Equity in prescription drug use among older Ontarians: a preliminary analysis based on linked survey and administrative data

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Introduction

Prescription drugs increasingly play an important role in the prevention and treatment of disease. However, the financing of prescriptions drugs in Canada differs from that of most other medical services. Ambulatory prescription drugs are excluded from the protections of universal access to care granted by the Canada Health Act. As a result of this exclusion, provincial coverage for ambulatory prescription drugs and the amount that patients need to pay to access these drugs varies across the country, depending on the structure of the provincial plans (Demers et al., 2008). The lack of universal coverage and the fact that patients are often required to cover some of the cost of these drugs raises a number of concerns about equity of access in each province. Like most other provincial pharmaceutical programs, the Ontario Drug Benefit (ODB) program does not provide universal coverage, but rather only provides comprehensive coverage to the population groups who are in greatest need and have least ability to pay. While it is clear then that there is inequitable access to public coverage between people who are eligible for ODB coverage and those who are not, it has not been investigated whether inequities in access still exist for those who have public coverage for prescription drugs.

This paper has two main aims. The first aim is to assess the extent of inequity in pharmaceutical usage for people eligible for ODB coverage. Although the program provides coverage to a number of populations, the study focuses on the population group that makes up the majority of the ODB program recipients: individuals aged 65 years and older[1]. For the purpose of this research, equity is defined as the receipt of services or medicines on the basis of need, and the payment of services on the basis of ability to pay (Evans, 1983). Need is determined on the basis of the expectation of protecting, promoting or restoring health (Birch & Abelson, 1993; Culyer & Wagstaff, 1993; Evans, 1983; Evans, 1992; Giacomini et al., 2004). Inequity can be assessed empirically using the concentration curve, which indicates

[1] For the 65 years and older population group, the ODB database includes information for almost the entire population of this age unlike for other groups where coverage can change over time (e.g. with movement in and out of paid jobs) and because of eligibility requirements (Levy et al., 2003).

how concentrated the use of health services (or expenditure) is along the distribution of income in a population (O'Donnell et al., 2008). Inequity in utilization would arise if the use of medicines is concentrated among higher or lower income groups, and inequity in finance would be indicated by a concentration of out-of-pocket payments among those with lower income.

The article's second aim is to examine the comparability of two data sources on prescription drug utilization data available in Ontario for the purpose of evaluating equity in prescription drug usage. Data on prescription drug utilization is available from community surveys and administrative data sources. Each of these data sources offers advantages and disadvantages as a means of evaluating equity in drug utilization. There is also the possibility to link these two data sources at the individual level. In order to address the first aim of the paper, the researcher needs to first determine which data source is the most appropriate for evaluating equity in the public drug program.

This paper is organized in three parts. First, we provide a brief introduction to the financing of prescription drugs, with a focus on the public drug program in Ontario. Second, we describe the analysis of comparability of survey and administrative sources of medicine use. Third, we outline our assessment of inequity in the use of medicines using linked survey and administrative data. The paper concludes with a summary of the findings along with some suggestions for future research.

Financing prescription drugs

The role of prescription drugs in the health system has increased markedly in the past 20 years; for example, as a proportion of total health spending, pharmaceuticals constituted 9.5% in 1985 compared to 17% in 2007 in Canada (CIHI 2008). Pharmaceuticals currently represent the largest category of health spending in Canada after hospitals (Canadian Institute for Health Information, 2008). The rising total cost for prescription drugs has been attributed to increased utilization (accounting for over half of the rise in spending) in addition to changes in therapeutic choice, and less so to increases in drug prices (Morgan, 2004).

Pharmaceuticals can also represent significant costs to individuals. Even though the majority of Canadians have some form of insurance for prescription drugs, the average Canadian family

is estimated to spend over $1200 out-of-pocket (on top of any drug insurance premium) per year on prescription drugs (Commission on the Future of Health Care in Canada, 2002). The costs of medicines not only create a financial burden for poorer households, but they may also present barriers to access. There is extensive evidence demonstrating that people are sensitive to the price of medicines (Gemmill et al., 2008; Lexchin & Grootendorst, 2004). To protect population groups who are less able to pay, provincial public drug insurance programs in Canada provide coverage for defined populations, primarily those aged 65 or over and those receiving social assistance (although income-based programs for which the entire population is eligible are in place in some provinces). These income- and age-based programs are in place to protect those without employer-based prescription drug insurance, coverage that exists for the majority of the working-age population. In light of the extensive evidence that individuals are sensitive to the price of medicines, public drug programs aim to ensure equitable access to medicines and a more equitable distribution of the burden of costs (Evans, 2005).

An example of such a program is the Ontario Drug Benefit (ODB) program, which funds about half of the total cost of prescription medications in Ontario. It covers about 2.8 million Ontario residents at a cost of approximately $3.8 billion. Eligible beneficiaries of the program include individuals aged 65 and over (this group makes up the majority of ODB program recipients), those on social assistance, families with high drug costs relative to their income (covered by the Trillium Program), residents of long-term care facilities and recipients of home care.

About two-thirds of the recipients of the ODB program are individuals who are aged 65 years or older. Within this group there are two programs with different cost-sharing arrangements. The default category that an individual enters upon turning 65 is the 'high-income senior' program, which is associated with a $100 annual deductible and a $6.11 co-payment per drug that is dispensed. If an individual provides documentation of their low-income status[2], he or she becomes eligible for the low-income senior program which has no deductible, and may include a $2 co-payment per drug that is dispensed. The relatively low threshold for eligibility for the low-income senior category raises some concern over equity whereby the out-of-pocket payments may deter the appropriate use of medicines among this low-income group.

[2] An individual is considered to be low-income if he or she has a net annual income below $16,018 if single, and below $24,175 if a couple.

Among those aged 65 years and older, some with higher income may also hold private prescription drug coverage. The ODB program is the payer of first resort; private insurers would cover part of the costs of drugs that are not included in the ODB formulary as well as the ODB deductible (Paterson et al., 2008). The proportion of the population with such supplementary insurance is not known, although it is estimated to be around 20% of the population aged 65 years and older (Paterson et al., 2008). Although the aim of the ODB program is to allow for more equitable drug access across the provincial population, there has been relatively scant attention paid to evaluating the performance of the ODB program, in particular, the extent to which it achieves an equitable distribution of medicines and an equitable distribution of the burden of payment for the population for which it provides coverage.

Data on prescription drug use: assessing comparability

Investigations of equity in the pharmaceutical sector require information on medicine use at the individual level. Two of the most commonly used sources of information on medicine use are survey data and prescription drug claims data. The few studies that have examined the non-need correlates of medicine use have relied on survey data (Ballantyne et al., 2005; Grootendorst, 1995; Zhong, 2007). The comparison of self-reported use of hospital and physician services with administrative data has been extensive and shows relatively high comparability (Cleary, 1984; Glandon et al., 1992; Jobe et al., 1990; Marquis et al., 1976; Roberts et al., 1996), even in the 65 years and older population (Raina et al, 2002; Wallihan et al., 1999). There may be differences in how an individual interprets a health care contact and how that contact is recorded in administrative databases, such as in the classification of a hospital admission versus an outpatient visit. However, a great number of difficulties arise in the efforts to compare data sources of prescription drug utilization.

The main difference between survey data of medicine use and pharmacy claims data is that the former measures drugs that are actually consumed by the patient, whereas the latter measures drugs that are dispensed. There are many reasons why a drug may not be consumed after it has been dispensed. One reason is that the drug may be prescribed on an ‘as needed’ basis, and the patients has not yet needed the drug. Another is that the patient may not adhere to the treatment plan. Non-adherence could arise for numerous reasons: because the patient may not remember to take the drug; he may start taking the drug but then discontinue use because the

symptoms are reduced or relieved, or because he experiences side effects; or he may decide not to take the drug for other reasons (for instance, he may give it or sell it to another person).

Although surveys are designed to gather information on the medicines that have been taken by the respondent, the ability of survey respondents to accurately recall their medicine use varies according to the design and implementation of the survey (Gama, Correia, & Lunet, 2009). Surveys that ask respondents about the details of the drugs that they are taking, such as the names, dosage, etc, for example by checking in their medicine cabinet, show high comparability with pharmacy claims data (Johnson & Vollmer, 1991; Klungel et al., 2000). However surveys that include questions that are more open-ended, or ask respondents to estimate expenditures, have shown less comparability.

One study from the Netherlands found that self-reported utilization of medicines in a three-month period (measured simply as the use of at least one medicine in that time period) was less comparable to administrative data than for hospitalization and physiotherapy (Reijneveld & Stronks, 2001). Studies of Medicare beneficiaries in the US also found discrepancies in the reporting of medicine use in surveys with information from pharmacies. One found that 24% of survey respondents did not report prescription drug expenditures, in spite of pharmacy records showing purchases (Berk, Schur, & Mohr, 1990). Among those who reported any expenditures, on average they underreported actual expenditures by 23%. More accurate reporting was associated with higher education, having private insurance, and the younger ages (Berk et al., 1990). Another study found an underreporting of medicine use by about 18%, and expenditure by 17%; also nearly a quarter of the sample over-reported their use of medicines (Poisal, 2003). A review of the evidence from 1980-1997 on accuracy of patient self-reports of health care use found 13 studies of medicine use and stated that "the studies available suggest that the ability of patients to recall their drug use is unsatisfactory" (Evans & Crawford, 1999, p.249).

The comparability of self-reported medication use and pharmacy claims data is made difficult by the inability to ascertain whether inaccurate reporting stems from recall problems or from non-adherence. The two data sources have different strengths and weaknesses for research into equity in the use of medicines. Self-reported utilization may be inaccurate due to problems with recall and they may include over-the-counter medicines and drugs that are purchased privately, although the survey questions refer to medicines that are actually consumed. Claims

data of dispensed medicines are not biased by recall, they contain information on expenditure, and they are limited to the prescription drugs that are purchased within the public drug program; however, the patient may not consume all drugs that are dispensed (in some cases because the drugs were not needed at the time).

Description of the data

This study makes use of two data sources in Ontario, Canada that are linked at the individual level: the Canadian Community Health Survey (CCHS) and the drug claims database of the ODB program. The ODB database contains the information that pharmacists submit on the medication that is dispensed, including the drug name, dosage form and strength, the date, quantity and duration of the dispensation. Levy et al. audited 50 pharmacies in Southern Ontario and found extremely high reliability of the coding of drug type, date, quantity and duration of the dispensed drugs in the ODB claims database (Levy et al., 2003)[3]. The database that we include in this study includes the drug information for the 25 most commonly prescribed drugs.

The CCHS is a cross-sectional survey produced by Statistics Canada of 133,300 individuals from 136 health regions across Canada. The CCHS targets persons aged 12 years and older who are living in private dwellings. Excluded populations are those living on Indian Reserves or Crown lands, residents of institutions, full-time members of the Canadian Armed Forces, and residents of some remote regions. The first wave of the survey was collected between 2000 and 2001. It includes a comprehensive set of information on economic, social, demographic, occupational and environmental correlates of health, and numerous questions on health care utilization. We draw on the Ontario sample of the survey. An optional survey module on medication use was administered in 29 out of the 37 public health regions in Ontario.

The CCHS data for Ontario are linked to the ODB database through the specialized Ministry of Health and Long Term Care link files. The focus is on those aged 65 years and older who live in private dwellings because for this population the ODB program is the primary payer for all

[3] Similar studies have not been conducted in the rest of the province. The southern Ontario region has a greater proportion of chain pharmacies than for the province as a whole, so it is possible that the reliability of these data may differ to some extent throughout the province (Levy et al 2003).

prescription medicines included in the formulary, and the sample is representative of this older population.

To compare reported and dispensed drugs, the cohort for the study included a subset of individuals who had at least one drug dispensed in the 30-day period prior to their survey interview. Figure 1 illustrates how the sample was selected. Starting with 37,681 individuals who were in the Ontario sample of the CCHS, we ended up with 829 individuals who agreed to be linked to administrative data sources, had some prescription drug claims in the ODB program (within a six-year period), were aged 65 years or older at the time of the survey, completed the optional survey module on medicine use, and had at least one drug claim in the 30 days prior to their survey interview date (the reference period for the survey question).[4] The three drug categories that are included in the ODB database and also referred to in the CCHS survey questions on medicine use are for "blood pressure", "heart", and "stomach remedies"; the medicine survey questions and the corresponding ODB drug names are listed in Table 1. For the remainder of the medicines referred to in the survey, there were no clear matches with the drugs in the ODB database (these include pain relievers, medicine for asthma, cough/cold, allergies, diabetes, sleeping pills). The sample was selected in order to address the question of whether individuals who had prescriptions dispensed (under the ODB program) reported this usage in the CCHS.

Empirical analysis of comparability

We compare the information on prescription claims in the ODB database with self-reported use of medicines in the CCHS, and then estimate the factors associated with under-reporting. Table 1 outlines the drugs that are investigated. Taking blood pressure medications as an example, individuals in the survey were asked whether they had taken any medication for blood pressure in the past 30 days. Four drugs in the ODB database were categorized as hypotensives. Among those individuals who had at least one of the hypotensive drugs in the 30-day period according to ODB, we first observe the proportion that reported to have used

[4] There is a possibility of response bias being introduced at either of the two points of selection: whether the survey respondent agrees to have his or her records linked (and providing the Ontario health card number), and completion of the optional survey module on drug use. A previous study found no substantive difference in socioeconomic, health and demographic characteristics between those who answered the optional drug module and those who did not. Furthermore, since individuals did not decide to respond, but rather the decision was made for health regions, there is no individual-level selection in effect (Zhong 2007). Finally there appears to be no significant differences in health, demographic, socioeconomic and health utilization indicators between the full Ontario sample of the CCHS and the sample that agreed to record linkage.

medication for blood pressure in the survey, and second we estimate the individual level characteristics that are associated with discrepancies between self-report and administrative records.

For three subgroups, those who had drug claims for blood, heart or stomach medicines, we calculate the proportion of under-reporting as the percentage of those with at least one of the relevant prescription drug claims who did not self-report their use in the survey.
Then we model the probability of 'under-reporting' (i.e. not reporting use in the survey) on a set of individual level characteristics using a probit equation.

The dependent variable is equal to 1 if the individual did not report to have used the relevant medication (blood pressure/heart/stomach remedies) in the past month; it is equal to 0 if the individual correctly reports use. Independent variables include demographic, health-related variables, and socioeconomic variables. Health status is measured by general self-assessed health in five categories and ranges from excellent to poor, the number of reported chronic conditions, whether they had two or more medicines in the past month (compared to one). Age is measured in five categories: 65-69, 70-74, 75-79, 80-84 and 85 years and older. We measure socioeconomic status by the drug program for low-income seniors, the level of education (less than secondary education, secondary, some post-secondary, and post-secondary), and immigration status.

Findings from the comparability study

Almost all of those included in the cohort of individual who had a drug claim in the 30-day period prior to the survey interview reported to have taken some kind of medicine in the past month. However, the reporting of the use of drugs for blood pressure, heart and stomach remedies was less comparable. About 16% of those who had taken at least one blood pressure medication according to the ODB database did not report this in the survey, 58% of those who were taking a cardiovascular drug did not report taking heart medicines, and 42% of those who had claims for gastrointestinal medications did not report taking stomach remedies in the survey (Table 2).

Among those who had any blood pressure medications dispensed in the past month, we modeled the likelihood of not reporting this use on a set of demographic, health and

socioeconomic variables (Table 3). The only factors that are significantly associated with under-reporting the use of blood pressure medicines are gender, education and being born in Canada. Taking the marginal effects calculated from probit coefficients, it appears that women and those with a secondary education (compared with less than secondary education) have about a 10% reduced likelihood of under-reporting (not reporting taking blood pressure medications among those who had positive use in the ODB). Those who were born in Canada have an 8% higher likelihood of under-reporting. As for heart medicines, there is a substantial degree of under-reporting. Unlike with blood pressure medications, women have an 18% increased likelihood of under-reporting heart medicine use, while people in poorer self-reported health and with more chronic conditions have significantly lower likelihood of under-reporting. The model of self-reported stomach remedies is not significant, although poorer self-assessed health, and being in age category 80-84 reduces the likelihood of under-reporting.

Overall, there appears to be relatively low comparability of the two data sources of medicine use. It is possible that some people who had drugs dispensed did not actually take the drug during the 30-day period. This is more likely with the stomach remedies (these drugs are mostly used to treat gastric reflux disease), than with blood pressure medicines, since the latter ought to be taken daily. It is also possible that some people do not know what blood pressure medication is, or that they even have a diagnosis of hypertension (Muhajarine et al, 1997; Tu et al, 2007). The findings are consistent with previous studies that show relatively low concordance between survey and registry data of medicine use (Berk et al., 1990; Evans & Crawford, 1999; Reijneveld & Stronks, 2001), with higher rate of reporting among the better educated (Reijneveld & Stronks, 2001).

However there are some important limitations with this analysis. The small sample sizes in this analysis limits its power, and the restriction of the drug data to the top-25 prescribed drugs limits the ability to generalize these findings to the entire population of medicine users. Further studies are needed to explore the comparability of different data sources and the association between education and recall of drug use. This analysis suggests that we must be cautious when we interpret self-reported medicine use from the CCHS. Furthermore, analyses of equity that are based on self-reported data, in particular if the studies include information on the types of drugs that are consumed, and the questions do not include details of the drugs, or requests for respondents to check their medicine cabinets, may yield different findings than those based on claims data. The finding that higher educated individuals who had drugs

dispensed are more likely to report their medicine use in surveys suggests that studies that rely on survey data may overestimate the education effect on pharmaceutical usage and bias estimates toward pro-rich inequity.

Assessment of equity in the use of medicines

To assess equity in the pharmaceutical sector we need accurate information on medicine use, socioeconomic status and other individual characteristics. In light of the high level of under-reporting of medicine use in survey data, the inclusion of over-the-counter drugs in these data, and the lack of expenditure information, claims data are likely to be the more appropriate measure of utilization. In this section, we describe the concentration index approach to measuring inequity in the use of prescribed drugs, and in out-of-pocket expenditure, and then we report results from a preliminary analysis based on linked survey and administrative data.

There has been little assessment of the extent of inequity in the use of and expenditure on medicines within Ontario's public drug program. The few studies to date have relied on survey data (Ballantyne et al., 2005; Grootendorst, 1995; Zhong, 2007), which as we outline above, may not be appropriate for at least two reasons. First, if the limited comparability of survey and administrative data relate to recall difficulties, and this recall is more accurate among higher socioeconomic groups, then this would bias the estimate of socioeconomic inequity upwards. Second, over-the-counter (OTC) medicines are often costly; therefore, the distribution of OTC medicine use is likely to be more concentrated among higher income groups. The inclusion of OTC drugs in analyses of equity in the ODB program could lead to an overestimation of pro-rich inequity (or under-estimation of pro-poor inequity).

With linked administrative and survey data, one can estimate inequity in the use of and expenditure on prescription drugs within the public drug program. Survey data include important information on individuals' socioeconomic status, their level of health, and other characteristics that affect the use of health care services and of medicines. Administrative data of prescription drug use include information on expenditure, which can be separated into the costs borne by the province (through the public drug plan) and those that are borne by the patient (in the form of out-of-pocket payments).

Empirical analysis

One approach (and the only one based on an explicit social welfare function) to the assessment of inequity is with the concentration index, which indicates how concentrated the use of medicine is along the distribution of income in the population (O'Donnell et al., 2008; Wagstaff & van Doorslaer, 2000). This method derives from the literature on income inequality. The concentration curve, similar to the Lorenz curve that describes the distribution of income in a population, describes the relationship between the cumulative proportion of the population ranked by income (on the x-axis) and the cumulative proportion of health services or medicine use (on the y-axis). Like the Gini index that provides a measure of income inequality, the concentration index is a measure of income-related inequality in use of health services or medicines and it is estimated as twice the area between the concentration curve and the line of perfect equality (the diagonal). When utilization is more concentrated in the upper end of the income distribution, after adjusting for differences in need as measured by health status, there is "pro-rich" inequity. It is also possible for the level of needs-adjusted utilization to be concentrated among the lower income groups; in the literature this is referred to as "pro-poor" inequity. Such "pro-poor" inequity could be understood as an *over*-utilization among the poorer groups, which could be problematic in the case of medicines due to the increased risk of adverse events that is associated with poly-pharmacy. The concentration index could also be used to provide evidence of inequity in the financing of prescription drugs, whereby a positive concentration of out-of-pocket payments would suggest that the payment system is progressive, since higher income individuals are paying proportionately more out-of-pocket than those with lower income.

This empirical research can thus serve as an assessment of inequity in Ontario's public drug program. To the extent that after adjusting for differences in need medicine use is greater for those with higher socioeconomic status, and that out-of-pocket expenditure is higher for lower income individuals, there is some evidence of inequity in the public drug program.

For this analysis we make use of five years of ODB drug claims data (of the 25 most commonly prescribed drugs) for individuals aged 65 years and older, linked to the CCHS from 2001.[5] The final sample consists of 6016 individuals over the period 2001-2006 (yielding a total of 23,517 observations). The dependent variables of interest are the total number of

[5] The analysis included only those older people who were in private residence, and not residents of long-term care institutions, since the CCHS covers only the private resident population.

claims that an individual made per year (this covers all ODB claims and not just the top-25 prescribed drugs), the total expenditure on prescription drugs, and the total out-of-pocket expenditure on prescription drugs. Because these variables are highly skewed we took the natural logarithm of each as the dependent variables (but because there are not many zeros there is no real need for a two-step model). The independent variables are derived from the survey data (from 2001) and are separated into those that relate to need for medicines, including age, sex, and health status, and those that we consider unrelated to need, including income, education, marital and immigrant status, overweight, lifestyle factors (current or past smoker, drinking heavily once per week, eats five portions of fruit and vegetable per day) and year dummies.

Three random effects regression models are run to estimate the effects of need and non-need variables on medicine use and expenditure, accounting for the panel nature of the data. Then we calculate the concentration indices of inequality, as the covariance between the income rank in the population and expenditure, to measure how concentrated is use/expenditure along the distribution of income. We calculate inequity as the extent of inequality that remains after adjusting for differences in need across the income distribution[6].

Results of preliminary analysis of equity in medicine use

There appears to be an association between individuals' income and their use of medicines, the total expenditure incurred and their out-of-pocket expenditure (Table 4). Seniors with higher income have fewer prescription drug claims on average, incur fewer costs, and spend more out-of-pocket than those with lower income.

The results of the random effect panel analyses confirm that socioeconomic factors affect the use of medicines (Table 5). After adjusting for age, self-reported health status, and lifestyle factors, individuals in the low-income senior program make 20% more drug claims than those in the high-income senior program. Higher educated individuals make 6.4% fewer claims and

6 The process of needs adjustment is not straightforward and requires measurable indicators of need. The literature has relied mostly on self-reported health as a proxy for need, whereby, on average, individuals who report worse health are assumed to have greater need for health services. This approach has advantages and disadvantages. On the one hand, numerous studies have found that self-reported health is a strong predictor of mortality and health service use (Idler & Benyamini, 1997). On the other hand, there may be bias in reporting of self-assessed health and self-reported health conditions that may be related to age and possibly also to socioeconomic status (Bago d'Uva, O'Donnell, & van Doorslaer, 2008).

incur 5.3% less cost on prescription drugs than those with less than a secondary school education. Canadian born individuals incur 6.4% more costs on prescription drug medicines. The strongest predictors of medicine use, as expected, are health status and age: people who are older, with worse self-reported health, more chronic conditions and limitations in activity make more drug claims than relatively younger and healthier individuals. Total expenditure is related to worse health, but younger age. The concentration indices of inequality in the use of and total expenditure on medicines are negative and significant, indicating a significant concentration in the lower end of the income distribution. Health status is worse, on average, among lower income individuals; therefore, after adjusting for health and age, the concentration index reduces, but remains negative and significantly different from zero. For total expenditure, the index of inequity is very close to zero (which implies an equitable distribution of expenditures).

The analysis of out-of-pocket expenditures confirms that wealthier individuals spend more out-of-pocket than those with lower income (Table 5). We find a significant association between income and out-of-pocket payments after adjusting for demographic and socioeconomic characteristics. The significant difference in out-of-pocket expenditure is between the low-income seniors (in the program for the lowest income group) and the rest of the population. This is not surprising given that the public drug program nearly eliminates cost sharing for individuals below a low-income threshold (they have no deductible and may have to pay $2 co-payment for each drug that is dispensed). This analysis is supported by the concentration indices that are positive, and significantly different from zero; there is a greater concentration of out-of-pocket payments among the higher income seniors. While this program is successful at protecting the lowest income individuals from the burden of costs, the overall progressivity of the program is limited since payments are not related to income for the remainder of the population.

Discussion

One of the objectives of the public drug program in Ontario is to ensure equitable access to medicines. This paper examined the comparability of two sources of prescription drug use data for the purpose of evaluating equity in prescription drug use, and then it presented a preliminary assessment of inequity within Ontario's public drug program. It appears that the comparability of the CCHS and ODB data of medicine use varies across the different drug

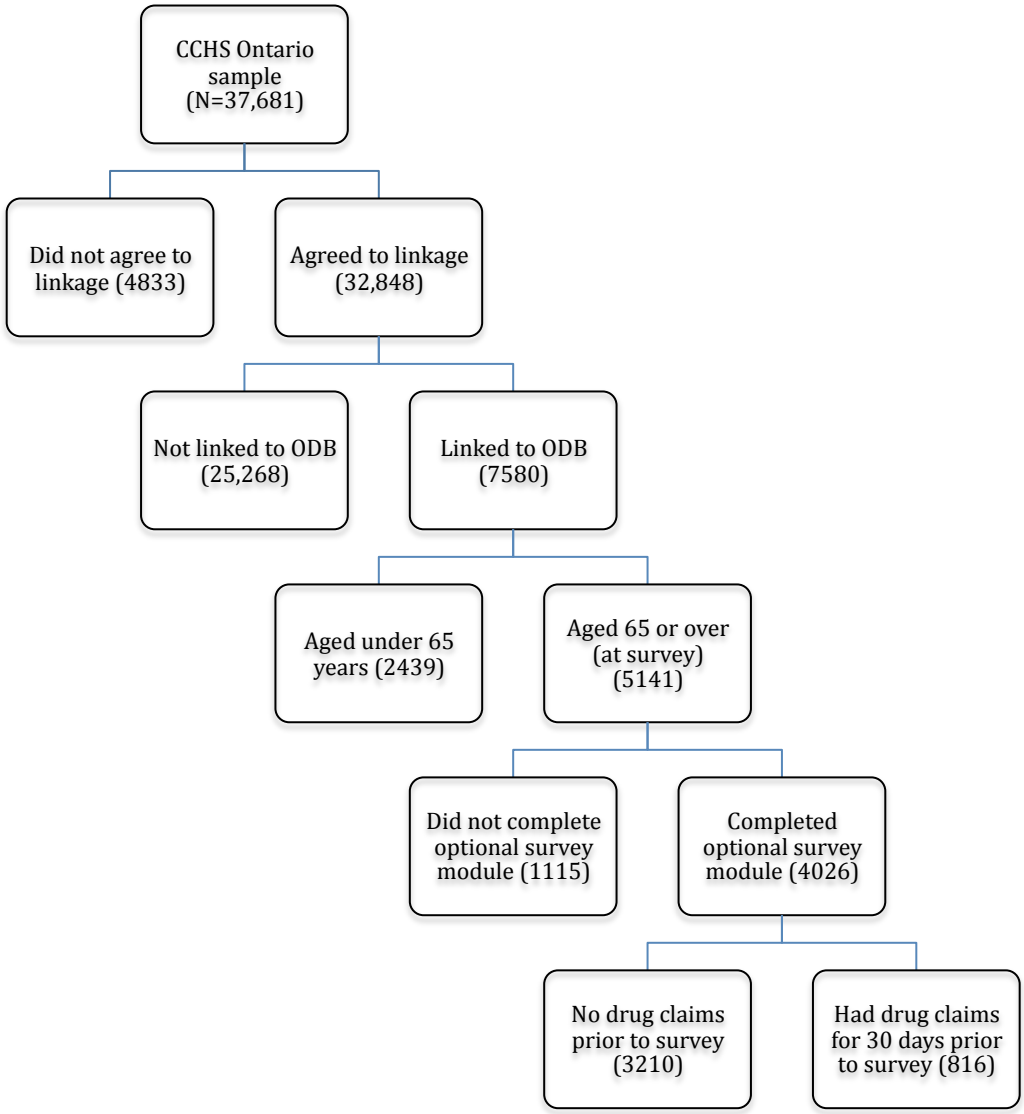
categories but with relatively high rates of under-reporting. In light of this finding, and that the survey does not include information on the drug costs incurred, claims data were used to analyze the socioeconomic effects on drugs dispensed in the public program.

The study found a significant association between income and the use of medicines, along with a negative index of inequity, which suggests that there is little evidence of inequity in favour of the rich. On the contrary, the elevated use of medicines among lower income groups, even after we control for health status, raises some concern associated with the potential increased risk of adverse events, and of contraindications associated with poly-pharmacy (Kroenke & Pinholt, 1990). These findings contrast those of Zhong (2007), who found a slight "pro-rich" inequity in the total number of drugs used among the 65 years and older population in Ontario (with an index of 0.02), and a slightly greater degree of inequity among the working-age population. This latter finding is expected since among this population, there are some individuals who do not have either public or private insurance. However it is possible that recall error in self-reported medicine use, along with the inclusion of over-the-counter medicines, explain the Zhong (2007) findings for the older population. It could also be that this study includes only the top-25 prescribed drugs and not all drugs.

In this study we find that people with lower income make more drug claims than those with higher income, but this income effect is not seen when utilization is measured in terms of total expenditure. Since the total expenditure is restricted to the top-25 drugs, whereas the total number of claims refers to all drugs dispensed, the patterns of prescription drug use by different income groups warrant further attention. There are some additional hypotheses that are worth exploring, such as whether perhaps people with higher income demand more expensive, brand-name drugs (drugs that would be paid for through the public system if they are included in the provincial formulary). Also higher income patients may be more likely to persuade their doctors to prescribe limited use drugs, drugs that are not included in the formulary but may be accessed under special circumstances. Disaggregated analyses by different therapeutic categories could shed some light on these patterns of medicine use. Furthermore, the patterns of out-of-pocket spending could be investigated further to investigate whether cost sharing poses a financial barrier to access among poor individuals whose income is not low enough to be eligible for cost sharing exemptions.

Figures

Figure 1. Number of people excluded in each step of the procedure to create the sample



Tables

Table 1. Matched survey question and claims data for three drug categories

CCHS Survey question: In the past month, did you take …?	Drugs included in ODB database (top 25 prescribed drugs)	Therapeutic drug sub-category
"Medicine for blood pressure"	Enalapril, Maleate, Nifedipine, Ramapril.	Hypotensive drugs
"Medicine for the heart"	Nifedipine, Diltiazem HCL, Amlodipine;	Cardiac drugs
	Simvastatin, Atorvastatin, Rosuvastatin, Enalapril Maleate, Ramapril.	Antilipemic drugs
	Enalapril Maleate, Nifedipine, Ramapril;	Hypotensive drugs
"Stomach remedies"	Omeprazole, Pantoprazole, Rabeprazole, Lansoprazole.	Gastrointestinal drugs

Table 2. Comparison of self-reported and dispensed medicines

Self-reported medication use in the past month (CCHS)		
	N	% total sample
Blood pressure	572	70.1
Heart	320	39.22
Stomach	179	21.94
Medicines dispensed in the past month (ODB)		
	N	%
Blood pressure	338	41.42
Heart	671	82.23
Stomach	144	17.65
Under-reporting (dispensed but did not self-report)		
	N	%
Blood pressure	54	15.98
Heart	388	57.82
Stomach	61	42.36

Table 3. Factors associated with the under-reporting of medicine use among those with prescription drug claims

	Blood pressure		Heart medicine		Stomach remedies	
	ME	SE	ME	SE	ME	SE
Age 70-74	0.095	0.068	0.044	0.058	-0.173	0.125
Age 75-79	0.054	0.061	0.008	0.057	-0.068	0.125
Age 80-84	0.033	0.074	-0.008	0.066	**-0.237**	0.117
Age 85+	0.136	0.101	-0.048	0.083	-0.213	0.152
female	**-0.104**	0.042	**0.172**	0.043	0.041	0.096
prog3 (low income senior)	-0.062	0.040	0.021	0.047	0.061	0.100
sah2 (very good)	-0.055	0.077	-0.056	0.105	**-0.349**	0.148
sah3 (good)	0.042	0.099	-0.165	0.101	-0.282	0.190
sah4 (fair)	0.052	0.100	**-0.243**	0.101	-0.285	0.204
sah5 (poor)	0.229	0.159	**-0.344**	0.100	-0.229	0.210
Number of chronic conditions	-0.018	0.010	**-0.079**	0.011	-0.032	0.023
educ2 (secondary)	**-0.096**	0.039	0.085	0.058	0.090	0.134
educ3 (some post-secondary)	-0.088	0.058	0.027	0.091	0.346	0.164
educ4 (post-secondary)	-0.048	0.040	0.008	0.050	-0.056	0.114
canada born	**0.076**	0.037	-0.038	0.044	-0.136	0.105
total2 (2 or more drugs in past 30 days)	-0.017	0.040	-0.028	0.042	0.056	0.092
Number of observations	338		671		144	
Pseudo R2	0.1197		0.1382		0.0889	
Chi2	**35.55**	0.0033	**126.27**	0	17.44	0.3575

Note: ME is marginal effect, SE is standard error, bold is significant at $p<0.05$; sah is self-assessed health

Table 4. Mean expenditure, out-of-pocket (OOP) expenditure, and number of claims (and standard deviation, SD) by income quintile and by program type

	Total expenditure ($) Mean (SD)	OOP expenditure ($) Mean (SD)	Total claims (number) Mean (SD)
Individual income quintile			
lowest income quintile (mean income $8,494.58)	850.92 (785.31)	43.71 (63.75)	48.19 (91.49)
Q2 (mean $14,602.44)	955.14 (873.84)	49.69 (58.31)	41.88 (48.65)
Q3 (mean $19,926.83)	837.60 (780.81)	70.90 (74.38)	34.78 (42.22)
Q4 (mean $26,970.55)	831.57 (741.51)	75.29 (71.31)	29.40 (34.35)
highest income quintile (mean $50,838.9)	724.40 (642.75)	71.55 (65.73)	25.63 (30.33)
ODB Program			
Low-income senior	884.68 (794.98)	20.55 (36.67)	49.75 (77.04)
High-income senior	812.40 (749.76)	78.34 (70.18)	29.36 (34.16)

Note: the total number of claims includes repeat prescriptions and refills, and covers all claims in the ODB; total and out-of-pocket expenditure is for the top-25 prescribed drugs.

Table 5. The marginal effects of demographic, health and socioeconomic factors on the number of claims, total expenditure on prescription drugs, and out-of-pocket expenditure, and indices of inequality, 2001-2006

	Total claims (ln)		Total expenditure (ln)		OOP expenditure (ln)	
	ME	SE	ME	SE	ME	SE
Demographic and health variables						
Age 70-74	**0.035**	0.014	-0.004	0.017	**-0.095**	0.019
Age 75-79	**0.102**	0.018	-0.003	0.021	**-0.096**	0.023
Age 80-84	**0.200**	0.022	-0.013	0.026	-0.023	0.026
Age 85+	**0.260**	0.028	**-0.064**	0.033	-0.014	0.033
Female	-0.030	0.021	**-0.149**	0.025	**-0.085**	0.022
sah2 (very good)	**0.160**	0.034	**0.090**	0.041	-0.038	0.037
sah3 (good)	**0.305**	0.034	**0.223**	0.040	0.026	0.036
sah4 (fair)	**0.459**	0.037	**0.278**	0.045	0.058	0.040
sah5 (poor)	**0.578**	0.047	**0.264**	0.057	0.064	0.051
limit2 (severe limitation)	**0.137**	0.024	0.027	0.029	-0.001	0.026
Number chronic conditions	**0.102**	0.005	**0.078**	0.006	**0.029**	0.006
Socioeconomic and lifestyle factors						
inc2 (2nd quintile)	-0.001	0.032	0.026	0.039	-0.023	0.035
inc3	0.032	0.034	0.028	0.041	0.016	0.037
inc4	-0.029	0.035	0.046	0.042	0.054	0.038
inc5 (highest quintile)	-0.055	0.036	-0.007	0.043	0.029	0.039
high education	**-0.064**	0.019	**-0.053**	0.023	-0.065	0.021
born in Canada	0.031	0.021	**0.064**	0.025	0.015	0.022
married	**-0.086**	0.020	-0.003	0.025	-0.001	0.022
Current or past smoker	0.014	0.021	-0.029	0.025	0.002	0.023
Overweight	0.010	0.019	**0.052**	0.023	0.032	0.020
Eats veg/fruit 5 per day	-0.006	0.018	0.018	0.022	0.004	0.020
Heavy drinking	**-0.078**	0.032	**-0.105**	0.038	-0.023	0.034
Low-income program	**0.195**	0.025	0.029	0.030	**-1.459**	0.028
Year dummies						
2002	**0.063**	0.011	**0.335**	0.014	**0.187**	0.018
2003	**0.137**	0.011	**0.460**	0.014	**0.328**	0.018
2004	**0.199**	0.011	**0.585**	0.014	**0.433**	0.018
2005	**0.243**	0.011	**0.698**	0.014	**0.492**	0.018
2006 (Jan-March)	(n.a)		**-0.457**	0.015	**-1.150**	0.019
Constant	**2.278**	0.052	**5.477**	0.062	**3.747**	0.057
Indices of inequality	Index	95% CI	Index	95% CI	Index	95% CI
Unadjusted inequality index	**-0.032**	*(-0.035, -0.028)*	**-0.004**	*(-0.004, -0.002)*	0.053	*(0.049, 0.057)*
Adjusted inequality index (Inequity)	**-0.015**	*(-0.018, -0.012)*	**-0.003**	*(-0.005, -0.001)*	**0.054**	*(0.05, 0.058)*

Note: bold is significant at p<0.05; sah is self-assessed health

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