The effects of catastrophic drug plan deductibles on older women's use of cardiovascular medicines: a retrospective cohort study

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Article word count: 3,240
Running head: Deductibles and women's use of prescription drugs

Keywords: pharmaceuticals, prescription drugs, access to medicines, deductibles, Canada

Contributions
SM is responsible for study concept and design, interpretation of results, and drafting of the draft manuscript. EG and DW assisted with study design, analysis of data, interpretation of results, and revising the manuscript for important intellectual content. NK assisted with study design, interpretation of results, and revising the manuscript for important intellectual content.

Funding
This work was supported in part by the Canadian Institutes of Health Research [CIHR DCO150GP]. The funding agency had no role in the study or decision to publish. All opinions and conclusions are those of the authors.

Disclosure of Interests
The authors have no conflicts of interest to declare.

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Background

We sought to examine the effects of income-based deductibles under British Columbia's Fair PharmaCare system on older patients' use of cardiovascular medicines in 2013, ten years after the policy change.

Methods

This is a retrospective analysis of linked administrative databases for the province of British Columbia, Canada. We study rates of cardiovascular medication used by two cohorts of older, married women who had different levels of public drug subsidy based solely on the age of their spouses. We compare 2013 period prevalence and quantity of hypertension treatment and cholesterol treatment use with multivariable statistical models controlling for age, general health status, indicators of need for specific drug classes, ethnicity, and rural residence.

Results

For women with incomes under $50,000 (42% of our study population), having preferential public drug coverage by way of spousal age was associated with a 15% increase in the adjusted odds of filling one or more prescription for hypertension treatment (AOR = 1.15; 95% CI = [1.06, 1.24]) and a 13% increase in the adjusted odds of filling one or more prescription for cholesterol treatments (AOR = 1.13; 95% CI = [1.06, 1.21]). There were no statistically significant effects on the number of days of therapy purchased per user of these cardiovascular medicines.

Interpretation

These results add to the body of evidence in support of the idea that public drug coverage design can effect access to necessary medications.

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Introduction

Public drug coverage in many Canadian provinces initially evolved as a form of targeted benefit for society's more vulnerable population sub-groups: e.g., the poor and the elderly.[1] In recent years, however, several provinces have implemented income-based catastrophic drug coverage in effort to provide at least some form of universal drug coverage while limiting government liability for escalating costs of medicines needed for an aging population.[2] The deductibles under these plans are set as a percentage of household income and range from 3% to 10% of median household incomes across provinces that offer such benefits.[3]

To date, the largest province to adopt a universal, income-based drug plan is British Columbia. It implemented its universal, income-based plan, called "Fair PharmaCare," in 2003.[4] Prior to this, the British Columbia "PharmaCare" program was an age-based public drug plan in the sense that, in addition to complete coverage of medicines for social assistance recipients of all ages, the public plan also covered virtually all drug costs, without deductibles, for people over age 65.[5]

To ease the transition from age-based to income-based drug coverage, the Fair PharmaCare program provided more comprehensive coverage for households with one or more family member born in 1939 or earlier – see Table 1. Policy-makers hoped the enhanced terms of coverage for older patients at the time of the policy change would prevent adverse drug utilization responses – and political pressures – stemming from the implementation of deductibles for older patients who were previously entitled to comprehensive public drug coverage.[6]

Despite efforts to mitigate the effects of the change in benefits, the implementation of Fair PharmaCare was shown to have reduced treatment adherence among older patients with respiratory disease, depression, and those who experienced myocardial infarction.[7-10] More recent research has also shown that British Columbians reported cost-related non-adherence to prescribed therapies more frequently than residents of other provinces.[11,12] It has been difficult to ascertain whether the more recent perceptions of barriers to accessing medications in British Columbia are the sustained effect of the move

to an income-based policy more than 10 years ago or the result of other influences on medication accessibility, such as relatively high housing costs.

In this study, we examine the effects of the income-based deductibles under British Columbia's Fair PharmaCare system on older patients' use of cardiovascular medicines in 2013, ten years after the policy change. We use the household-level at which public drug coverage was offered to older British Columbians as a form of natural experiment. Specifically, we compare utilization of prescription drugs by two groups of married women born from 1940 to 1944: the first group comprised those who qualified for enhanced Fair PharmaCare coverage solely because their spouses were born in 1939 or earlier; the second group comprised married women of the same age who did not qualify for enhanced assistance because their spouses were born after 1939. The women with enhanced assistance by way of marriage faced lower deductibles and co-insurance levels than those who received standard assistance.

Methods

Study design and setting

This is a retrospective study of outpatient prescription drug dispensations to older British Columbians during 2013. All residents of British Columbia are covered under a universal, public health insurance program for medically necessary physicians' services and hospital care, including prescription drugs used in hospital, without direct cost to the patient. Residents are also eligible for pharmaceutical coverage under British Columbia's universal, income-based public drug benefit plan, Fair PharmaCare.

Data sources and cohort

We obtained de-identified linked health datasets from Population Data BC with approval of relevant data stewards and the University of British Columbia's Behavioural Research Ethics Board.[13-15] The datasets included sociodemographic information and records of all prescription drug dispensations, fee-for-service physician visits, and hospitalizations for all study subjects during 2013. Our data on prescription drug purchases came from BC PharmaNet, which includes records of every prescription dispensed outside of acute care hospitals regardless of how the prescription was financed. These datasets excluded military veterans, registered First Nations, and inmates of federal penitentiaries (4% of the population, combined).

Our study cohort included all women born from 1940 to 1944 who were alive and resided in British Columbia for at least 275 days in 2013 and whose spouses were alive at the beginning of 2013 (because

benefits by way of spousal age only last one year following the death of that spouse). Among these women, those with spouses born in 1939 or earlier were eligible for enhanced Fair PharmaCare assistance, those with spouses born in 1940 or later were eligible for standard assistance. Too few men qualified for enhanced assistance by way of marriage to older spouses for us to conduct robust equivalent analyses for married men of the same generation.

Datasets contained no information about whether women had private insurance for drug costs not paid for by the PharmaCare program. Those costs are simply identified as private expenditure on dispensed prescriptions, whether paid for out-of-pocket or through voluntary private insurance.

Administrative datasets contain a primary diagnostic code (ICD-10) for every fee-for-service medical visit, and up to 25 diagnostic codes for each record of an acute care hospitalization (including day procedures). To ensure complete and comparable capture of available diagnostic information, we excluded subjects who lived in geographic areas that receive 25% or more of their medical care from non-fee-for-service providers (excluded regions accounted for less than 4% of the population). We also excluded residents of long-term care facilities and all recipients of social assistance because these individuals have unique health care needs and receive benefits under specific PharmaCare programs that do not involve deductibles. Finally, we excluded individuals who spent the more than half the year, 183 days, in an acute care hospital (where drug costs are fully covered but not entered into available databases) because there would be incomplete prescription drug use data for such patients.

Variables

Using drug identification codes in the datasets, we identified all prescriptions for antihypertensives and cholesterol medications – details in Appendix A. We constructed two measures of the use of medications within each drug class. The first was a period prevalence measure of exposure: whether or not a study subject filled one or more prescription from the relevant drug class during 2013. The second was a measure of the quantity of relevant treatments used during the 2013 period: the number of days of therapy purchased over the course of the year among subjects that filled one or more prescription from the relevant drug class. Though this latter measure is similar to common adherence measures, it should be interpreted as adherence among prevalent users, not just new users, of the treatments.

For each patient, we searched all medical and hospital records for 2013 to find diagnoses related to indicated uses for each drug class studied. For regression analyses, we grouped relevant diagnoses into

Expanded Diagnostic Clusters of the John Hopkins ACG case-mix adjustment system (version 10.0) – details in Appendix B.

Also using the diagnoses in all medical and hospital records for 2013, we gauged overall health status using counts of major Aggregated Diagnostic Groups of the John Hopkins ACG case-mix adjustment system. This approach to risk-adjustment for general health status has been validated for studying pharmaceutical use in British Columbia.[16]

Owing to high rates of participation in the income-based drug plan among older British Columbians, our datasets contained validated household-specific income information for 94% of our study population.[17] The remaining 6% of study subjects had not applied for coverage under the Fair PharmaCare program, perhaps because of lack of awareness or lack of need for the subsidy.[18] We assigned these individuals incomes based on the average taxable income per household in the neighbourhood in which they lived. We also assigned them to the level of Fair PharmaCare coverage they would have qualified for based on the age of their spouse (as these women's ages alone would qualify them all for standard assistance).

We assigned patients to ethnicity groups using a validated algorithm to identify surnames of the dominant ethnic minorities in British Columbia: Chinese (40% of minorities) and South Asians (26% of minorities).[19,20] Finally, we categorized neighbourhood urbanization based on the population density of the Local Health Area in which people lived.

Statistical analyses

We calculated population characteristics for the cohorts of women who qualified for either standard Fair PharmaCare or enhanced Fair PharmaCare assistance based on the age of their spouses. We estimated logistic regressions of our binary, period prevalence measures of drug utilization: use being defined as filling one or more relevant prescription in 2013. For the subset of users of each class of medicines, we estimated linear regressions of a continuous utilization measure: the number of days of therapy dispensed to patients over the year.

Our primary focus was the comparison of enhanced versus standard Fair PharmaCare assistance on utilization measures. Differences in enhanced versus standard PharmaCare assistance levels are greatest at income levels below $50,000. Therefore, we tested for the effect of enhanced assistance below and equal or above $50,000 using separate dummy variables for each of these ranges of income.

After testing for collinearity between explanatory variables and comparing goodness of fit across models, our final models controlled for age, general health status, indicators of need for specific drug classes, ethnicity, level of neighbourhood urbanization, and enhanced assistance for pharmacare. We ran sensitivity analyses on samples stratified by income levels (above and below $50,000) and on different specifications of income levels and enhanced assistance. For all analyses, a value of $p < 0.05$ was considered statistically significant. All analyses were performed using Stata version 13.1 (College Station, TX) and SAS version 9.3 (SAS Institute, Cary, NC).

Findings

A total of 53,285 women met our study inclusion criteria, 53% of whom qualified for enhanced assistance under the Fair PharmaCare program by way of their spouse's age. Table 2 lists the characteristics of the study cohort, stratified by assistance level. Women who qualified for enhanced assistance under the Fair PharmaCare program were older than women receiving standard assistance, which was expected given they had to be married to older spouses. They were also more likely to have a greater number of comorbid conditions, have lower family income, and were more likely to have registered for the public drug plan. Women who qualified for enhanced assistance were also more likely to have a Chinese surname, which reflects greater average differences in spouses' age among Asian couples.[21] There were no significant differences between beneficiary groups in terms of overall use of medical or hospital care.

Table 3 lists detailed results from regression analyses for the drug classes of interest: antihypertensive drugs and cholesterol drugs. There was an age gradient in the period prevalence of exposure to antihypertensives and cholesterol drugs in our study cohort, as expected, with older subjects being more likely to fill prescriptions for these medications than younger subjects. Patients with worse overall health status, as measured by higher counts of major ADGs, were also more likely to fill antihypertensive and cholesterol prescriptions. When compared to exposure to therapy, age and general health status had fewer statistically significant effects on the average duration of therapy used per patient filling one or more prescription for antihypertensives or cholesterol drugs.

Patient ethnicity had some statistically significant effects on the use of the cardiovascular medicines studied. After controlling for other factors, the model found women of Chinese ethnicity to be less likely to fill one or more prescription for antihypertensives (AOR = 0.63, 95% CI = [0.57, 0.69]), but more likely to fill one or more prescription for cholesterol drugs (AOR = 1.24, 95% CI = [1.14, 1.34]). Chinese women

who filled one or more prescriptions for hypertension purchased fewer overall days of antihypertensives than other women (Beta = -49.5, 95% CI = [-64, -35]). South Asian women were also less likely to fill one or more prescription for antihypertensives (AOR = 0.83, 95% CI = [0.73, 0.94]) and more likely to fill one or more prescription for cholesterol drugs (AOR = 1.44, 95% CI = [1.30, 1.60]). South Asian women who filled one or more cholesterol prescription purchased fewer days of those treatments than other women (Beta = -17.4, 95% CI = [-27.4, -7.3]).

After controlling for other factors in the model, we found income had no statistically significant effects on the likelihood that women in our study filled one or more prescription for hypertension treatments. Income also had limited statistically significant effects on the likelihood of filling one or more prescriptions for cholesterol drugs. Higher incomes were associated with purchasing more days of antihypertensive and cholesterol therapy among those using these therapies.

Enhanced assistance under the Fair PharmaCare program had statistically significant effects on the likelihood of filling one or more prescription for antihypertensives and cholesterol drugs. After controlling for other health and socioeconomic factors, the model found women with incomes below $50,000 who qualified for enhanced assistance by way of the age of their spouses to have 15% higher adjusted odds of filling one or more prescription for antihypertensives than women who did not qualify for enhanced assistance (AOR = 1.15, 95% CI = [1.06, 1.24]). Women with incomes below $50,000 who qualified for enhanced assistance had 13% higher adjusted odds of filling one or more prescription for cholesterol drugs than women who did not qualify for enhanced assistance (AOR = 1.13, 95% CI = [1.06, 1.21]).

Among women with incomes above $50,000, enhanced Fair PharmaCare assistance did not have a statistically significant effect on the odds of filling one or more prescription for antihypertensives. Women with incomes above $50,000 who qualified for enhanced assistance by way of the age of their spouses had 8% higher adjusted odds of filling one or more prescription for cholesterol drugs than women who did not qualify for enhanced assistance (AOR = 1.08, 95% CI = [1.01, 1.15]).

Enhanced assistance under the Fair PharmaCare program had no statistically significant effects on the average duration of treatment purchased by study subjects who filled one or more prescription for antihypertensives or cholesterol drugs.

Discussion

Using a natural experiment by way of public drug plan design in British Columbia, we found lower deductibles under an income-based drug benefit program to be associated with increased access to cardiovascular medications. For women with incomes under $50,000 (42% of our study population), having lower deductibles under the Fair PharmaCare program in British Columbia was associated with a 15% increase in the odds of filling one or more prescription for hypertension treatment in 2013 (AOR = 1.15; 95% CI = [1.06, 1.24]) and a 13% increase in the odds of filling one or more prescription for cholesterol treatments (AOR = 1.13; 95% CI = [1.06, 1.21]) after controlling for other factors associated with medication use, including income.

Our findings concerning the effects of health status, age, and ethnicity were consistent with prior research on medication use among the more general population in British Columbia.[22-24] Our findings concerning the effects of Fair PharmaCare deductibles on access to cardiovascular treatments are also consistent with earlier studies of the drug plan in British Columbia. Those studies found that the implementation of income-based deductibles for older residents' drug coverage reduced the use of statins and beta blockers (a hypertension drug class).[8,9]

We found that lower deductibles by way of enhanced assistance under the Fair PharmaCare program had little effect on the quantity of treatments purchased among patients filling one or more prescription for the cardiovascular drug classes studied. This finding appears to be inconsistent with studies showing that comprehensive drug coverage improves persistence with prescribed therapies following index prescriptions.[25] We note, however, that the effect of cost-related non-adherence is likely to appear in our exposure statistics rather than quantity measures. This is because only a fraction of the patients in our period prevalence exposure measures (i.e., those filling one or more prescription for medications in 2013) would have been truly incident users in that year. Most patients identified as users of medicines in our study would have initiated therapy years prior to 2013, potentially many years prior. Those who initiated treatment in prior years and then stopped treatment quickly because of cost don't show up in our data as "low-quantity users," they show up in our data as "non-users."

Study limitations

The natural experiment used in this study has advantages insofar as the means of qualifying for enhanced coverage in British Columbia – spousal age – was independent of health needs or other

factors related to medication accessibility. This study is not without drawbacks, however. First, developing comparable cohorts of enhanced versus standard benefits recipients required that we focus on a narrow age-range of a specific demographic. Our findings for the older married women in this study may not generalize to men, unmarried women, or younger populations. Furthermore, the limited sample sizes resulting from our study design made it infeasible to use index events (such as heart attack) to measure differences in treatment initiation and subsequent persistence. Limitations of sample size also resulted in relatively wide confidence intervals.

While the administrative data used in this study do not contain details, such as disease severity, that are important determinants of prescription decision-making, our natural experiment involved a mechanism of assigning subjects to enhanced versus standard coverage for medications based on a personal characteristic that is unlikely to be correlated with unobserved confounding. There were income and health status differences in our study cohorts; yet, those differences likely stemmed from the fact that enhanced assistance beneficiaries were closer in age to the upper limit of 73 years (because their husbands were all 74 years of age or older). There were also ethnic differences in our cohorts, which may have arisen from cultural norms concerning the average age difference between spouses for the generation of persons in our study sample. Once age, income, and ethnicity were controlled for, it is unlikely that differences in likelihood of treatment exposure found in our study resulted from unobserved confounding.

Finally, the government of British Columbia does not collect data on whether or not citizens have private insurance for drug costs below the deductibles under the public drug plan and our study assessed utilization patterns as a function of benefit levels 10 years after the initial implementation of income-based deductibles for public coverage of medicines used by older British Columbians. By that time, many individuals who could access private drug coverage through their employment may have done so. The unmeasured existence of voluntary private insurance is an unobserved confounding factor that may bias our results toward the null hypothesis of no difference in drug utilization between groups. This is because the control group of women in our study – those with standard assistance under the Fair PharmaCare system – were more likely to have private insurance because they were married to younger men. This is because it is more likely that younger (virtually always male) spouses were more likely to be working at the time of our analysis than older spouses, and they were therefore more likely to have employer-provided private insurance.[3]

Conclusion

We have found that the level of income-based deductibles under catastrophic drug benefit plans can affect the use of cardiovascular drug treatments, even long after deductibles are put in place. The results of this study therefore add to the body of evidence in support of the idea that public drug coverage designs should limit the costs to patients for treatments that are essential to the maintenance of good health.[25,26]

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Table 1 – Terms of Enhanced and Standard Fair PharmaCare Assistance

Enhanced assistance for households with one or more member born in 1939 or earlier			
Household income	**Deductible, as percentage of household income**	**Co-insurance paid by household after deductible is reached**	**Threshold beyond which government pays all drug costs as percentage of household income**
Less than $33,000	0%	25%	1.25%
$33,000 to $50,000	1%	25%	2%
Over $50,000	2%	25%	3%
Standard assistance for all other households			
Household income	**Deductible, as percentage of household income**	**Co-insurance paid by household after deductible is reached**	**Threshold beyond which government pays all drug costs as percentage of household income**
Less than $15,000	0%	30%	2%
$15,000 to $30,000	2%	30%	3%
Over $30,000	3%	30%	4%

Table 2 – Characteristics of study population, stratified by eligibility for enhanced Fair PharmaCare

	Standard Assistance	Enhanced Assistance
Number of subjects	28,359	24,926
Age*		
69	31.6%	13.3%
70	26.3%	16.9%
71	19.8%	20.4%
72	13.5%	22.9%
73	8.8%	26.5%
Health Status *		
1-2 Major ADGs	43.8%	44.8%
3+ Major ADGs	6.9%	7.7%
1+ diagnoses of primary indications*		
Antihypertensives	58.6%	62.3%
Cholesterol drugs	19.8%	21.2%
Income*		
$0-$14,999	2.5%	2.8%
$15,000-$29,999	11.1%	15.9%
$30,000-$32,999	2.0%	5.5%
$33,000-$42,999	11.6%	14.5%
$43,000-$49,999	8.6%	10.6%
$50,000-$56,999	12.1%	9.7%
$57,000-$69,999	14.8%	11.1%
$70,000+	37.2%	30.0%
Fair PharmaCare*		
Registered for plan	91.1%	96.0%
Ethnicity*		
Chinese	6.1%	11.3%
South Asian	4.1%	4.0%
Rural dwelling		
Rural	8.1%	8.2%
Overall health care use		
Average total cost of medical care	$1,112	$1,167
Average number of medical care visits	16.8	17.7
Average total cost of hospital care	$1,067	$1,112
Share with 1 or more hospitalization	22.1%	22.3%

* Difference significant at p = 0.05

Table 3 – Regression results: adjusted odds ratios for the likelihood of filling at least one prescription, and adjusted difference in days of therapy per person filling at least one prescription, antihypertensives and cholesterol treatments

	Exposure to treatment		Duration of treatment	
	Antihypertensives	Cholesterol treatments	Antihypertensives	Cholesterol treatments
	AOR [95% CI]	AOR [95% CI]	BETA [95% CI]	BETA [95% CI]
Age (69 = ref.)				
70	1.01 [0.94, 1.08]	**1.10 [1.03, 1.17]**	2.1 [-9.1, 13.3]	-0.7 [-7.7, 6.2]
71	**1.15 [1.07, 1.24]**	**1.10 [1.03, 1.18]**	9.1 [-2.2, 20.5]	-3.5 [-10.5, 3.6]
72	**1.14 [1.06, 1.24]**	**1.14 [1.06, 1.22]**	**17.6 [5.9, 29.4]**	**-2.1 [-9.4, 5.2]**
73	**1.19 [1.10, 1.29]**	**1.19 [1.11, 1.28]**	**14.5 [2.5, 26.5]**	**-2.1 [-9.5, 5.3]**
Health: # of Major ADGs (0 = ref.)				
1 to 2	**1.30 [1.23, 1.37]**	**1.26 [1.20, 1.32]**	**14.7 [6.5, 22.8]**	4.7 [-0.5, 9.8]
3+	**1.34 [1.21, 1.49]**	**1.39 [1.28, 1.52]**	-1.4 [-15.2, 12.5]	**-5.6 [-14, 2.7]**
Ethnicity (White/other = ref.)				
Chinese	**0.63 [0.57, 0.69]**	**1.24 [1.14, 1.34]**	**-49.5 [-64, -35]**	-3.2 [-11.4, 5]
South Asian	**0.83 [0.73, 0.94]**	**1.44 [1.30, 1.60]**	-10.9 [-28.6, 6.8]	**-17.4 [-27.4, -7.3]**
Setting (Urban/suburban = ref.)				
Rural setting	**1.10 [1.01, 1.21]**	0.94 [0.86, 1.02]	6.6 [-6.6, 19.7]	-0.4 [-8.9, 8.2]
Income (Under $15,000 = ref.)				
$15,000-$29,999	1.01 [0.86, 1.20]	**1.19 [1.03, 1.37]**	**34.4 [10.6, 58.2]**	5.6 [-8.7, 19.9]
$30,000-$32,999	0.89 [0.73, 1.09]	1.15 [0.97, 1.37]	**47.5 [18.5, 76.4]**	-0.4 [-17.8, 17]
$33,000-$42,999	0.99 [0.83, 1.17]	1.12 [0.97, 1.30]	**52.6 [28.0, 77.1]**	11.7 [-3.0, 26.5]
$43,000-$49,999	0.96 [0.81, 1.15]	1.05 [0.90, 1.23]	**46.6 [21.2, 72.0]**	12.5 [-2.8, 27.8]
$50,000-$56,999	1.00 [0.83, 1.19]	1.11 [0.95, 1.30]	**44.8 [18.8, 70.8]**	**17.6 [2.0, 33.3]**
$57,000-$69,999	1.02 [0.86, 1.22]	0.96 [0.82, 1.13]	**40.6 [14.8, 66.4]**	**19.3 [3.7, 34.9]**
$70,000+	0.93 [0.78, 1.10]	0.89 [0.77, 1.03]	**35.5 [10.9, 60.1]**	**23.6 [8.8, 38.4]**
PharmaCare assistance (Standard = ref.)				
Enhanced under $50,000	**1.15 [1.06, 1.24]**	**1.13 [1.06, 1.21]**	7.5 [-3.6, 18.7]	6.1 [-0.7, 12.8]
Enhanced over $50,000	0.98 [0.91, 1.04]	**1.08 [1.01, 1.15]**	4.1 [-6.2, 14.5]	-0.3 [-6.7, 6.2]

Note: all models also adjusted for category-specific indications for use that are listed in Appendix B. Bolded estimates are statistically significant ($p<0.05$).