September 2017 to March 2021. This provided 16 months of data prior to the 2019 policy change and 27 months after. While we intended to use more pre-intervention data, our initial data inspection of the number of households registered in Fair PharmaCare between 2013 and 2021 showed a large decrease in registration rates of 13% between June 2017 and September 2017. This drop was driven completely by a decline in the number of households registered in Fair PharmaCare, not by an increase in number of households registered for MSP. This decline in registration rate was present across all neighbourhood income deciles. Our investigations into the reason for this drop did not reveal any firm explanation. Therefore, to avoid any potential bias, we used a study start date of September 2017 when

registration rates stabilized. The post-period was determined by data availability at the time of data analysis, which was March 2021.

3.2.4 Outcomes of Interest

The primary outcome of interest was the impact of the policy change, as measured by monthly registration rate. This was defined as the total number of households enrolled in Fair PharmaCare during the month (using unique MSP IDs) divided by the total number of households eligible for Fair PharmaCare who were not already enrolled in another relatively comprehensive public drug plan in that same month.

3.2.5 Statistical Analysis

Our interrupted time series analysis was conducted using the following model:

$$Outcome = \beta_0 + \beta_1(time) + \beta_2(level) + \beta_3(trend) + \beta_4(control) + \beta_5(control)(time) + \beta_6(control)(level) + \beta_7(control)(trend) + \varepsilon_t$$

Each unit of time represented one month. Level was a categorical variable that represented pre or post policy change, and trend represented the number of time periods (i.e., months) that had passed since the policy change. The impact of the policy change was captured in β_6 as the differential change in the level of outcome (registration rate) between the intervention and the control group immediately following the policy change, and β_7 as the differential change in the trend of the outcome between the intervention and control group following the intervention over time.

3.3 Results

3.3.1 Cohort Characteristics

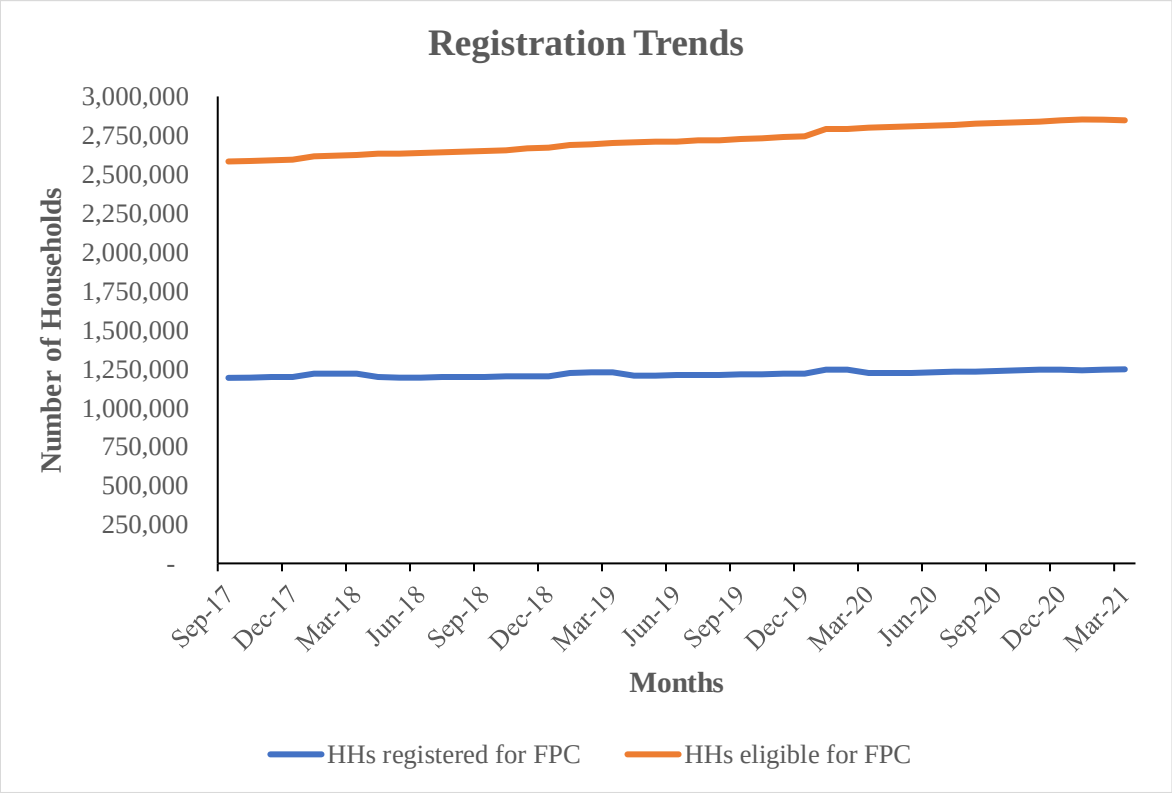
As shown in Table 3.2, on January 1, 2019, the date of the intervention of interest, the control group contained 479,623 households, of which 251,431 (52.4%) were not registered and 228,192 (47.5%) were registered. The intervention group contained 537,205 households, of which 304,207 (63.4%) were not registered and 232,998 (48.6%) were registered. A greater proportion of households in the intervention cohort did not contain a child, did not contain a female, and were a single household.

Table 3.2 Household characteristics on January 1, 2019

	Control Group (High SES)						Intervention Group (Low SES)					
	Not Registered (%)		Registered (%)		Total (%)		Not Registered (%)		Registered (%)		Total (%)	
Total Population	**251,431**		**228,192**		**479,623**		**304,207**		**232,998**		**537,205**	
Health Authority												
IHA	38,216	15.2%	36,428	16.0%	74,644	15.6%	44,894	14.8%	44,236	19.0%	89,130	16.6%
FHA	74,259	29.5%	72,322	31.7%	146,581	30.6%	101,157	33.3%	77,294	33.2%	178,451	33.2%
VCH	75,943	30.2%	58,940	25.8%	134,883	28.1%	89,800	29.5%	60,903	26.1%	150,703	28.1%
VIHA	44,355	17.6%	47,071	20.6%	91,426	19.1%	52,627	17.3%	41,136	17.7%	93,763	17.5%
NHA	18,655	7.4%	13,431	5.9%	32,086	6.7%	15,715	5.2%	9,427	4.0%	25,142	4.7%
Missing					*3*						*16*	
Household contains Single Parent												
No	239,291	95.2%	221,593	97.1%	460,884	96.1%	290,488	95.5%	225,041	96.6%	515,529	96.0%
Yes	12,140	4.8%	6,599	2.9%	18,739	3.9%	13,719	4.5%	7,957	3.4%	21,676	4.0%
Household contains a child												
No	191,317	76.1%	187,030	82.0%	378,347	78.9%	252,287	82.9%	202,129	86.8%	454,416	84.6%
Yes	60,114	23.9%	41,162	18.0%	101,276	21.1%	51,920	17.1%	30,869	13.2%	82,789	15.4%
Household contains female												
No	85,898	34.2%	35,565	15.6%	121,463	25.3%	127,745	42.0%	52,026	22.3%	179,771	33.5%
Yes	165,533	65.8%	192,627	84.4%	358,160	74.7%	176,462	58.0%	180,972	77.7%	357,434	66.5%
Household Size												
1	149,988	59.7%	90,282	39.6%	240,270	50.1%	219,795	72.3%	134,206	57.6%	354,001	65.9%
2	49,746	19.8%	95,551	41.9%	145,297	30.3%	46,682	15.3%	71,191	30.6%	117,873	21.9%
3	20,878	8.3%	17,285	7.6%	38,163	8.0%	19,270	6.3%	13,410	5.8%	32,680	6.1%
4+	30,819	12.3%	25,074	11.0%	55,893	11.7%	18,460	6.1%	14,191	6.1%	32,651	6.1%
Household contains individual aged 60 and over												
No	207,088	82.4%	94,617	41.5%	301,705	62.9%	261,661	86.0%	97,028	41.6%	358,689	66.8%
Yes	44,343	17.6%	133,575	58.5%	177,918	37.1%	42,546	14.0%	135,970	58.4%	178,516	33.2%

Legend: *High SES = Households living in dissemination areas with neighbourhood income deciles 9-10; Low SES = Households living in dissemination areas with neighbourhood income deciles 1-2; IHA = Island Health Authority; FHA = Fraser Health Authority; VCH = Vancouver Coastal Health Authority; VIHA = Vancouver Island Health Authority; NHA = Northern Health Authority*

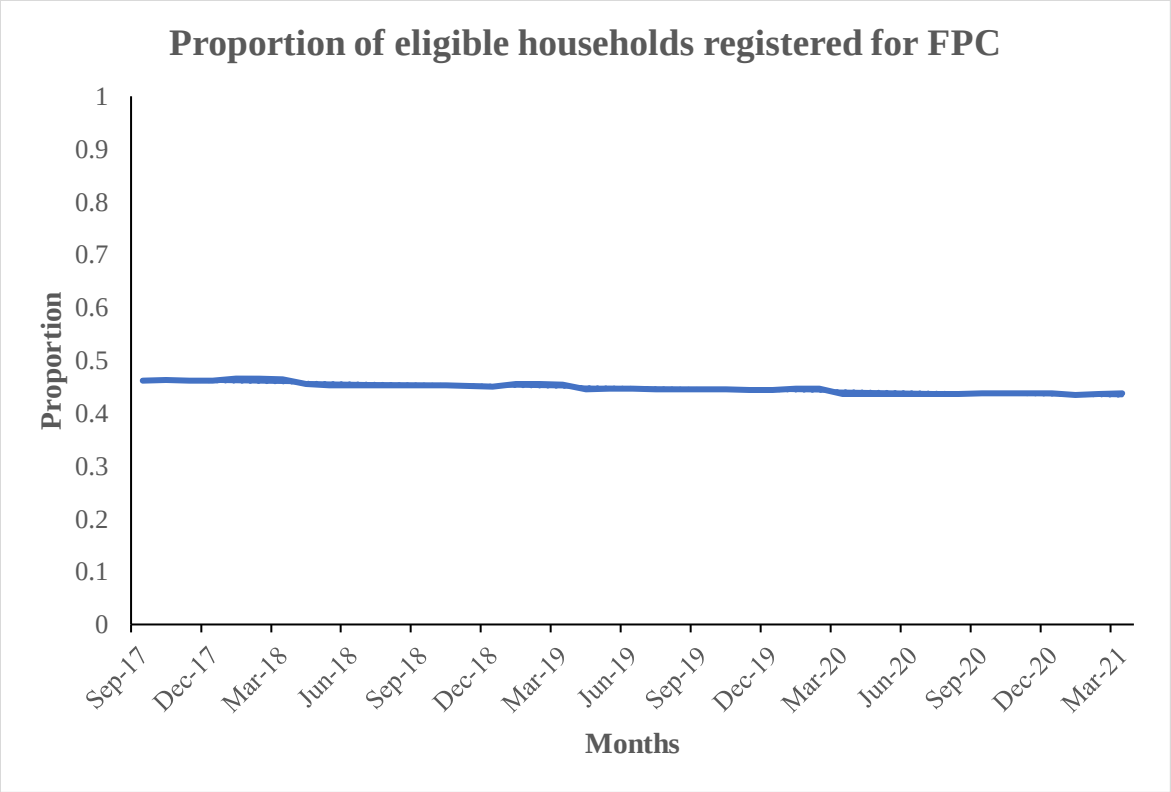
Numbers and proportions of households eligible for and registered for Fair PharmaCare from September 2017 through March 2021 are shown in Figures 3.1 and 3.2 respectively. The overall registration rate in Fair PharmaCare decreased over time, as the raw number of households registered in Fair PharmaCare did not increase as quickly as the number registered in MSP.



Legend: *HH = households; FPC = Fair PharmaCare*

Figure 3.1 Fair PharmaCare registration trend over time

Orange trendline shows the number of households eligible for Fair PharmaCare from September 2017 to March 2021. Blue trendline shows the number of households registered for Fair PharmaCare from September 2017 to March 2021.



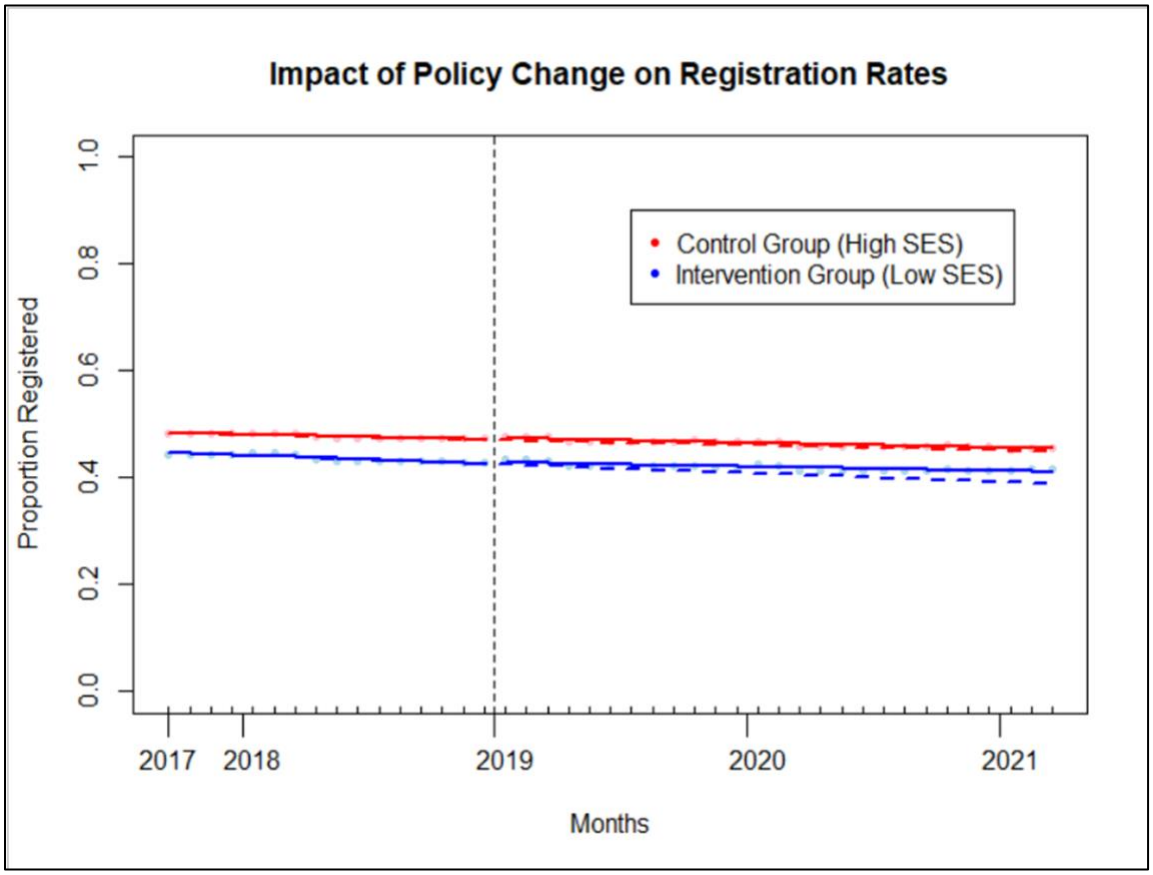
Legend: *FPC = Fair PharmaCare*

Figure 3.2 Proportion of eligible households registered for Fair PharmaCare

The trendline shows the proportion of households eligible for and registered for Fair PharmaCare between September 2017 and March 2021. The graph shows registration rates of 46.2% (1,192,167 households registered/2,582,155 households eligible) in September 2017, 45.5% (1,223,782 households registered/2,689,954 households eligible) in January 2019 and 43.8% (1,246,943 households registered/2,848,061 households eligible) in March 2021.

3.3.2 Impact of Policy Change on Registration Rates

The policy change that reduced deductibles and coinsurance implemented on January 1, 2019 did not have a significant impact on registration rates. We found no statistically significant differential change in either the level (-0.00063; 95% CI: -0.00689 to 0.00567) nor in the trend (0.00063; 95% CI: -0.00011 to 0.00137) of registration in Fair PharmaCare following the policy change on January 1, 2019. Figure 3.3 presents the ITS with control model for Fair PharmaCare registration rates.



Legend: *High SES = Neighbourhood income decile greater than or equal to 9; Low SES = Neighbourhood income decile lesser than or equal to 2.*

Figure 3.3 cITS analysis of Fair PharmaCare registration rates from September 2017 to March 2021

The cITS showed no differential change in level or trend after the policy change in January 1, 2019.

3.4 Discussion

3.4.1 Interpretation of Results

Registration for insurance programs is important as it can provide financial protection when medical expenditures rise. Within the BC Fair PharmaCare program, we found that while the raw number of households registered for Fair PharmaCare increased over time, the number of households eligible for Fair PharmaCare increased more quickly. Overall, this led to an overall decrease in the registration rate for Fair PharmaCare over time. We found that the 2019 reduction in deductibles and copayments for lower income households did not appear to impact Fair PharmaCare registration rates. These results are congruent with the findings in Chapter 2, which suggested that households register for Fair PharmaCare when the need arises, as represented by higher baseline drug expenditures, greater year-over-year changes in drug expenditures and increasing age. As discussed in Section 3.1.3, the population not yet registered for Fair PharmaCare has traditionally had lower prescription drug needs. These households were less likely to benefit from registering for Fair PharmaCare, and therefore, a reduction in deductibles and/or copayments may not incentivize them to register. It may also, of course, be the case that they are unaware of the potential benefits of registering or of the change in coverage.

3.4.2 Policy Implications

The results of this study suggest that any benefits from the policy changes made in 2019 would have largely accrued to households that were already registered for the program. Further research would need to be conducted to understand the reasons why the policy change did not incentivize households to register for Fair PharmaCare – whether it was due to a lack of an immediate need for coverage, lack of knowledge about the policy change, or the magnitude of the reduction in deductibles/copayments not being meaningful for the household.

3.4.3 Study Strengths and Limitations

In creating the control and intervention cohorts, validated income information was not available for households that were not registered. As a result, we used neighbourhood income deciles as a proxy for actual household income. It is important to note that this is only a best estimate made given the data that is available, and as such, households may have been improperly classified as control (household income >$45,000/$50,000) or intervention (household income <$45,000/$50,000).[66] Any such misclassification might bias us toward a null result. However, there was no indication of change in the point estimates we calculated. Finally, it is unclear how these results might extrapolate to other provinces or jurisdictions with income-based drug coverage plans.

3.5 Conclusion

This study found that the 2019 change in policy to Fair PharmaCare which reduced and eliminated deductibles and copayments for lower income households did not appear to change registration rates. This indicates that the policy change did not incentivize households to register for the plan. Given the results in the prior chapter suggesting that households register when their drug needs increase, this may or may not have resulted in alleviating cost-related issues accessing medicines. However, it may be the case that patients are not obtaining financial benefits that are available to them.

Chapter 4 – Examining the Association between Registration, Drug Expenditures, and Drug Utilization

4.1 Introduction

4.1.1 Background

Drug coverage in Canada is a patchwork of private and public plans that vary across the country.[8] Public drug plans financed 43.6% of total drug expenditures in Canada in 2019.[5, 8] They play a critical role in the patchwork of drug coverage as many Canadians lack other coverage, and private plans are continuing to add cost-controlling mechanisms in order to reduce expenditures.[3, 75, 76] Households with lower levels of drug insurance have higher out-of-pocket costs, and a continuous need for drugs (for example because of chronic condition) can lead to higher out-of-pocket costs and then to greater rates of CRNA.[33, 39] Therefore, understanding registration in public drug plans is important.

Commonly studied outcomes of research examining associations between public, private, and no drug insurance plans include CRNA, health outcomes, health resource utilization, drug expenditures, and drug utilization. Results show that there is an association between drug insurance and health outcomes. Studies comparing and simulating the effects of different drug plans suggest that comprehensive, publicly financed pharmacare models that limit out-of-pocket expenditures to a maximum level of household income can provide protection against catastrophic drug expenditures.[77, 78] Catastrophic drug plans are common in Canada: 9 out of 11 provinces offer catastrophic public drug plans to the general population.[8]

In British Columbia, there are ten targeted drug plans (e.g. for populations with specific health conditions) and one catastrophic drug plan for the general public called Fair PharmaCare.[11] Since Fair PharmaCare assigns deductibles and coinsurance based on household income, registration is required for households to provide consent for the Canada Revenue Agency (CRA) to release their income information to the BC Ministry of Health. In the absence of registration, individuals are automatically assigned a deductible of $10,000, indicating that they will not receive any pharmacare coverage until they have spent over $10,000

on drug expenditures that are accepted under the provincial formulary.[11] Although Fair PharmaCare is available for everyone who is registered in MSP, the results in Chapter 3 showed that only 44% of the eligible population was registered as of March 2021.

Chapter 2 examined the correlation between needs-based factors, area-based factors, household-level factors and registration. We found a strong association between needs-based factors such as drug expenditures and registration, indicating that registration occurs around the time that households start accruing a greater volume of drug expenditures. While there was an association, neither the magnitude of the change in drug spending nor utilization behaviours around the time of registration were clear. This chapter seeks to understand the extent and magnitude of change in behaviours around the time of registration in Fair PharmaCare. It also examines the shift of expenditures from private to public, and the change in PharmaCare-paid drug expenditures as a way to understand how much financial protection this catastrophic drug plan provides to households.

4.2 Methods

4.2.1 Study Context/Study Design

As shown in the results of Chapter 2, registration is strongly associated with needs-based factors, as proxied by drug expenditures. An interrupted time series (ITS) analysis was selected for this study as it is one of the most robust quasi-experimental research designs For evaluating the longitudinal effects of interventions.[74] The ITS was used to assess the changes in drug expenditures and drug utilization in the year of registration in Fair PharmaCare and beyond. The ITS method measures the immediate changes in the year of registration in Fair PharmaCare as well as the longitudinal trends in drug expenditures and utilization over time.

4.2.2 Data Sources

This study used the data sources described in Section 1.16 which were provided by Population Data BC. This analysis used the PharmaNet file, PharmaCare Eligibility Table, and MSP Consolidation File.

4.2.3 Study Cohort/Study Period

Cohort definition

Our cohort was derived from the overall cohort described in Section 1.17. From this overall cohort, we selected only the households that registered for Fair PharmaCare between January 1, 2014 and December 31, 2020. Households were considered to be registered for Fair PharmaCare if their dominant PharmaCare plan was Plan I or Plan J according to the hierarchy described in Section 1.17. Households were excluded from the cohort if they were already registered for Fair PharmaCare or another relatively comprehensive public drug plan on January 1, 2014, if they never registered for Fair PharmaCare during the study period, and if they registered for another relatively comprehensive public drug plan during the study period.

Study period

The study period of January 1, 2014 to December 31, 2020 was selected due to availability of data at the time of data analysis. While data was available for 2013, it was not possible to distinguish which households registered in prior years from households that registered in 2013. The start date for households that met the inclusion criteria was the earlier of 2014 and the year that they first appeared in the MSP Consolidation File. The study end period for each household was the latter of either 2020 or the year in which the last member in the household died or moved away from BC. Given this, it is possible that a household may not contribute to every timepoint within the ITS.

4.2.4 Outcomes of Interest

Patterns of drug utilization and expenditure around registering for Fair PharmaCare were assessed through the following outcome variables.

Drug expenditures

Several expenditure outcome variables were examined. Table 4.1 provides a description of the variables examined that were either extracted or calculated based on PharmaNet.

Table 4.1 Definitions for drug expenditure outcome variables of interest

Variable	Definition
Billed expenditures ($)	Total billed amount from PharmaNet calculated as billed ingredient cost, professional fee, and special service fee. This is the full cost of drug dispensations without consideration of insurance coverage.
PharmaCare accepted drug expenditures ($)	Total accepted amount from PharmaNet calculated as accepted drug/ingredient cost plus accepted professional fee and accepted special service fee. Accepted drug expenditures are expenditures that were approved by PharmaCare and count towards a household's deductible and family maximum, and would be paid above the deductible.
Drug expenditures paid by PharmaCare ($)	The amount that PharmaCare paid toward the submitted claim from PharmaNet.
Drug expenditures paid by private payers ($)	Derived amount, calculated as Billed expenditures less drug expenditures paid by PharmaCare. Private payers include both private insurers as well as household out-of-pocket payments.
Household with drug expenditures above deductibles (%)	Derived categorical variable, identifying any household that had any drug dispensation during the year where the PharmaCare paid amount was greater than $0.

The above variables are described as household-level variables. To calculate the average values amongst the cohort of interest, each of the above variables were aggregated across all households and then divided by the total number of households for each study year.

Drug utilization

Several drug utilization variables were also extracted or derived from PharmaNet. Table 4.2 provides a description of these variables.

Table 4.2 Definitions for drug utilization outcome variables of interest

Variable	Definition
Count of drug dispensations	Each row of data within PharmaNet contains information on one dispensation, the total row count for each household is the count of drug dispensations for that household during that time period.
Count of drug dispensations paid by PharmaCare	Each row of data where PharmaCare paid was greater than $0 was considered one dispensation paid by PharmaCare. The total row count for each household is the count of drug dispensations paid by PharmaCare for that household during that time period.

The above variables were described as household-level variables. To calculate the average values amongst the cohort of interest, each of the above variables was aggregated across all households and then divided by the total number of households for each study year.

4.2.5 Statistical Analysis

Our interrupted time series analysis was conducted using the following formula:

$$\text{Outcome} = \beta_0 + \beta_1(\text{time}) + \beta_2(\text{level}) + \beta_3(\text{trend}) + \varepsilon_t$$

Level was a categorical variable that represented pre or post registration in Fair PharmaCare, and trend represented the number of time periods (i.e., years) that had passed since registration in Fair PharmaCare. β_1 and β_2 estimated the immediate level and trend change in drug expenditures and utilization following registration in Fair PharmaCare, respectively.

The unit of analysis in our model was calendar years. To calculate time since registration, the year in which the household first registered for Fair PharmaCare, as defined in Section 4.2.3, was identified. The specific date of registration was not considered, just the year of registration. The difference between the beneficiary year and the year of registration formed the variable time since registration. Time 0 for each household was set to the year within the study period in which they registered for Fair PharmaCare. Depending on when a household registered during the study period, each household could contribute up to seven years of "pre-registration" time and six years of "post-registration" time. As the first possible year of registration that was considered was 2014 and the last year of data available was 2020, the post-registration period was 6 years. Likewise, as the last possible year of registration was 2020 and the first year of data available was 2013, the pre-registration period was 7 years.

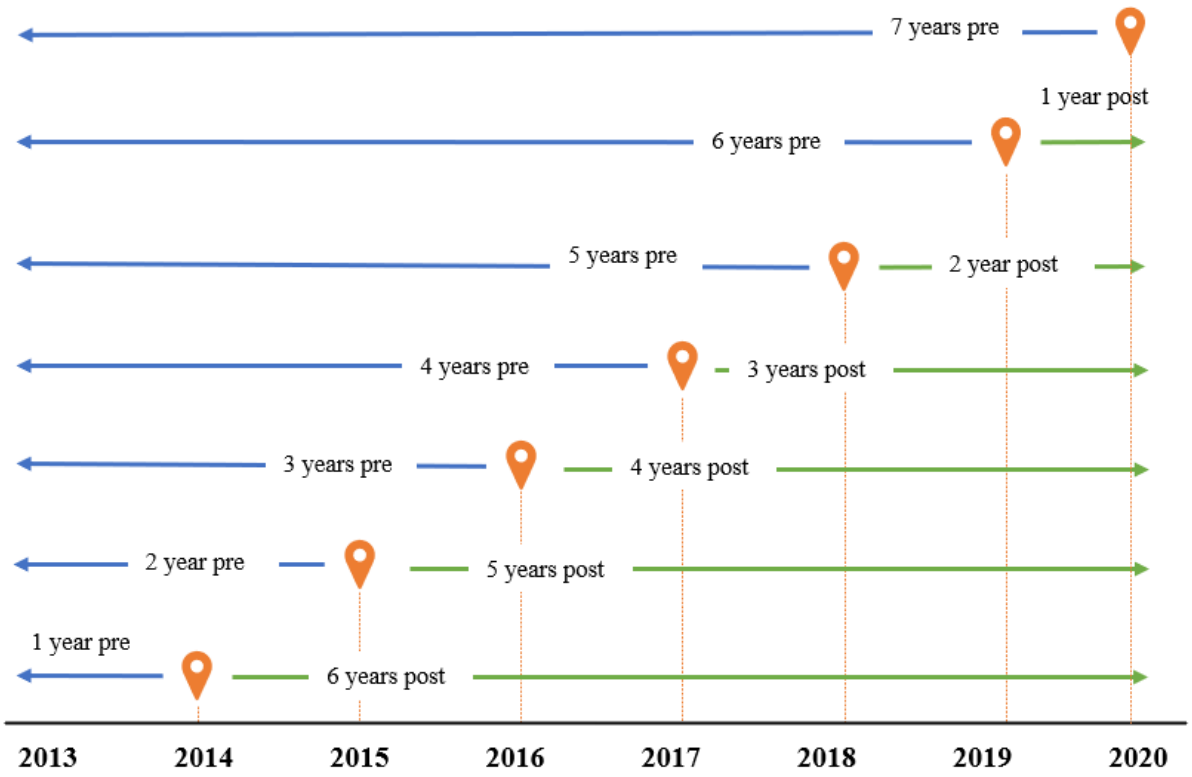


Figure 4.1 Diagram of pre and post periods for ITS

Orange markers represent year of registration; green arrows represent number of years post registration; and blue arrows represent number of years prior to registration.

The presence of autocorrelation was tested for using the Durbin Watson test, autocorrelation function (ACF), and partial autocorrelation function (PACF) graphs. Appropriate autocorrelation adjustments were made based on the results of these tests, and a likelihood ratio test (LRT) was used to compare the final models with other autocorrelation options. The analyses in this study were performed using SAS Version 9.4 and R Version 3.6.2.

4.3 Results

4.3.1 Cohort Characteristics

Table 4.3 shows that households registered throughout the study period between January 1, 2014 and December 31, 2020. There were 878,928 households that registered for Fair PharmaCare, which together contributed a total of 3,751,251 household-year observations, or an average of 4.2 years per household. There was an unexplained dip in registration in 2017, which is consistent with the observation made in Chapter 3, and an increase in registration in 2020. Table 4.4 shows that the number of households in the dataset decreased with years since registration, as not every household contributed data across all 7 possible pre periods and all 6 possible post periods.

Table 4.3 Number of households in each year of registration

Year of Registration	No. of Households
2014	133,301
2015	144,616
2016	130,935
2017	58,599
2018	131,486
2019	92,830
2020	187,161

Table 4.4 Number of households in each study year

Years since Registration	No. of Households
-7	14,511
-6	33,597
-5	57,301
-4	88,415
-3	129,155
-2	183,995
-1	269,986
0	**878,928**
1	607,808
2	496,776
3	366,164
4	318,675
5	210,994
6	94,946

Household characteristics of the population in their year of registration are shown in Table 4.5. In the year of registration, 80% of households had drug expenditures accepted by PharmaCare greater than $0, and 58% had drug expenditures accepted by PharmaCare greater than $100. The greatest proportion of registrants were from Fraser Health Authority followed by Vancouver Coastal Health, and contained at least one female in the year of registration.

Table 4.5 Characteristics of households that registered for Fair PharmaCare between 2014 and 2020

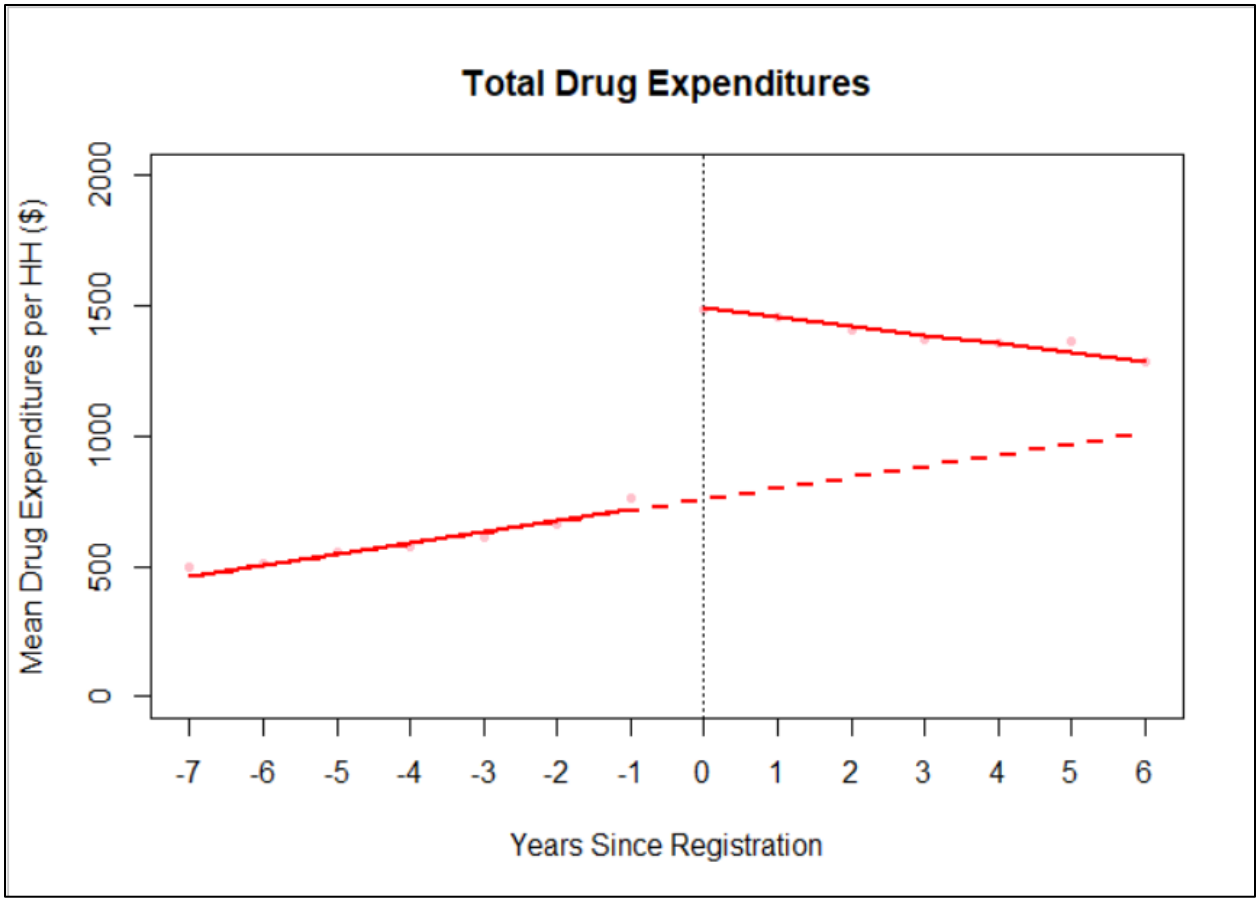
Household Characteristics in Year of Registration		
Characteristic	**No. of HHs**	**% of HHs**
Total Households	**878,928**	
Health authority		
IHA	145,479	16.6%
FHA	321,149	36.5%
VCH	203,469	23.1%
VIHA	151,826	17.3%
NHA	46,618	5.3%
Unknown/unspecified	10,387	1.2%
Neighbourhood income decile		
1 (low)	75,486	8.6%
2	81,185	9.2%
3	86,400	9.8%
4	86,187	9.8%
5	88,294	10.0%
6	90,041	10.2%
7	89,116	10.1%
8	94,900	10.8%
9	88,743	10.1%
10 (high)	80,453	9.2%
Unknown/unspecified	18,123	2.1%
Drug expenditures accepted by PharmaCare		
$0	177,755	20.2%
$1 - $100	194,275	22.1%
$101 - $499	288,810	32.9%
$500 - $1,000	102,850	11.7%
>$1,000	115,238	13.1%
Household contains a single parent		
No	846,830	96.3%
Yes	32,098	3.7%
Household contains a child		
No	726,005	82.6%
Yes	152,923	17.4%
Household contains a female		
No	227,616	25.9%
Yes	651,312	74.1%
Household size		
1	510,045	58.0%
2	232,354	26.4%
3	63,341	7.2%
4+	73,188	8.3%
Household contains an individual aged 60 and over		
No	588,573	67.0%
Yes	290,355	33.0%

Legend: *IHA = Island Health Authority; FHA = Fraser Health Authority; VCH = Vancouver Coastal Health Authority; VIHA = Vancouver Island Health Authority; NHA = Northern Health Authority*

4.3.2 Impact of Registration on Drug Expenditures and Utilization

Drug expenditures

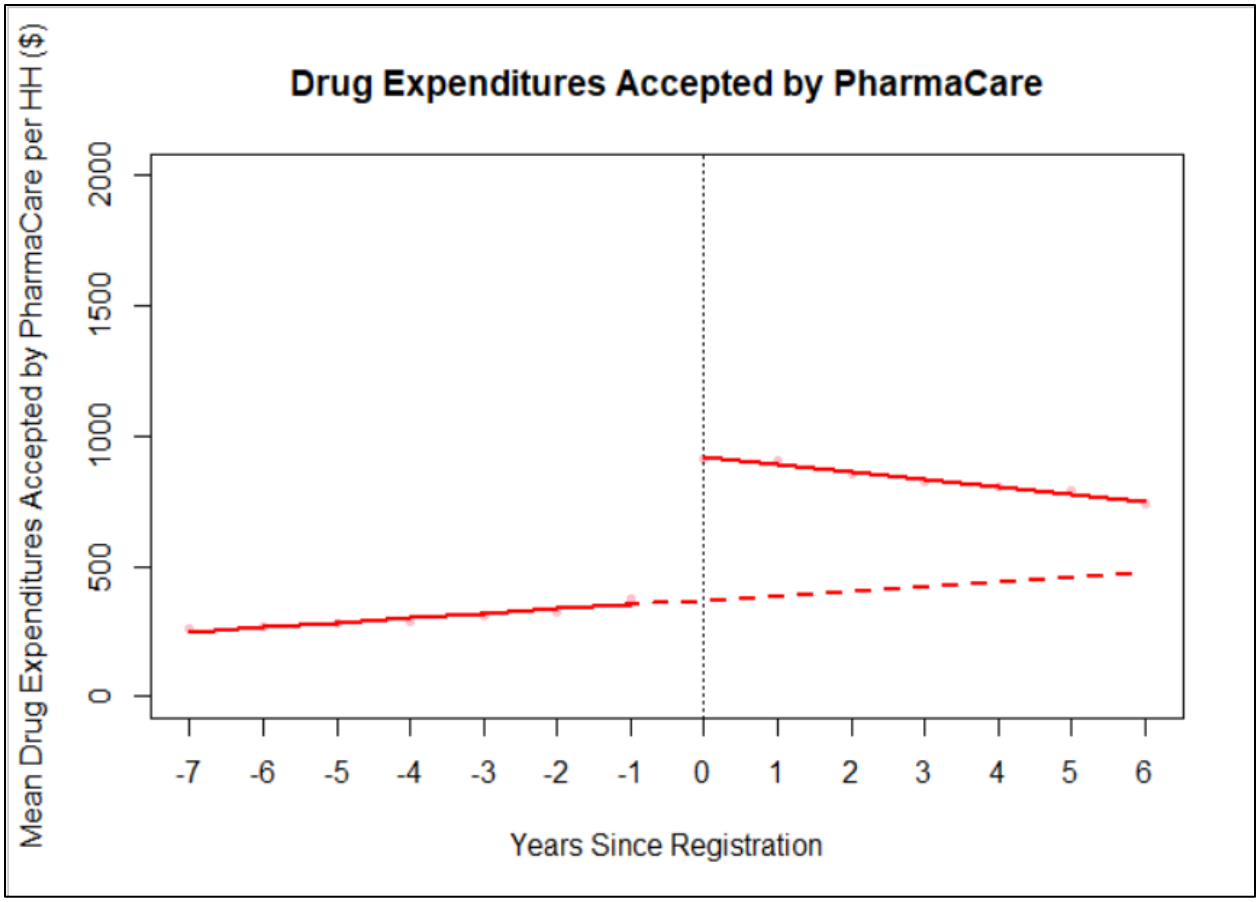
Figure 4.1 shows that in the year of registration, total drug expenditures regardless of insurance coverage increased significantly ($809.47; 95% CI $807.61 to $811.34). After this initial level change in the year of registration, total drug expenditures trended downwards over time (-$76.32 per year; 95% CI: -$76.48 to -$76.16). Figure 4.2 shows that a similar pattern was observed in drug expenditures accepted by PharmaCare, which displayed a significant increase in the year of registration ($591.95; 95% CI: $564.45 to $619.43) followed by a downwards slope over time (-$45.84; 95% CI: -$52.60 to -$39.07).



Legend: *HH = Household*

Figure 4.1 Total annual billed drug expenditures among British Columbians that registered for Fair PharmaCare between 2014 and 2020

In the year that households registered for Fair PharmaCare, an immediate significant increase of $809.47 followed by a significant decrease of $76.32 per year after the initial year of registration occurred.



Legend: *HH = Household*

Figure 4.2 Total annual drug expenditures accepted by PharmaCare among British Columbians that registered for Fair PharmaCare between 2014 and 2020

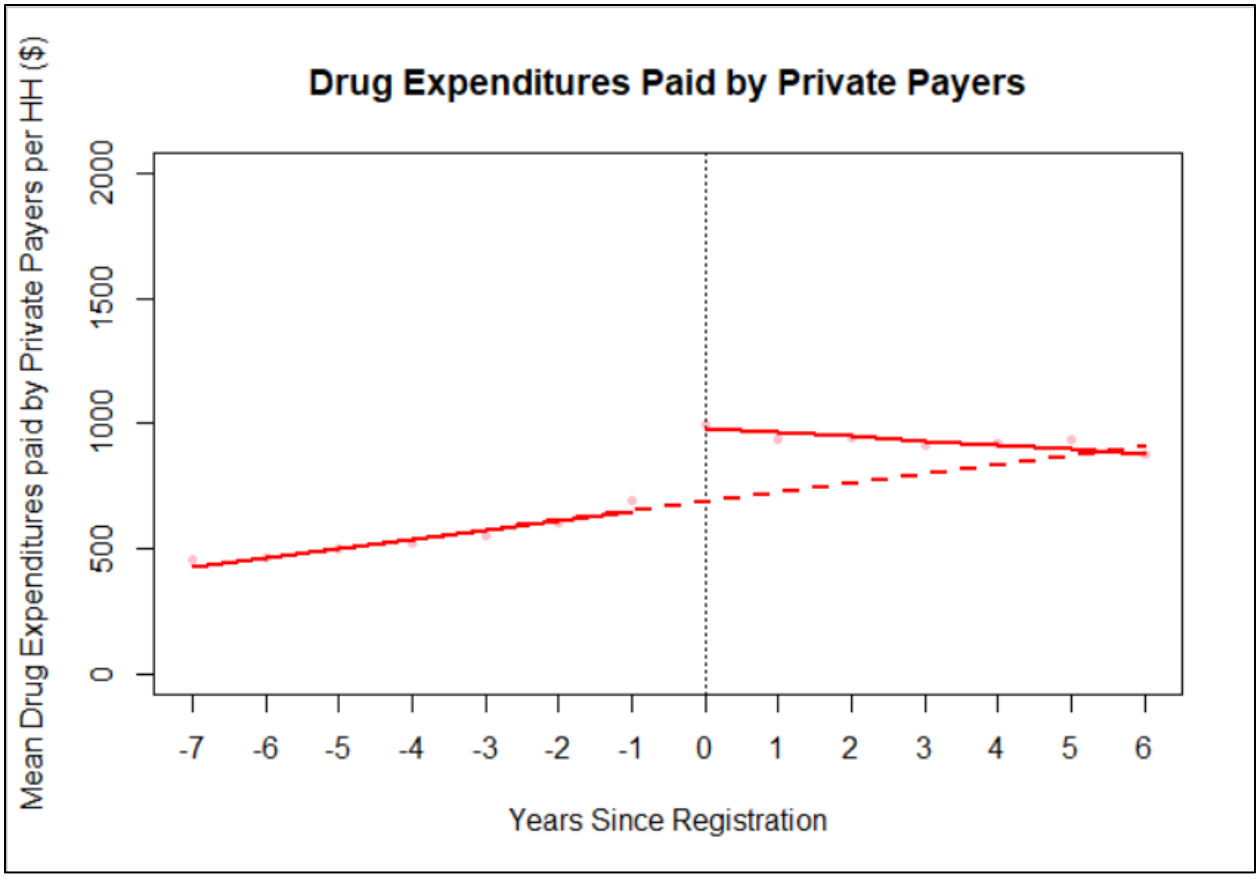
In the year that households registered for Fair PharmaCare, an immediate significant increase of $591.95 followed by a significant decrease of $45.84 per year after the initial year of registration occurred.

Financing of drug expenditures

Figure 4.3 and Figure 4.4 show that this increase in drug expenditures in the year of registration was financed more significantly by PharmaCare (57%), but also by private payers (43%) as shown by the significant level changes in expenditures paid by PharmaCare and private payers after registration (PharmaCare: $458.54; 95% CI $447.58 to $469.50 | Private: $350.54; 95% CI: $325.64 to $375.35). Prior to registration, PharmaCare-paid expenditures per household were very low; and drug expenditures were financed almost fully by private payers. The level change increase in PharmaCare-paid expenditures was composed of new drug expenditures, and potentially also a shift of drug expenditures from private to public payers.

Following the initial year of registration, there was a downward trend change for private payers (-$54.34; 95% CI -$58.43 to -$50.24). Approximately five years after initial registration, the trendline of drug expenditures paid by private payers crossed the counterfactual, suggesting that after the initial shock in increase in drug expenditures diminishes, private payers end up paying less than they would have if the household did not register for Fair PharmaCare. PharmaCare-paid expenditures also decreased over time after the initial increase in drug expenditures in the year of registration; however, this downward trend change is smaller than that for private payers (-$20.52; 95% CI -$23.02 to -$18.02).

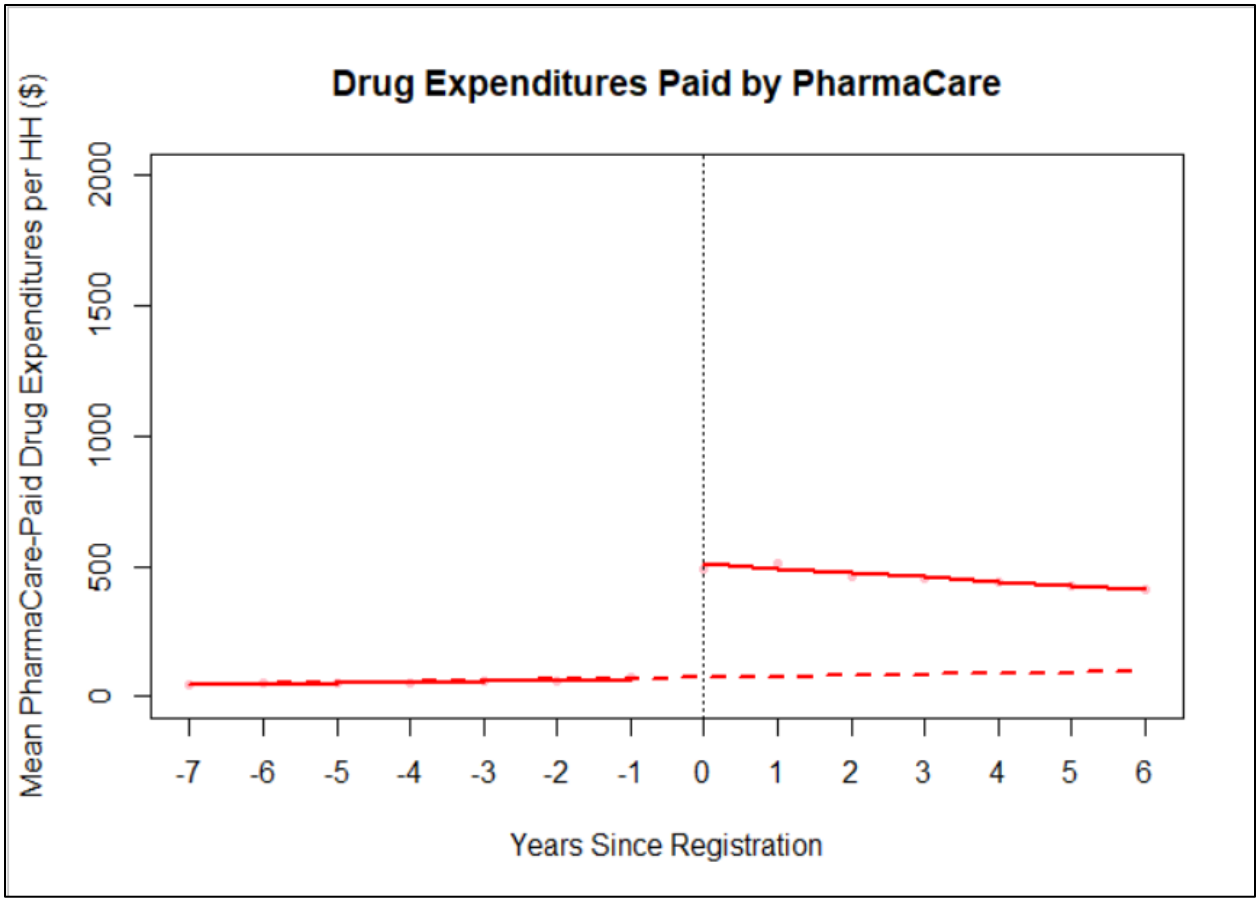
Further, Figure 4.5 shows that in the year of registration, there was a significant increase in the percentage of households with drug expenditures above their deductibles (16.2%; 95% CI: 14.8% to 17.7%). As with the change in expenditures, the proportion of households with drug expenditures above their deductibles also showed a gradual downward trend year-over-year after the initial year of registration (-1.2%; 95% CI: -1.6% to - 0.9%). In the absence of registration, all else held equal, the counterfactual suggested that the proportion of households with expenditures above their deductibles continues to slowly increase over time.



Legend: *HH = households*

Figure 4.3 Drug expenditures paid by private payers among British Columbians that registered for Fair PharmaCare between 2014 and 2020

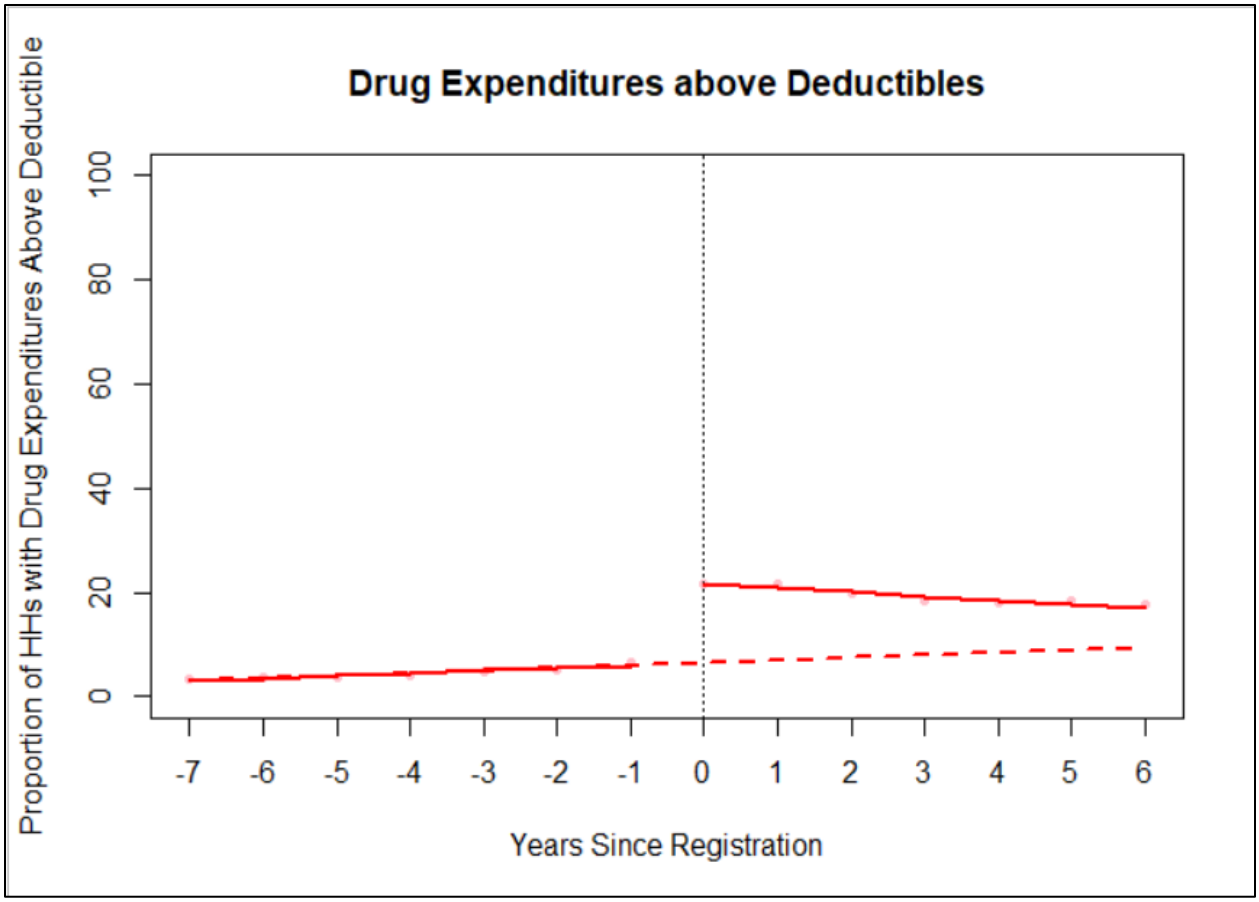
In the year that households registered for Fair PharmaCare, an immediate significant increase of $350.54 followed by a significant decrease of $54.34 per year after the initial year of registration occurred. Trendline representing cohort that registered for Fair PharmaCare crosses the counterfactual representing households that did not register for Fair PharmaCare 5 years after registration for Fair PharmaCare, indicating regression to the mean.



Legend: *HH = households*

Figure 4.4 Drug expenditures paid by PharmaCare among British Columbians that registered for Fair PharmaCare between 2014 and 2020

In the year that households registered for Fair PharmaCare, an immediate significant increase of $458.54 followed by a significant decrease of $20.52 per year after the initial year of registration occurred.



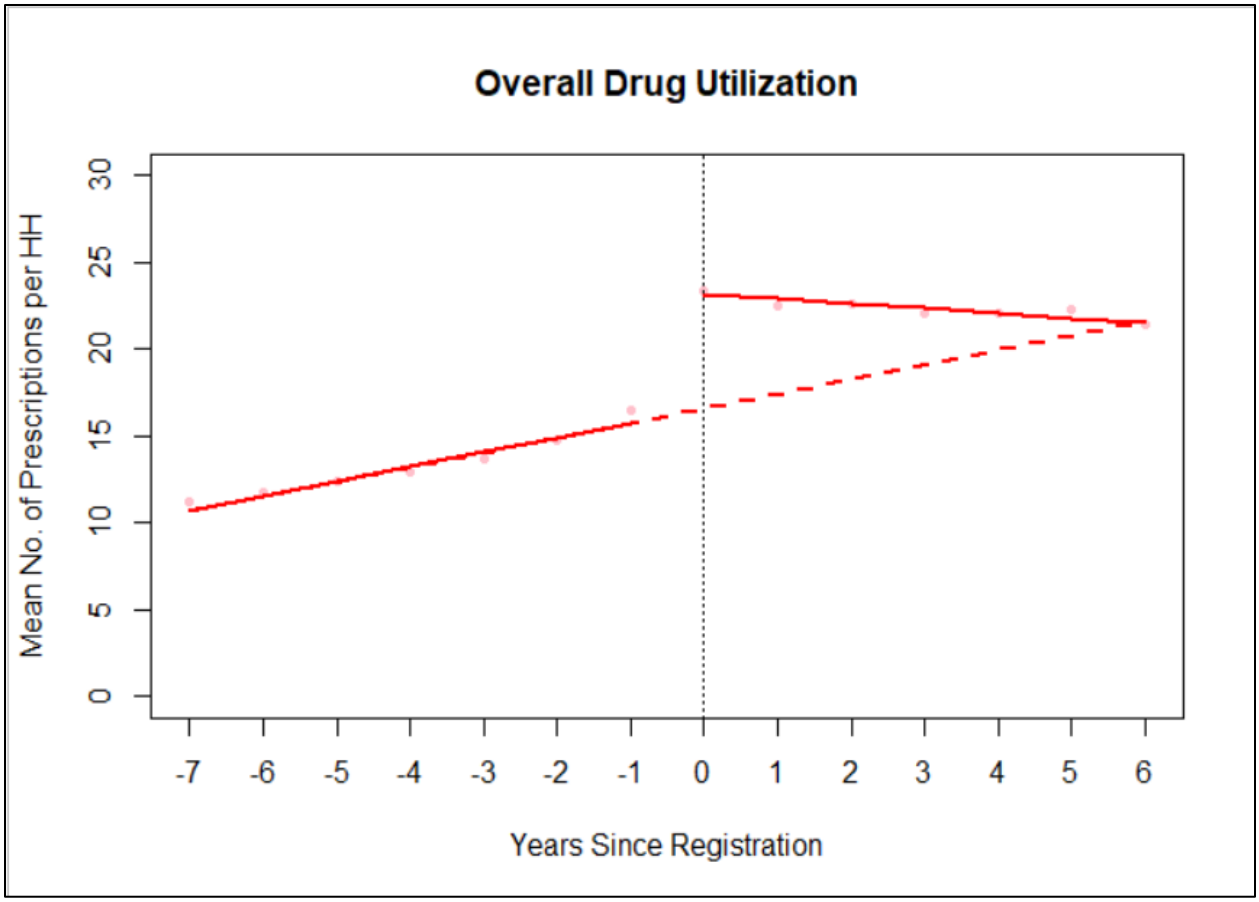
Legend: *HH = households*

Figure 4.5 Proportion of households with drug expenditures above deductibles among British Columbians that registered for Fair PharmaCare between 2014 and 2020

In the year that households registered for Fair PharmaCare, an immediate significant increase of 16.2% followed by a significant decrease of 1.2% per year after the initial year of registration occurred.

Drug utilization

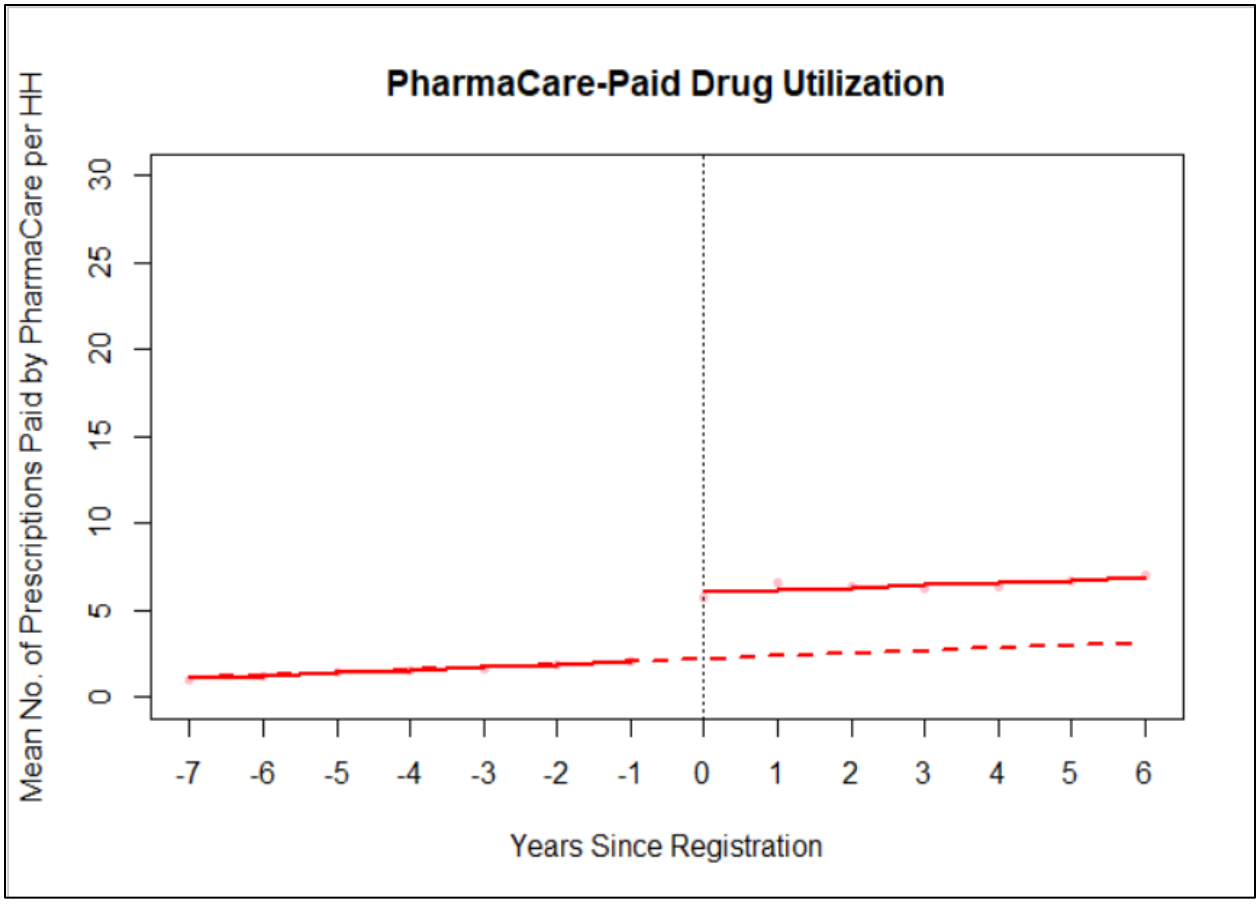
Similar to the significant increase in drug expenditures in the year of registration, there was also a significant increase in the average total drug dispensations made overall (7.71; 95% CI: 7.32 to 8.11) as shown in Figure 4.6. This significant increase in level change in the year of registration was followed by a small but significant annual decrease (-1.12; 95% CI: -1.18 to -1.05) over time. Figure 4.7 shows that the mean number of prescriptions paid by PharmaCare also increased significantly in the year of registration (3.82; 95% CI: 3.35 to 4.29). The year-over-year change in mean number of prescriptions paid by PharmaCare was not statistically significant (-0.01; 95% CI: -0.13 to 0.10).



Legend: *HH = households*

Figure 4.6 Overall drug utilization among British Columbians that registered for Fair PharmaCare between 2014 and 2020

In the year that households registered for Fair PharmaCare, an immediate significant increase of 7.71 prescriptions followed by a significant decrease of 1.12 prescriptions per year after the initial year of registration occurred. The counterfactual crosses with the registration cohort 6 years after registration, indicating regression to the mean.



Legend: *HH = households*

Figure 4.7 PharmaCare paid drug utilization among British Columbians that registered for Fair PharmaCare between 2014 and 2020

In the year that households registered for Fair PharmaCare, an immediate significant increase of 3.82 prescriptions followed by a sustained level of prescriptions after the initial year of registration occurred.

4.4 Discussion

4.4.1 Interpretation of Results

Our findings in this study reinforce the results from Chapter 2 which showed that households with higher drug expenditures were more likely to register, indicating an association between need and registration. We found that registration was associated with annual drug expenditures that were $809 higher per household, which is a 94% increase from the year prior to registration. As expected, the higher drug expenditures corresponded with an increase in annual drug utilization increase of 42% from the year prior to registration. This increase in drug expenditure was financed primarily by PharmaCare (57%). After the initial increase in the year of registration, drug expenditures decreased over time while drug utilization was largely sustained. The initial increases in drug expenditure and utilization suggests that a substantial need for drugs arise in the year of registration, or that a substantial change in need for drugs may be motivating registration. The sustained level of drug utilization suggests that households have a continuous need for at least some of these prescriptions.

Meanwhile, this pattern of decreasing drug expenditures and sustained drug utilization on average, also suggests that the average cost per prescription decreases after registration for the public drug plan. This could indicate that households are switching to lower cost drugs after registration to abide to the rules of the PharmaCare formulary. While not all drugs would have been privately covered prior to registration in Fair PharmaCare, this explanation would apply to the portion of expenditures that was previously privately covered and is consistent with past research which shows that lower average costs per prescription are associated with public coverage in comparison to private coverage.[79, 80] This can result from several factors, including more efficient cost management strategies in public plans, such as stricter price caps on ingredient costs and dispensing fees.[79, 80] The Competition Bureau has previously found that private insurers pay more for the same medicines as public insurers.[79] In a recent study conducted in Quebec between 2015 and 2019, privately insured patients paid 17.6% more on average per drug prescription than publicly insured patients.[81]

While the results of the ITS alone do not reveal whether registration led to an increase in drug expenditures or whether an increase in need for drugs led to registration, it does indicate that there is a substantial change in the pattern of drug utilization behaviour that occurs around the time of registration. It is more likely that an arising need leads to registration for Fair PharmaCare.

4.4.2 Policy Implications

The results of this objective demonstrates that households register for Fair PharmaCare when the need arises. Therefore, policymakers should try to identify ways to register households when these needs arise. This may mean targeting dissemination of information about Fair PharmaCare at pharmacies, physicians' offices or other common points of care. Finally, the decreased cost per prescription dispensed supports the existing literature that there are cost savings that can be realized associated with registration in a public drug plan.

4.4.3 Study Limitations

The primary limitation is that the unit of time used was one calendar year. While deductibles and coinsurance are calculated on an annual basis, registration can occur at any point during the calendar year. As such, the effects of the level change may be underestimated as households could register later in the calendar year and therefore only a partial year's worth of drug coverage would contribute to the annual level change. When measuring the change in drug utilization, consideration was not placed on the days supply of the dispensation. Every dispensation was considered equal regardless of days supply, and therefore the results of our study are limited to informing us on the raw number of prescriptions rather than the total volume of drugs dispensed. We did not expect, however, that registration in Fair PharmaCare would change the days supply of dispensations on a population level.

Another limitation of this study is the inability to determine causality in whether needs-based increase in drug expenditures and utilization leads to registration; or whether being registered and having better coverage leads to an increase in drug expenditures/utilization. While the ITS showed a change in drug spending and utilization behaviour before and after registration, it does not explain the change in behaviour. To answer this question of causation, further work would need to be performed to understand how households change their drug utilization patterns around the time of their registration with Fair PharmaCare. A more refined analysis showing the timing of registration and drug costs, as described in the prior paragraph may help to better confirm the direction of effect. Finally, as this study used data from PharmaNet, we were not able to separate out expenditures paid out-of-pocket by an individual household and expenditures paid by a private insurer. As such, while the results of this study showed a downward trend in private payer expenditures, it is unclear how much of an offset that PharmaCare payments make toward household out-of-pocket medication fees.

4.5 Conclusion

This study found that average drug expenditures increased significantly in the year of registration and then decreased over time and regresses toward the mean. Drug utilization also increased substantially in the initial year of registration. While overall drug utilization regressed toward the mean, PharmaCare-paid drug utilization is more sustained after registration.

Chapter 5 – Simulating the Cost Savings to Private Payers and Budgetary Impact to the Public Payer Associated with Full Registration Amongst the Population Currently Not Registered

5.1 Introduction

5.1.1 Public/Private Drug Expenditures

Canada's drug expenditures are covered by a mixture of public and private plans, as well as out-of-pocket payments. In 2019, $14.8 billion (43.1%) of total drug spending was financed by the public sector, $12.7 billion (36.9%) by private insurers, and $6.8 billion (19.9%) out-of-pocket by Canadian households.[5] In British Columbia, the universal public drug plan that is available to all households registered for the Medical Services Plan is Fair PharmaCare. This plan acts as first payor on claims, meaning that any outpatient drugs dispensed are first adjudicated for coverage by Fair PharmaCare, and then subsequently against any private insurance or billed to the individual out-of-pocket.[11] Currently, some employers and private insurers require that individuals be registered in Fair PharmaCare in order to be eligible for their private plans; however, this is not the case with all private plans.

5.1.2 Ministry of Health Budget on Prescription Medications

BC is currently spending approximately 6% of its annual health budget on pharmacare, and this amount has increased by an average of 4.7% annually.[82] According to the BC Ministry of Health Annual Report, in fiscal 2019/2020, the actual spending on the PharmaCare program was $1.23 billion.[83] The 2020/21 – 2022/23 BC Ministry of Health service plan highlights plan changes that reduced or eliminated PharmaCare deductibles for 240,000 BC families with net incomes up to $45,000 to improve access to medications.[55] This provides context for understanding the intent of the Ministry of Health to make prescription medications more affordable for low-income families. However, the actual spending on PharmaCare in recent fiscal years has been 8.6% below budget, indicating that spending levels are currently below the forecasted expenditures.[83]

5.1.3 Current Registration Trends in Fair PharmaCare

The results presented in Chapter 3 show that the proportion of the population registered for Fair PharmaCare has been trending downward over time, and currently sits at around 44%. Further, the results from Chapter 2 show that households with higher drug expenditures have a greater hazard of registration, and the results from Chapter 4 show that households experience a significant increase in drug expenditures and utilization in the year of registration. However, what is unclear from the results of these analyses is whether patients are foregoing benefits by not registering for Fair PharmaCare and having their deductible set based on their actual income rather than defaulting to the highest deductible. From a policy perspective, it is also important to understand the potential financial impact of increasing registration on the public purse. Therefore, we simulated the difference in PharmaCare expenditures that would result if everyone in the province were registered for Fair PharmaCare.

5.2 Methods

5.2.1 Study Context/Study Design

As Fair PharmaCare plans are determined based on household income, households must consent to the Canada Revenue Agency sharing income information with the BC Ministry of Health in order to be assigned a household deductible. To estimate the potential cost savings to private payers (including personal out-of-pocket payments and payments made by private insurers), we simulated what coverage households would have received had they registered.

5.2.2 Data Sources

This study used the same data sources as those described in Section 1.16 which were provided by Population DataBC. The specific datasets used for this chapter are PharmaNet, the PharmaCare Eligibility Fact Table, and the MSP Consolidation File.

5.2.3 Study Cohort/Time Period

Overall cohort

The overall cohort for this objective was derived from the overall cohort described in Section 1.17. We then extracted all households that were registered for MSP between January 1, 2019 and December 31, 2019. We selected 2019 as this was the latest full year dataset available at the time of data analysis that was not potentially impacted by the effects of COVID-19. Deductibles and family maximums are determined on a calendar year basis, which is why the simulation was conducted over an entire calendar year.

Study groups

From the overall cohort for this objective, we derived a reference group based on all households that were registered in the same Fair PharmaCare plan (Plan I or Plan J) for the entirety of 2019. These households were used to determine the distribution of Fair PharmaCare deductibles in the different census neighbourhood income deciles.

From the overall cohort for this objective, we derived a simulation group by selecting all households that were not registered in a specific Fair PharmaCare plan or another relatively comprehensive public plan for the entirety of 2019 based on the PharmaCare Eligibility Fact Table. Both the reference group and simulation groups were then stratified based on whether the household contained an individual born prior to 1940. This stratification was performed as households containing individuals born prior to 1940 are subject to different income brackets, deductibles, and family maximums.

5.2.4 Outcomes of Interest

Our outcomes focused on the increase in PharmaCare expenditures that would result from households moving to a more generous plan in the simulation. For the main outcome, we calculated both average (e.g., per household) and aggregate (province-wide) estimates.

Table 5.1 Outcome variable definitions

Variable	Definition
Mean PharmaCare-paid difference	Calculated as the difference between the simulated amount of PharmaCare-paid and the actual PharmaCare-paid amount per household from PharmaNet. The per-household data is based on MSP IDs, while the aggregate represents all households that were in the simulation.
Proportion of households with PharmaCare-paid difference greater than $100 and $1,000	Each household with a PharmaCare-paid difference as calculated in the variable listed above greater than both $100 and $1,000 was flagged. The proportion for each measure was calculated by taking the total count of households flagged divided by the total households in the simulation cohort.

5.2.5 Statistical Analysis

We performed a cross sectional simulation using a bootstrapping approach to assess the potential impact of registering for Fair PharmaCare amongst households not yet registered. Bootstrapping is a statistical method used to estimate sampling variances, confidence intervals and other statistical properties thorugh repeated random sampling with replacement from the original data.[84, 85] The simulation assigned hypothetical Fair PharmaCare plans based on their neighbourhood income decile to households that were not actually registered in Fair PharmaCare or another relatively comprehensive public plan in 2019. This was done to create a proxy, as actual household income was not available for households not registered for Fair PharmaCare. Neighbourhood income deciles were provided by the MSP Consolidation File. The postal code associated with the household in the MSP Consolidation File was mapped to the average household income (adjusted for household size) in the area in the nearest census year. A census is completed every 5 years and the nearest census is defined as 2 years before a census year, the census year itself, plus the two years following a census year.[57] Statistics Canada collates average household income across Census Dissemination Areas which are small, relatively stable geographic units comprising of around 400 to 700 persons. These dissemination areas are then sorted by income and aggregated into

1,000 strata, which are then collapsed to deciles.[65, 66] The neighbourhood income deciles for 2019 in our study were based on the 2020 census.

There are 40 distinct Fair PharmaCare plans for households with no individuals born before 1940 and 38 plans for households with an individual born before 1940.[11] Each plan is based on a range of incomes and sets the household deductible and family maximum. Details of each plan's features can be found in Table 5.2 and Table 5.3 below.

Table 5.2 Regular assistance levels for Fair PharmaCare coverage

Once an individual meets the family deductible, PharmaCare covered 70% of eligible costs until the household meets the family maximum, after which, PharmaCare covered 100% of eligible costs.[11]

Family Net Income	Family Deductible	Family Maximum
<=$13,750.00	$0.00	$0.00
$13,750.01 – $15,000.00	$0.00	$100.00
$15,000.01 – $16,250.00	$0.00	$200.00
$16,250.01 – $18,750.00	$0.00	$300.00
$18,750.01 – $21,250.00	$0.00	$400.00
$21,250.01 – $23,750.00	$0.00	$500.00
$23,750.01 – $26,250.00	$0.00	$600.00
$26,250.01 – $28,750.00	$0.00	$700.00
$28,750.01 – $30,000.00	$0.00	$800.00
$30,000.01 – $31,667.00	$650.00	$900.00
$31,667.01 – $35,000.00	$800.00	$1,150.00
$35,000.01 – $38,333.00	$950.00	$1,350.00
$38,333.01 – $41,667.00	$1,100.00	$1,500.00
$41,667.01 – $45,000.00	$1,300.00	$1,700.00
$45,000.01 – $48,333.00	$1,400.00	$1,875.00
$48,333.01 – $51,667.00	$1,500.00	$2,000.00
$51,667.01 – $55,000.00	$1,600.00	$2,150.00
$55,000.01 – $58,333.00	$1,700.00	$2,275.00
$58,333.01 – $61,667.00	$1,800.00	$2,400.00
$61,667.01 – $65,000.00	$1,900.00	$2,550.00
$65,000.01 – $70,833.00	$2,000.00	$2,675.00
$70,833.01 – $79,167.00	$2,250.00	$3,000.00
$79,167.01 – $87,500.00	$2,500.00	$3,350.00
$87,500.01 – $95,833.00	$2,750.00	$3,675.00
$95,833.01 – $108,333.00	$3,000.00	$4,000.00
$108,333.01 – $125,000.00	$3,500.00	$4,675.00
$125,000.01 – $141,667.00	$4,000.00	$5,350.00
$141,667.01 – $158,333.00	$4,500.00	$6,000.00
$158,333.01 – $183,333.00	$5,000.00	$6,675.00
$183,333.01 – $216,667.00	$6,000.00	$8,000.00
$216,667.01 – $250,000.00	$7,000.00	$9,350.00
$250,000.01 – $283,333.00	$8,000.00	$10,000.00
$283,333.01 – $316,667.00	$9,000.00	$10,000.00
$316,667.01 – $999,999,999.00	$10,000.00	$10,000.00

Table 5.3 Enhanced assistance levels for families with at least one registrant born before 1940

Once an individual meets the family deductible, PharmaCare covered 75% of eligible costs until the household meets the family maximum, after which, PharmaCare covered 100% of eligible costs.[11]

Family Net Income	Family Deductible	Family Maximum
<= $14,000.00	$0.00	$0.00
$14,000.01 – $18,000.00	$0.00	$200.00
$18,000.01 – $22,000.00	$0.00	$250.00
$22,000.01 – $26,000.00	$0.00	$300.00
$26,000.01 – $30,000.00	$0.00	$350.00
$30,000.01 – $33,000.00	$0.00	$400.00
$33,000.01 – $37,500.00	$350.00	$700.00
$37,500.01 – $42,500.00	$400.00	$800.00
$42,500.01 – $47,500.00	$450.00	$900.00
$47,500.01 – $50,000.00	$500.00	$1,000.00
$50,000.01 – $52,500.00	$1,000.00	$1,500.00
$52,500.01 – $57,500.00	$1,100.00	$1,650.00
$57,500.01 – $62,500.00	$1,200.00	$1,800.00
$62,500.01 – $67,500.00	$1,300.00	$1,950.00
$67,500.01 – $72,500.00	$1,400.00	$2,100.00
$72,500.01 – $77,500.00	$1,500.00	$2,250.00
$77,500.01 – $82,500.00	$1,600.00	$2,400.00
$82,500.01 – $87,500.00	$1,700.00	$2,550.00
$87,500.01 – $92,500.00	$1,800.00	$2,700.00
$92,500.01 – $97,500.00	$1,900.00	$2,850.00
$97,500.01 – $106,250.00	$2,000.00	$3,000.00
$106,250.01 – $118,750.00	$2,250.00	$3,375.00
$118,750.01 – $131,250.00	$2,500.00	$3,750.00
$131,250.01 – $143,750.00	$2,750.00	$4,125.00
$143,750.01 – $162,500.00	$3,000.00	$4,500.00
$162,500.01 – $187,500.00	$3,500.00	$5,250.00
$187,500.01 – $212,500.00	$4,000.00	$6,000.00
$212,500.01 – $237,500.00	$4,500.00	$6,750.00
$237,500.01 – $275,000.00	$5,000.00	$7,500.00
$275,000.01 – $325,000.00	$6,000.00	$9,000.00
$325,000.01 – $375,000.00	$7,000.00	$10,000.00
$375,000.01 – $425,000.00	$8,000.00	$10,000.00
$425,000.01 – $475,000.00	$9,000.00	$10,000.00
$475,000.01 – $999,999,999.00	$10,000.00	$10,000.00

We used the distribution of these different Fair PharmaCare plans across neighbourhood income deciles within the registered population to determine how plans were distributed in the population. This informed us on the proportion of households that fell into each Fair PharmaCare plan given that they are living in a dissemination area belonging to a particular neighbourhood income decile.

Based on the distribution of plans in each income decile, we used bootstrapping methods to randomly assign a Fair PharmaCare plan to each household in the simulation cohort based on the probabilistic distribution of actual plans within the reference cohort living in neighbourhoods with the same income decile. Based on the simulated plan assignment in each iteration, a new deductible and family maximum were assigned to each household in the simulation cohort. We then used the actual accepted expenditure in the year to recalculate what the PharmaCare-paid amounts would have been had the household had the simulated deductibles and maximum based on their income decile. As deductibles were calculated on an individual level rather than a household level, the cohort was first assessed at the individual level, then aggregated back to the household level to calculate the total amount that PharmaCare would pay for the household given their new simulated plan.

This simulation was run 5000 times. To determine whether this number of simulations was sufficient, we derived histograms for each outcome and assessed whether they had a smooth distribution. Based on these final simulations, we calculated the mean and 95% confidence interval for our outcomes.

A summary of the steps described above are depicted in Figure 5.1 below.

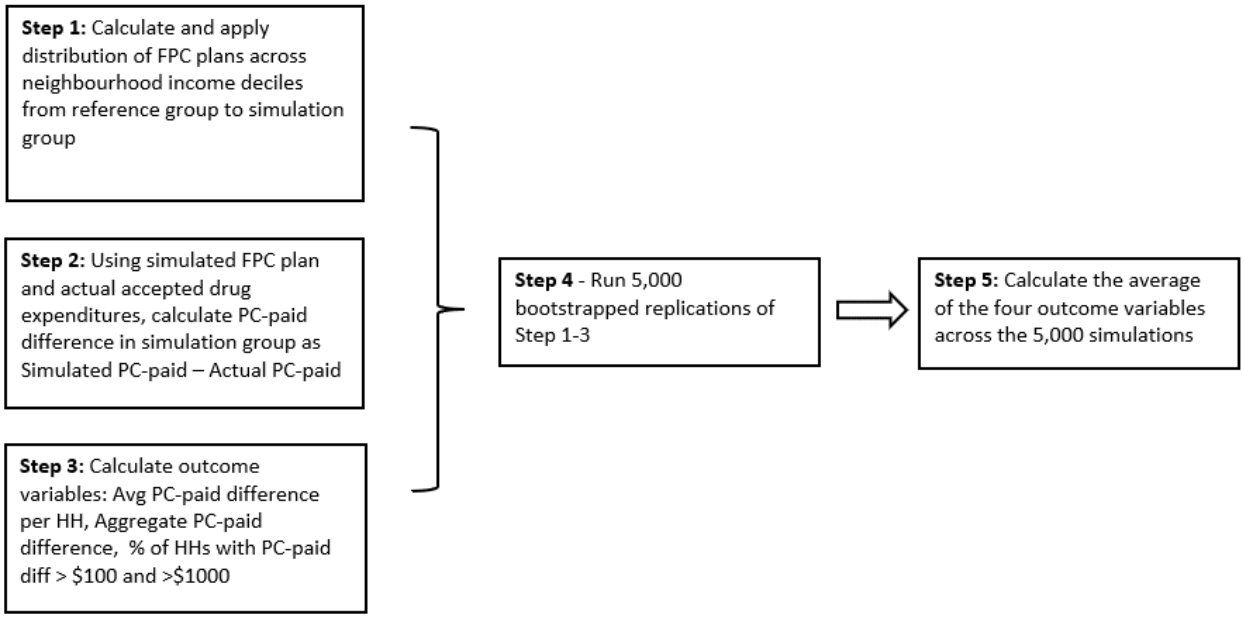


Figure 5.1 Flowchart demonstrating steps of the simulation

Legend: *FPC = Fair PharmaCare; PC = PharmaCare; Avg = Average; HH = Household*

Results were stratified by neighbourhood income decile, as well as accepted drug expenditure category, where accepted drug expenditures was defined as drug expenditures that were considered eligible costs by PharmaCare. Households with accepted drug expenditures above $0 were examined separately.

5.3 Results

5.3.1 Cohort characteristics

Our results are stratified into households with only household members born after 1940 (Plan I) and those with one or more members born before 1940 (Plan J).

Plan I Cohort

The characteristics of households eligible for Plan I are displayed in Table 5.4. In 2019, 971,841 (42%) households were registered for the same Fair PharmaCare plan through the entire calendar year, and 1,341,866 (58%) households were not registered for any Fair PharmaCare plan or were in one of the

excluded plans. Of the households that were not registered, 42% had no accepted drug expenditures during the year, compared to 14% of the group that was registered. Any hypothetical Fair PharmaCare plan assigned to households without expenditures would clearly not result in any simulated cost differences. In terms of demographics, 87% of households not registered did not contain an individual 60 years or older, as compared to the 50% of households that were registered. There was also a greater proportion of single person households not registered than registered. The distribution of households across neighbourhood income deciles for households that were not registered and registered was fairly even.

Table 5.4 Characteristics of households eligible for Plan I in 2019

	Not Registered		Registered	
Total Households	**1,341,866**		**971,841**	
Health authority				
IHA	197,509	14.7%	163,050	16.8%
FHA	487,344	36.3%	367,544	37.8%
VCH	365,970	27.3%	225,839	23.2%
VIHA	215,962	16.1%	169,688	17.5%
NHA	75,054	5.6%	45,718	4.7%
Neighbourhood income decile *(1= lowest; 10 = highest)*				
1	145,179	10.8%	85,126	8.8%
2	139,060	10.4%	94,318	9.7%
3	142,380	10.6%	97,106	10.0%
4	133,375	9.9%	98,514	10.1%
5	135,606	10.1%	99,786	10.3%
6	139,819	10.4%	102,218	10.5%
7	131,026	9.8%	100,268	10.3%
8	136,590	10.2%	107,458	11.1%
9	123,163	9.2%	98,658	10.2%
10	115,668	8.6%	88,389	9.1%
Drug expenditures accepted by PharmaCare				
$0	558,291	41.6%	139,755	14.4%
$1 - $100	396,117	29.5%	192,285	19.8%
$101 - $499	316,855	23.6%	353,568	36.4%
$500 - $1,000	48,588	3.6%	130,455	13.4%
>$1,000	22,015	1.6%	155,778	16.0%
Single drug expenditure >$1,000				
No	1,338,271	99.7%	943,170	97.1%
Yes	3,595	0.3%	28,671	3.0%
Drug expenditure over $10,000				
No	1,341,545	100.0%	955,823	98.4%
Yes	321	0.0%	16,018	1.7%
Household contains a single parent				
No	1,277,811	95.2%	936,689	96.4%
Yes	64,055	4.8%	35,152	3.6%
Household contains a child				
No	1,059,127	78.9%	784,333	80.7%
Yes	282,739	21.1%	187,508	19.3%
Household contains a female				
No	517,890	38.6%	172,312	17.7%
Yes	823,976	61.4%	799,529	82.3%
Household size				
1	883,584	65.9%	423,867	43.6%
2	230,042	17.1%	364,806	37.5%
3	102,412	7.6%	79,413	8.2%
4+	125,828	9.4%	103,755	10.7%
Household contains an individual aged 60 and over				
No	1,167,081	87.0%	482,455	49.6%
Yes	174,785	13.0%	489,386	50.4%

Legend: *IHA = Island Health Authority; FHA = Fraser Health Authority; VCH = Vancouver Coastal Health Authority; VIHA = Vancouver Island Health Authority; NHA = Northern Health Authority*

Plan J cohort

The characteristics of households eligible for Plan J are displayed in Table 5.5. Among these, 18,304 (10%) were not registered for Fair PharmaCare, and 163,682 (90%) were registered for Fair PharmaCare. Within the population not registered, 52% had no accepted drug expenditures in 2019, indicating that any Fair PharmaCare plan that was assigned to them would not result in any simulated cost differences. Further, only 7% of households not registered had accepted drug expenditures greater than $1,000, as compared to 33% of households that were registered. In terms of income, 18% of the households not registered lived in dissemination areas belonging to the lowest neighbourhood income decile, as compared to the 10% of households in the highest income decile.

Table 5.5 Characteristics of households eligible for Plan J in 2019

	Not Registered		Registered	
Total Households	**18,304**		**163,682**	
Health authority				
IHA	2,648	14.5%	31,836	19.4%
FHA	5,329	29.1%	53,229	32.5%
VCH	5,420	29.6%	38,639	23.6%
VIHA	4,260	23.3%	34,037	20.8%
NHA	644	3.5%	5,939	3.6%
Neighbourhood income decile *(1=lowest; 10 = highest)*				
1	3,453	18.9%	17,699	10.8%
2	1,890	10.3%	18,623	11.4%
3	1,693	9.2%	17,292	10.6%
4	1,702	9.3%	18,256	11.2%
5	1,636	8.9%	16,540	10.1%
6	1,557	8.5%	15,712	9.6%
7	1,443	7.9%	15,065	9.2%
8	1,502	8.2%	15,211	9.3%
9	1,549	8.5%	14,937	9.1%
10	1,879	10.3%	14,347	8.8%
Drug expenditures accepted by PharmaCare				
$0	9,585	52.4%	13,719	8.4%
$1 - $100	2,119	11.6%	12,293	7.5%
$101 - $499	3,955	21.6%	50,205	30.7%
$500 - $1,000	1,398	7.6%	33,412	20.4%
>$1,000	1,247	6.8%	54,053	33.0%
Single drug expenditure >$1,000				
No	18,228	99.6%	161,411	98.6%
Yes	76	0.4%	2,271	1.4%
Drug expenditure over $10,000				
No	18,292	99.9%	162,272	99.1%
Yes	12	0.1%	1,410	0.9%
Household contains a single parent				
No	18,298	100.0%	163,664	100.0%
Yes	6	0.0%	18	0.0%
Household contains a child				
No	18,276	99.9%	163,579	99.9%
Yes	28	0.2%	103	0.1%
Household contains a female				
No	4,304	23.5%	26,761	16.4%
Yes	14,000	76.5%	136,921	83.7%
Household size				
1	13,362	73.0%	102,592	62.7%
2	4,906	26.8%	60,935	37.2%
3	25	0.1%	126	0.1%
4+	11	0.1%	29	0.0%
Household contains an individual aged 60 and over				
No	-	0.0%	-	0.0%
Yes	18,304	100.0%	163,682	100.0%

Legend: *IHA = Island Health Authority; FHA = Fraser Health Authority; VCH = Vancouver Coastal Health Authority; VIHA = Vancouver Island Health Authority; NHA = Northern Health Authority*

Cohort of households with PharmaCare-eligible expenditures

As registration would not impact households that had no actual accepted drug expenditures during the year, the cohort was further stratified by drug expenditures at and above $0 in order to understand the potential impact of registration on a more targeted population. These cohort characteristics are displayed in Table 5.6 and Table 5.7 below.

Amongst the population not registered but eligible for Plan I, 49% still had PharmaCare-eligible (accepted) drug expenditures $500 and above. At 76%, an even greater proportion of the population not registered but eligible for Plan J had drug expenditures $500 and above. The registered population had a greater proportion of households with higher accepted drug expenditures in both plans.

Table 5.6 Characteristics of households eligible for Plan I with accepted drug expenditures > $0

	Not Registered		Registered	
Total Households	**783,575**		**832,086**	
Health authority				
IHA	118,526	15.1%	142,445	17.1%
FHA	290,576	37.1%	316,889	38.1%
VCH	198,517	25.3%	185,521	22.3%
VIHA	129,579	16.5%	146,998	17.7%
NHA	46,376	5.9%	40,231	4.8%
Neighbourhood income decile *(1=lowest; 10 = highest)*				
1	76,710	9.8%	70,693	8.5%
2	77,103	9.8%	79,685	9.6%
3	80,709	10.3%	82,434	9.9%
4	77,384	9.9%	84,512	10.2%
5	79,303	10.1%	85,371	10.3%
6	83,329	10.6%	87,551	10.5%
7	79,069	10.1%	86,168	10.4%
8	83,840	10.7%	92,837	11.2%
9	75,468	9.6%	85,901	10.3%
10	70,660	9.0%	76,934	9.2%
Drug expenditures accepted by PharmaCare				
$1 - $100	396,117	50.6%	192,285	23.1%
$101 - $499	316,855	40.4%	353,568	42.5%
$500 - $1,000	48,588	6.2%	130,455	15.7%
>$1,000	22,015	2.8%	155,778	18.7%
Single drug expenditure >$1,000				
No	780,231	99.6%	803,594	96.6%
Yes	3,344	0.4%	28,492	3.4%
Drug expenditure over $10,000				
No	783,254	100.0%	816,068	98.1%
Yes	321	0.0%	16,018	1.9%
Household contains a single parent				
No	737,706	94.2%	802,739	96.5%
Yes	45,869	5.9%	29,347	3.5%
Household contains a child				
No	567,884	72.5%	664,287	79.8%
Yes	215,691	27.5%	167,799	20.2%
Household contains a female				
No	210,521	26.9%	121,720	14.6%
Yes	573,054	73.1%	710,366	85.4%
Household size				
1	415,938	53.1%	323,858	38.9%
2	176,406	22.5%	339,724	40.8%
3	83,120	10.6%	72,259	8.7%
4+	108,111	13.8%	96,245	11.6%
Household contains individual aged 60 and over				
No	660,446	84.3%	388,135	46.7%
Yes	123,129	15.7%	443,951	53.4%

Legend: *IHA = Island Health Authority; FHA = Fraser Health Authority; VCH = Vancouver Coastal Health Authority; VIHA = Vancouver Island Health Authority; NHA = Northern Health Authority*

Table 5.7 Characteristics of households eligible for Plan J with accepted drug expenditures > $0

	Not Registered		Registered	
Total Households	**8,719**		**149,963**	
Health authority				
IHA	1,621	18.6%	29,656	19.8%
FHA	2,354	27.0%	48,725	32.5%
VCH	2,397	27.5%	34,457	23.0%
VIHA	1,995	22.9%	31,644	21.1%
NHA	352	4.0%	5,479	3.7%
Neighbourhood income decile *(1=lowest; 10 = highest)*				
1	915	10.5%	15,796	10.5%
2	834	9.6%	17,046	11.4%
3	753	8.6%	15,702	10.5%
4	798	9.2%	16,723	11.2%
5	824	9.5%	15,326	10.2%
6	795	9.1%	14,383	9.6%
7	777	8.9%	13,886	9.3%
8	887	10.2%	13,998	9.3%
9	899	10.3%	13,761	9.2%
10	1,237	14.2%	13,342	8.9%
Drug expenditures accepted by PharmaCare				
$1 - $100	2,119	24.3%	12,293	8.2%
$101 - $499	3,955	45.4%	50,205	33.5%
$500 - $1,000	1,398	16.0%	33,412	22.3%
>$1,000	1,247	14.3%	54,053	36.0%
Single drug expenditure >$1,000				
No	8,648	99.2%	147,706	98.5%
Yes	71	0.8%	2,257	1.5%
Drug expenditure over $10,000				
No	8,707	99.9%	148,553	99.1%
Yes	12	0.1%	1,410	0.9%
Household contains a single parent				
No	8,716	100.0%	149,946	100.0%
Yes	3	0.0%	17	0.0%
Household contains a child				
No	8,697	99.8%	149,864	99.9%
Yes	22	0.3%	99	0.1%
Household contains a female				
No	1,887	21.6%	23,633	15.8%
Yes	6,832	78.4%	126,330	84.2%
Household size				
1	5,902	67.7%	90,893	60.6%
2	2,789	32.0%	58,919	39.3%
3	21	0.2%	123	0.1%
4+	7	0.1%	28	0.0%
Household contains individual aged 60 and over				
No	-	0.0%	-	0.0%
Yes	8,719	100.0%	149,963	100.0%

Legend: *IHA = Island Health Authority; FHA = Fraser Health Authority; VCH = Vancouver Coastal Health Authority; VIHA = Vancouver Island Health Authority; NHA = Northern Health Authority*

5.3.2 Simulated Cost Savings

Mean PharmaCare-paid difference – Individual Level

Plan I cohort:

The results of the simulation for Plan I-eligible households are shown in Table 5.8. Across 5,000 simulations, the mean difference between drug expenditures paid by PharmaCare before and after the simulated registration was $23.17 per household (95% CI: $23.17, $23.17). When stratified by neighbourhood income decile, the mean PharmaCare-paid difference for the lowest neighbourhood income decile was $28.64 (95% CI: $28.63, $28.65) per household and for the highest neighbourhood income decile was $18.13 (95% CI: $18.12, $18.13) per household.

Table 5.8 Simulation results of mean PharmaCare-paid difference per household amongst population eligible for Plan I

Neighbourhood Income Decile	Mean PharmaCare-paid Difference per Household		
	Estimate ($)	95% CIs ($)	
1 (low)	28.64	28.63	28.65
2	26.72	26.71	26.73
3	25.44	25.43	25.45
4	24.19	24.18	24.19
5	22.78	22.77	22.78
6	22.29	22.28	22.30
7	21.45	21.44	21.46
8	20.70	20.69	20.71
9	19.72	19.71	19.73
10 (high)	18.13	18.12	18.13
Overall	**23.17**	**23.17**	**23.17**

Legend: *CI = Confidence Interval*

Table 5.9 shows results stratified for just households that had actual drug expenditures during the year. The overall mean difference per household between drug expenditures paid by PharmaCare before and after the simulated registration had an overall mean of $39.68 (95% CI: $39.68, $39.68). When stratified by neighbourhood income decile, the mean PharmaCare-paid difference for the lowest neighbourhood

income decile was $54.20 (95% CI: $54.19, $54.21) per household and $29.67 (95% CI: $29.66, $29.68) for the highest neighbourhood income decile.

Table 5.9 Simulation results of mean PharmaCare-paid difference per household amongst population eligible for Plan I with drug expenditures > $0

Neighbourhood Income Decile	Mean PharmaCare-paid Difference per Household		
	Estimate ($)	95% CIs ($)	
1 (low)	54.20	54.19	54.21
2	48.19	48.18	48.20
3	44.87	44.86	44.88
4	41.69	41.68	41.70
5	38.95	38.94	38.96
6	37.40	37.39	37.41
7	35.55	35.54	35.56
8	33.72	33.71	33.73
9	32.19	32.18	32.20
10 (high)	29.67	29.66	29.68
Overall	**39.68**	**39.68**	**39.68**

Legend: *CI = Confidence Interval*

Plan J cohort:

The results of the simulation for Plan J are shown in Table 5.10. Across 5,000 simulations, the overall mean difference per household between drug expenditures paid by PharmaCare before and after the simulated registration was $82.55 (95% CI: $82.52, $82.59) per household. When stratified by neighbourhood income decile, the mean PharmaCare-paid difference for the lowest neighbourhood income decile was $45.48 (95% CI: $45.44, $45.52) per household, and $88.71 (95% CI: $88.55, $88.87) for the highest neighbourhood income decile.

Table 5.10 Simulation results of mean PharmaCare-paid difference per household amongst population eligible for Plan J

Neighbourhood Income Decile	Mean PharmaCare-paid Difference per Household		
	Estimate ($)	95% CIs ($)	
1 (low)	45.48	45.44	45.52
2	80.99	80.90	81.08
3	100.05	99.94	100.15
4	94.83	94.72	94.95
5	91.53	91.42	91.64
6	97.46	97.33	97.59
7	90.98	90.84	91.13
8	96.05	95.90	96.21
9	81.61	81.47	81.75
10 (high)	88.71	88.55	88.87
Overall	**82.55**	**82.52**	**82.59**

Legend: *CI = Confidence Interval*

When we stratified Plan J for just households that had actual drug expenditures during the year, the overall simulated mean difference per household between drug expenditures paid by PharmaCare was $173.30 (95% CI: $173.23, $173.38) per household. When stratified by neighbourhood income decile, the mean PharmaCare-paid difference for the lowest neighbourhood income decile was $171.63 (95% CI: $171.47, $171.80) per household, and $134.75 (95% CI: $134.51, $134.99) for the highest neighbourhood income decile.

Table 5.11 Simulation results of mean PharmaCare-paid difference per household amongst population eligible for Plan J with drug expenditures > $0

Neighbourhood Income Decile	Mean PharmaCare-paid Difference per Household		
	Estimate ($)	95% CIs ($)	
1 (low)	171.63	171.47	171.80
2	183.54	183.34	183.74
3	224.94	224.70	225.17
4	202.26	202.01	202.50
5	181.73	181.50	181.95
6	190.88	190.61	191.14
7	168.97	168.70	169.24
8	162.65	162.40	162.91
9	140.61	140.37	140.86
10 (high)	134.75	134.51	134.99
Overall	**173.30**	**173.23**	**173.38**

Legend: *CI = Confidence Interval*

Mean PharmaCare-paid difference - Aggregate population level

Based on the 5,000 simulations, the total PharmaCare-paid difference across all households eligible for Plan I that were not registered (Table 5.12) was $31,089,785 (95% CI $31,086,572, $31,091,998). These differences were more concentrated in households in lower-income areas, with the aggregate mean PharmaCare-paid difference in the lowest income decile being twice as large as that of the highest income decile. For households eligible for Plan J that were not registered, the simulated difference was $1,511,016 (95% CI: $1,510,362, $1,511,669) and was much more evenly spread across income deciles.

Table 5.12 Simulation results of mean PharmaCare-paid difference aggregated amongst population eligible for Plan I

Neighbourhood Income Decile	Mean PharmaCare-paid difference – aggregate		
	Estimate ($)	95% CIs ($)	
1 (low)	4,157,796	4,156,804	4,158,788
2	3,715,407	3,714,404	3,716,410
3	3,621,807	3,620,810	3,622,805
4	3,225,897	3,224,902	3,226,892
5	3,088,501	3,087,501	3,089,501
6	3,116,379	3,115,356	3,117,402
7	2,811,102	2,810,096	2,812,108
8	2,827,264	2,826,230	2,828,298
9	2,429,135	2,428,129	2,430,141
10 (high)	2,096,499	2,095,537	2,097,461
Overall	**31,089,785**	**31,086,572**	**31,092,998**

Legend: *CI = Confidence Interval*

Table 5.13 Simulation results of mean PharmaCare-paid difference aggregated amongst population eligible for Plan J

Neighbourhood Income Decile	Mean PharmaCare-paid difference – aggregate		
	Estimate ($)	95% CIs ($)	
1 (low)	157,045	156,893	157,196
2	153,073	152,905	153,241
3	169,378	169,201	169,556
4	161,403	161,207	161,599
5	149,742	149,559	149,925
6	151,746	151,538	151,954
7	131,291	131,080	131,502
8	144,274	144,046	144,502
9	126,410	126,190	126,630
10 (high)	166,686	166,392	166,980
Overall	**1,511,016**	**1,510,362**	**1,511,669**

Legend: *CI = Confidence Interval*

Proportion of households with PharmaCare-paid difference above $100 and $1,000

Plan I cohort:

In the overall cohort, 5.4% (95% CI: 5.4%, 5.4%) of households had a simulated increase in PharmaCare-paid expenditures greater than $100. In the population limited to only households that had drug expenditures during the year, this was 9.2% (95% CI: 9.2%, 9.2%). Less than 1% of the overall cohort had a simulated difference in PharmaCare-paid expenditures greater than $1,000. These proportions were inversely correlated with neighbourhood income decile.

Table 5.14 Simulation Results of proportion of households with PharmaCare-paid amounts > $100 and $1,000 amongst population eligible for Plan I

Neighbourhood Income Decile	Proportion of households with PharmaCare-paid > $100			Proportion of households with PharmaCare-paid > $1,000		
	Estimate	95% CIs		Estimate	95% CIs	
1 (low)	6.8%	6.8%	6.8%	0.4%	0.4%	0.4%
2	6.3%	6.3%	6.3%	0.4%	0.4%	0.4%
3	6.1%	6.0%	6.1%	0.3%	0.3%	0.3%
4	5.8%	5.8%	5.8%	0.3%	0.3%	0.3%
5	5.4%	5.4%	5.4%	0.3%	0.3%	0.3%
6	5.1%	5.1%	5.1%	0.3%	0.3%	0.3%
7	4.8%	4.8%	4.8%	0.3%	0.3%	0.3%
8	4.6%	4.6%	4.6%	0.3%	0.3%	0.3%
9	4.4%	4.4%	4.4%	0.3%	0.3%	0.3%
10 (high)	4.1%	4.1%	4.1%	0.3%	0.3%	0.3%
Overall	**5.4%**	**5.4%**	**5.4%**	**0.3%**	**0.3%**	**0.3%**

Legend: *CI = Confidence Interval*

Table 5.15 Simulation results of proportion of households with PharmaCare-paid amounts > $100 and $1,000 amongst population eligible for Plan I with drug expenditures > $0

Neighbourhood Income Decile	Proportion of households with PharmaCare-paid > $100			Proportion of households with PharmaCare-paid > $1,000		
	Estimate	95% CIs		Estimate	95% CIs	
1 (low)	12.9%	12.9%	12.9%	0.7%	0.7%	0.7%
2	11.5%	11.4%	11.5%	0.6%	0.6%	0.6%
3	10.7%	10.7%	10.7%	0.6%	0.6%	0.6%
4	10.0%	10.0%	10.0%	0.6%	0.6%	0.6%
5	9.2%	9.2%	9.2%	0.5%	0.5%	0.5%
6	8.5%	8.5%	8.5%	0.5%	0.5%	0.5%
7	8.0%	8.0%	8.0%	0.5%	0.5%	0.5%
8	7.5%	7.5%	7.5%	0.5%	0.5%	0.5%
9	7.2%	7.2%	7.2%	0.5%	0.5%	0.5%
10 (high)	6.6%	6.6%	6.6%	0.4%	0.4%	0.4%
Overall	**9.2%**	**9.2%**	**9.2%**	**0.5%**	**0.5%**	**0.5%**

Legend: *CI = Confidence Interval*

Plan J cohort

In the overall cohort, 12.8% (95% CI: 12.8%, 12.8%) of households had a difference in simulated PharmaCare-paid expenditures above $100, while 2.2% (95% CI: 2.2%, 2.2%) of households had simulated difference in PharmaCare-paid expenditures above $1,000. There was no clear pattern between neighbourhood income decile and proportion of households with a difference in simulated PharmaCare-paid expenditures. However, the proportion of households with PharmaCare-paid expenditures above $100 was much lower for neighbourhood income decile 1 as compared to the other neighbourhood income deciles. In the population limited to only households that had drug expenditures during the year, 26.9% (95% CI: 26.9%, 26.9%) had simulated difference in PharmaCare-paid expenditures above $100, and 4.7% (95% CI: 4.7%, 4.7%) had simulated difference in PharmaCare-paid expenditures above $1,000.

Table 5.16 Simulation Results of proportion of households with PharmaCare-paid amounts > $100 and $1,000 amongst population eligible for Plan J

Neighbourhood Income Decile	Proportion of households with PharmaCare-paid > $100			Proportion of households with PharmaCare-paid > $1,000		
	Estimate	95% CIs		Estimate	95% CIs	
1 (low)	7.9%	7.9%	8.0%	1.2%	1.2%	1.2%
2	13.6%	13.6%	13.6%	1.9%	1.9%	1.9%
3	12.6%	12.6%	12.6%	2.8%	2.8%	2.8%
4	14.1%	14.1%	14.1%	2.6%	2.6%	2.6%
5	13.9%	13.9%	13.9%	2.0%	2.0%	2.0%
6	15.1%	15.1%	15.1%	2.6%	2.5%	2.6%
7	14.4%	14.3%	14.4%	2.7%	2.6%	2.7%
8	14.8%	14.8%	14.9%	2.8%	2.8%	2.8%
9	13.0%	13.0%	13.0%	2.4%	2.4%	2.4%
10 (high)	14.3%	14.3%	14.3%	2.6%	2.6%	2.6%
Overall	**12.8%**	**12.8%**	**12.8%**	**2.2%**	**2.2%**	**2.2%**

Legend: *CI = Confidence Interval*

Table 5.17 Simulation results of proportion of households with PharmaCare-paid amounts > $100 and $1,000 amongst population eligible for Plan J with drug expenditures > $0

Neighbourhood Income Decile	Proportion of households with PharmaCare-paid > $100			Proportion of households with PharmaCare-paid > $1,000		
	Estimate	95% CIs		Estimate	95% CIs	
1 (low)	30.0%	30.0%	30.0%	4.5%	4.5%	4.5%
2	30.8%	30.8%	30.8%	4.2%	4.2%	4.3%
3	28.3%	28.2%	28.3%	6.2%	6.2%	6.2%
4	30.1%	30.1%	30.1%	5.6%	5.6%	5.6%
5	27.6%	27.6%	27.7%	4.0%	4.0%	4.0%
6	29.5%	29.5%	29.6%	5.0%	5.0%	5.0%
7	26.7%	26.6%	26.7%	4.9%	4.9%	4.9%
8	25.1%	25.1%	25.2%	4.7%	4.7%	4.7%
9	22.4%	22.3%	22.4%	4.1%	4.1%	4.1%
10 (high)	21.7%	21.7%	21.7%	3.9%	3.9%	3.9%
Overall	**26.9%**	**26.9%**	**26.9%**	**4.7%**	**4.7%**	**4.7%**

Legend: *CI = Confidence Interval*

5.4 Discussion

5.4.1 Interpretation of Results

Not registering for available health insurance might result in individuals and households not obtaining benefits to which they are entitled. Overall, our results suggest that the amounts foregone by households in BC for not registering in Fair PharmaCare are comparatively small on a population basis, but do exist. Amongst households eligible for Plan I, the cohort that was not registered was comparatively young and had lower drug expenditures. Many of these households may not benefit from registering for Fair PharmaCare, given that they have no need for medications as indicated by their lack of actual drug expenditures. Even amongst the households that do have a need for medications as indicated by actual drug expenditure levels, the average cost savings per household were not substantial. The potential cost savings were greater for lower income households, as proxied by neighbourhood income deciles in this simulation. This is likely due to the lower deductibles and coinsurances that apply to lower income households as well as the known relationship between income decile and health status.[86]

Amongst households eligible for Plan J, a much smaller proportion of households were not registered. A higher proportion of households in this population have no drug expenditures or moderate drug expenditures less than $500. The potential cost savings for this population is more substantial on a per-household basis than those eligible for Plan I, which is likely driven by the greater use for medications in this population group. Across both the population eligible for Plan I and Plan J, we observed that while 42% and 52% respectively of the population not registered have no drug expenditures, and would not benefit from registering for Fair PharmaCare given their currently drug expenditure levels, amongst the population that did have drug expenditures, 9% and 27% of households respectively could still benefit from PharmaCare covering an additional $100 or more of drug expenditures if they registered.

On an overall basis, the potential budgetary impact for the PharmaCare program of additional registration is reasonably small in comparison to the overall PharmaCare budget. The aggregate overall additional funding that PharmaCare would have to pay if all households not currently registered in Fair PharmaCare

became registered, would be approximately $32 million, which is less than 1% of the overall $1.23 billion PharmaCare expenditure in fiscal 2019/20. This suggests that increases in registration would lead to more concentrated benefits for the target population, and relatively diffuse and small additional costs for taxpayers.

5.4.2 Policy Implications

The results of the simulation suggest that most households that are not registered in Fair PharmaCare would experience limited financial benefit from registering. As such, efforts by the Ministry to encourage further registration in Fair PharmaCare should focus on households that would benefit the most from registration, households that have a moderate to high level of drug expenditures. While there are a limited number of households with older adults born prior to 1940 that are not registered, those who are not registered would benefit the most from registration and as such concentrated efforts for registration should be focused on this group. As all households with individuals born prior to 1940 were automatically enrolled into Fair PharmaCare when the program was first introduced in 2003, the remaining households that are not registered are likely newcomers to BC after 2003. These findings also limit any concerns about major increases in PharmaCare expenditures that might result from promoting more households to register.

5.4.3 Study Limitations

It would have been helpful to be able to break down the simulated cost savings generated from enrolling in Fair PharmaCare between out-of-pocket payments and private insurers. However, our administrative data did not capture any information on private drug coverage, so this was not possible. Private insurance accounts for approximately 36% of drug financing in Canada, and 19.9% is paid for out-of-pocket by individuals.[5] These percentages likely do not directly apply to the households examined in this study, as there were more potential savings for groups that are less likely to hold private insurance coverage (older

and lower-income households).[30] However, it is still likely that a substantial portion of the cost savings would pertain to private insurance plans. This could reduce the incentive that individual households have to register for Fair PharmaCare given that they are still not needing to pay the entire cost out-of-pocket.

Another limitation is that actual income information is only available for individuals who have registered for Fair PharmaCare. Income levels for individuals who have not yet registered for Fair PharmaCare were simulated based on their neighbourhood income decile, which provides 10 income groups based on the postal code of the household. It is likely that there will be outliers in our population who have actual income levels outside of the average neighbourhood income decile.[66] However, this would only have impacted our estimates if the distribution of incomes across areas systematically varied between household not registered and households registered, which we believe is unlikely.

Further, our simulation uses actual drug expenditures incurred by the household in 2019, and thus assumes that household drug utilization would not change after registration. The results from Chapter 4 demonstrated that in the year of registration, households had increased drug expenditures and drug utilization, but it is unclear whether these changes are driven by a change in Fair PharmaCare registration status.

Finally, we note that within BC's public drug plan programs, there are many drugs subject to prior approval conditions known as special authority.[11] For these drugs, prescribers must submit a special authorization form to PharmaCare to request coverage for particular medications.[11] We noted that the rate of special authorization approvals in the registered population may differ from the population that is not registered due to a number of factors that are beyond the scope of this study. However, we found that both the cohort that was not registered and registered had similar rates of special authority approval (63% and 61% of expenditures on special authority drugs approved for coverage, respectively), suggesting rates of approval were similar between the groups. However, a remaining limitation of this study is that it is unclear whether households would change their behaviour around selecting drugs requiring special

authority and applying for special authority if they registered for Fair PharmaCare. As such, it is possible that our simulation cohort may underestimate actual PharmaCare expenditures were this to occur.

5.5 Conclusion

This study found that increasing registration in Fair PharmaCare would result in reasonably limited additional costs for the PharmaCare program, and modest benefits to most households. Most of the financial benefits would be concentrated amongst the population that has lower household income, is older in age, and has moderate levels of drug expenditures. As such, the Ministry of Health might consider strategies to increase registration among households that have a need for additional drug coverage based on the prescriptions they are using.

Chapter 6 – Conclusion

6.1 Summary of Findings

Fair PharmaCare, a catastrophic income-based public drug insurance plan in BC, was introduced in 2003 to manage rising drug costs. As a program that uses income-based deductibles, registration is required for the applicant to consent to the Canada Revenue Agency releasing their income information to the Ministry of Health. This registration requirement presents a potential barrier to access to medicines. In 2019, the BC government lowered deductibles and copayments for lower income households to improve accessibility to prescription medications. Knowing that having public drug insurance coverage can potentially reduce out-of-pocket costs for households and improve cost-related nonadherence, it is therefore important to understand the characteristics of households that are not registered, and determine whether registration in Fair PharmaCare would benefit this population.

This thesis addresses the following four research objectives: (1) obtain an understanding of the association between population characteristics and time until enrollment in Fair PharmaCare; (2) assess the impact of the 2019 Fair PharmaCare change that reduced and eliminated deductibles and copayments on registration rates; (3) assess the association between enrolling in Fair PharmaCare, drug expenditures and drug utilization; and (4) simulate the cost savings that private payers would realize from full enrollment of all households who were not enrolled in Fair PharmaCare. To address these research objectives and develop the literature supporting the conceptual framework shown in Figure 1.1, I conducted four studies using BC administrative data.

6.1.1 The Association between Population Characteristics and Time until Enrollment in Fair PharmaCare

Chapter 2 examined whether there was an association between needs-based characteristics, area-based characteristics, household-level characteristics, and the length of time it took for households to enroll in Fair PharmaCare. The results of our multivariate cox PH model found that needs-based characteristics

were highly associated with registration. A dose-response relationship was observed where the hazard of registering for Fair PharmaCare at a given point in time increased in line with drug expenditures. Needs-based characteristics were also proxied by age category, where households containing an individual aged 60 and over had a greater hazard of registering for Fair PharmaCare than that of households that did contain an individual aged 60 and over. A substantial portion of households not registered at the end of the study had drug expenditures accepted by PharmaCare below $100, which could explain why a number of households remained not registered by our study end date.

Household-level and area-based characteristics had similar levels of significance. Households containing more individuals, households living in areas with higher neighbourhood income deciles, households without children, households containing a female, households outside of the Vancouver Coastal Health region, and households containing a single parent were more likely to register. Overall, the results of this study suggest that households eligible for Fair PharmaCare register for the program when their prescription drug needs arise.

6.1.2 The Impact of Reducing Deductibles and Copayments for Lower Income Households on Registration Rates

Chapter 3 evaluated the impact of the policy change introduced on January 1, 2019 which reduced deductibles and copayments amongst lower income households on Fair PharmaCare registration rates. Our initial time series analysis showed that the average overall registration rate at the time of the policy change was approximately 45%. Between September 2017 and March 2021, a general downward trend in registration rates was observed across all income deciles, driven by faster growth in number of households eligible for Fair PharmaCare than growth in number of households actually registering.

A controlled interrupted time series analysis compared lower and higher income households as the former were more likely and the latter less likely to be affected by the policy change. Our findings suggested that the policy change did not have a significant impact on registration rates, as there was no significant

differential level or trend change between the control and intervention group after the policy change. The Ministry of Health reported that the policy change was expected to reduce or eliminate PharmaCare deductibles for 240,000 BC families with net incomes below $45,000; and that in the three months after the policy change, approximately 90,000 households benefited from the government's decision to eliminate deductibles for households with incomes below $30,000.[56] As registration rates did not increase within lower income households, our findings suggest that the policy change largely provided additional benefit to those who were already registered. This suggests that the reduction of deductibles and copayments did not encourage households that were not registered for Fair PharmaCare to register.

6.1.3 The Association between Registration, Drug Expenditures and Drug Utilization

Chapter 4 built on the prior chapters and examined the relationship between registration for Fair PharmaCare, drug expenditures and drug utilization. Using the administrative data available at the time of the study, we examined household drug spending and utilization behaviours in the years prior to registration as well as in the years after registration through an interrupted time series analysis. We found that in the year of registration, average drug expenditures per household increased significantly by $809, 57% of which was financed by PharmaCare. Drug utilization also increased significantly in the year of registration, by 7.71 prescriptions per household, a 42% increase. Over time, drug expenditures per household decreased by $76 annually, corresponding with a significant decrease of 1.12 prescriptions per year in overall drug utilization and sustained level of prescriptions in prescriptions paid for by PharmaCare.

These findings suggest that households experience a shock in the year of registration as demonstrated by the significant increases in both drug expenditures and drug utilization. The gradual decrease in drug expenditures over time coupled with the more consistent levels of drug utilization suggests that the cost per prescription decreased after registration. Amongst other reasons, this may be an indication that households are switching to more cost-effective drugs as a result of the public drug formulary. The

sustained level of drug utilization further indicates that households have a continued need for these additional prescriptions that occurred in the year of registration. While this ITS cannot determine whether registration in a public drug plan led to increased spendings and utilization, or whether the need for increased drug expenditures and utilization led to registration, we can conclude that a need for prescription medications was met in the year of registration.

6.1.4 Simulating the Cost Savings to Private Payers and Budgetary Impact to the Public Payer Associated with Full Registration Amongst the Population Currently Not Registered

Knowing that around 55% of the population is not registered in Fair PharmaCare, Chapter 5 sought to simulate the potential cost savings per household amongst the households that are not currently registered. This estimation was based on actual annual drug expenditures and simulated Fair PharmaCare deductibles and copayments. Fair PharmaCare plans were assigned to households that were not registered using simulation methods based on the distribution of Fair PharmaCare plans across neighbourhood income deciles amongst the registered population.

For the general population, across 5,000 simulations, we found that there was a relatively small amount of $23 in cost savings to private payers per household if they had registered for Fair PharmaCare in 2019. This would have translated to a limited budgetary impact of $31 million, which is less than 1% of the overall PharmaCare budget. Amongst the older population, born prior to 1940, across 5,000 simulations, we found that there was a more substantial, but still relatively small amount of $83 in cost savings to the private payer per household if they registered for Fair PharmaCare in 2019. As there was a small number of individuals amongst this population that is not registered, there was a smaller budgetary impact of $1.5 million associated with full registration. When the results were stratified for only households that had drug expenditures during the year, we found that 9% of the population eligible for Plan I and 27% of the population eligible for Plan J would experience private payer cost savings greater than $100.

The results of chapter 5 combined with the results from the prior chapters suggest that most households in the general population that are not yet registered would derive a fairly minimal benefit from registering for Fair PharmaCare. This is primarily due to low actual drug expenditures relative to household income resulting in scenarios where households would still spend amounts below their deductible even after registration. The benefits of registration are more concentrated and substantial at the household level, amongst the population that has higher drug expenditures and the remaining population of older adults eligible for Plan J.

6.2 Strengths and Limitations

6.2.1 Strengths

A major strength of this study is that it used population-based data across eight years, following ~2 million households across time. The overall cohort included all households in BC that were eligible for Fair PharmaCare between January 2013 and March 2021. Additional strengths of these studies are that they included important variables such as household income and age; included the older adult population eligible for Plan J; and incorporated the element of time through the Cox model. These elements were not directly examined in prior work.

6.2.2 Limitations

A major limitation in understanding factors that may be barriers to registration in Chapter 2 is the potentially important but missing explanatory variables. Only variables included in the administrative datasets were included. Some of the potentially important missing explanatory variables that would require access to additional datasets include gender, knowledge of official languages, ethnic origin, immigration status, highest level of education attained, and enrollment in a private drug plan. Overall, this means that there may be other barriers to registration that have not yet been examined.

In addition, a major limitation of administrative data from PharmaNet is the inability to disaggregate out-of-pocket expenditures from private insurance expenditures. PharmaNet only provides details on total amount billed and amounts paid by PharmaCare. As such, the results of the ITS in Chapter 4 showing the changes in private drug expenditures does not directly inform us on the relationship between registration and out-of-pocket expenditures, as described in the conceptual framework shown in Figure 1.1. From our results, we can only conclude that drug expenditures paid by private payers overall increased in the year of registration and subsequently declined over time, but we cannot determine whether registration in a public drug plan leads to reduced out-of-pocket expenditures. This limitation also applies to the cost simulation performed in Chapter 5, which could not isolate how much of the cost simulated cost savings pertained to out-of-pocket expenditures. Being able to quantify the cost savings for private insurers and households separately would be helpful, as it is likely that households would be more motivated to register if they knew how much they could potentially save, and private insurers would be more motivated to mandate registration if they knew how much costs they could potentially offset.

Another limitation which applies to the research questions in Chapter 2, 3, and 5 is the use of neighbourhood income deciles as a proxy for household income. Fair PharmaCare deductibles and family maximums are determined by household income; however, validated income information was not available for households that have not yet registered for Fair PharmaCare and consented to the release of their income information from the CRA to the Ministry of Health. In Chapter 2, neighbourhood income deciles were used to determine the association between registration and household income. In Chapter 3, neighbourhood income deciles were used to create the control and intervention groups, but these would not precisely identify the intervention group. In Chapter 5, neighbourhood income deciles were used to assign a Fair PharmaCare plan to households that were not registered. Research examining the validity of neighbourhood income deciles as a proxy for household income have concluded that while the two measures are highly correlated, there may still be outliers where households have actual incomes outside of the average neighbourhood income decile.[66] However, this limitation would only impact the validity

of our results across the three chapters if there was a systematic difference in the alignment of neighbourhood income deciles with actual household incomes across registered and not registered households, which we believe is unlikely.

Finally, the work in this thesis was only based on data in British Columbia, specifically within the Fair PharmaCare program. As such, caution should be taken in any attempts to generalize the results of this study to other provinces and territories in Canada and beyond.

6.3 Recommendations for Future Research

To fully understand what barriers to registration exist, future research should include the potentially important variables described previously. While these variables may be less accessible, they may reveal systematic inequities and barriers that should be addressed. A purely quantitative approach using secondary administrative data does not allow for us to determine causation of registration or change in drug expenditures and utilization. As such, our work could be further enhanced with a qualitative study that seeks to understand the causation behind registration, and changes in drug expenditure/drug utilization behaviours through interviews and/or survey-based studies.

A final recommendation would be to collaborate with a private insurer and link the details of private insurance coverage with PharmaNet. This would allow future researchers to disaggregate private expenditures into amounts paid by private insurers and amounts paid out-of-pocket by households, showing the association between registration in a public drug plan and the two types of private expenditures.

While our work focused specifically on the catastrophic public drug plan available to the general public in British Columbia, many other provinces in Canada also have similar public drug plans. The work conducted in this thesis could be carried out in other jurisdictions to determine the generalizability of the

results, which could be important for the creation of a more unified public drug insurance program across Canada.

6.4 Policy Implications

As the Ministry seeks to improve access to medications for residents while controlling costs, the results of our studies provide important information on the performance of the public drug insurance program in BC. Our results indicate that given the constructs of the current Fair PharmaCare program, increasing registration rates will likely not substantially improve access to medications for residents. In addition, the results of our analysis indicate that reducing deductibles and copayments for lower income households did not contribute toward improving registration rates. This may not be problematic as households who are not currently registered in Fair PharmaCare derive a small amount of additional benefit from registration in our other analyses. However, it is important to note that households register when the need arises, and in the year that registration occurs, there are significant increases in drug expenditures and drug utilization. In order to continue meeting households at their time of need by providing public coverage over catastrophic drug expenditures, the Ministry of Health should focus its attention on targeting dissemination of information about Fair PharmaCare at common points of care where need for medication is identified. While encouraging the general population that is not currently registered in Fair PharmaCare to register may not result in a material benefit to households, there is also limited budgetary impacts to increasing registration rates across the population as the impact would be less than 1% of the current PharmaCare budget.

6.5 Conclusions

Overall, this thesis suggests that there is a strong association between needs-based factors such as drug spending and registration in Fair PharmaCare. In the year of registration, household drug expenditures and utilization increase significantly and then regress to the mean. Households that are not currently

registered for Fair PharmaCare would not derive significant additional benefit from registration on average given their current household characteristics. In summary, households register for Fair PharmaCare when the need arises, and until then, registration will likely not significantly improve access to medicines and health outcomes.

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