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Does unmet health care lead to poorer health outcomes?*

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Abstract

Using the National Population Health Survey, a nationally representative longitudinal data set spanning 16 years, we analyze if the presence of perceived unmet health-care (UHC) needs affects health outcomes paying close attention to the potential endogeneity of this problem. Five different health-related outcomes are examined. We find clear and robust evidence that the presence of UHC either two-years previously or anytime in the past, affects negatively the current health of the individual – controlling for a host of other influences. The age of the individual does not affect this relationship.

Key words: Unmet health care; health outcomes; instrumental variables; medication use.

JEL Classification: I12; I10; I19.

1. Introduction

A significant proportion of the population across a wide-variety of countries claims to have unmet health care needs (UHC) (OECD, 2011). Why should this matter? In publicly-funded health care systems – where the 'price' associated with consuming health care services is very low – it is likely that some proportion of the population would want more care than is provided by the public system, even though such care may not be considered medically necessary. Certain conditions are untreatable: unmet health care in this case may reflect the limits of medical knowledge. It may also reflect the system kicking into gear: individuals with health problems may report UHC while waiting to receive treatment. If these reasons explain UHC, then perhaps its presence should not be of concern to policy makers.

In privately financed health care systems, the lack of financial resources may hamper individuals seeking care that could improve their quality of life. Individuals reporting UHC would be more likely to experience deterioration in their health status. In publicly financed systems, a high prevalence of UHC may be indicative of an underfinanced or health care system, possibly leading citizens to experience difficulty accessing appropriate care, and increasing the likelihood of a decline in health status. The prevalence of UHC in this case may be indicative of other lacks – such as difficulties accessing prescription drugs – amenable to thoughtful policy reforms.

UHC – and, in particular, increasing prevalence of UHC – should be of concern to policy makers if individuals reporting UHC are more likely to experience deteriorations in their health status than otherwise similar individuals. Therefore, the main research question motivating this paper is: does UHC cause poor health? We investigate this relationship the longitudinal Canadian National Population Health Survey (NPHS), which spans 18 years from 1994 to 2010.

This data set contains a rich set of measures of health outcomes, as well as information on a large number of socio-economic variables, enabling us to study the link between UHC and health while also taking account of time invariant unobserved heterogeneity.

Canada has a publicly funded health care system, and does not require co-payments for doctor or hospital visits. Unlike most other countries with publicly funded systems, however, only the elderly (age 65+) and individuals receiving social assistance have access to publicly funded prescription drugs; a significant proportion of the population does not have insurance coverage for prescription drugs. The period of our study reveals significant uptakes in the proportion of the population reporting UHC – rising from 4% to over 10% between 1994 and 2002. Since 2002, the percentage of UHC has hovered between 9 and 10 percent. Evidence suggests that accessing appropriate care has become more difficult in Canada over the past twenty years: for example, recent Canadian statistics on waiting times for necessary medical care have increased from 9.3 weeks in 1993 to 18.2 weeks in 2013, the longest among developed countries (Bacchus et al., 2014). These stylized facts mean that Canadian data are well suited to testing the hypothesis that UHC causes poor health.

We find clear and robust evidence that individuals who report UHC are more likely to experience a deterioration in their health status than otherwise similar individuals who do not report UHC. The negative impact of UHC persists and remains high even when focus is only on accessibility reasons such as long waiting and unavailable services in the area. The health impact of accessibility barriers is larger for those who do not have a regular family doctor, those who have low household income and for those without drug insurance. The effect of accessibility barriers on health is about the same for those who live in rural areas and urban areas.

2. Linking UHC and Health: What do we know?

The literature captures unmet health care in at least two ways. The first relies on assessments by health care professionals, and defines UHC as "the difference, if any, between the health care service(s) judged to be effective to deal with the health problem(s) a person experiences and the actual health care service they receive" (Carr and Wolf, 1976 p.417). The second relies on individuals' own assessments of the adequacy of the health care received as compared to the health care that they believe they need. Researchers commonly use self-reported measures of unmet health care needs (OECD, 2011), arguably superior to the alternative approach since individuals are better at assessing their own health status (Idler and Bemyamini, 1997) and are better able to identify deficiencies in the health care provided to them (Allin et al., 2010). Most research on UHC, regardless of the specific question of interest, does in fact rely on data on self-assessed UHC.

Research on the impact of UHC on health status is quite limited. An early paper by Alonso et al. (1997) found that unmet health care need (defined as no visits from a physician in the previous twelve months) was associated with an increased risk of mortality in the elderly. Wilson et al. (2007) investigate the factors associated with changes in health status using two rounds of a dataset (2001 and 2003) collected across four different neighbourhoods in Hamilton, Ontario. They use a logistic regression to explore how variables measured in the baseline year (2001) can predict improvements or declines in health status two years later (2003). They identify several characteristics important to predicting improvements in health status: daily smokers, overweight individuals and those reporting dissatisfaction with their health in the initial year are all more likely to report improvements in their health status two years later. UHC was not significantly associated with improvements or declines in health status.

Setia et al. (2012) study the difference between the health status of immigrants and Canadian born individuals using the first six cycles of the National Population Health Survey (NPHS). Using a random effects logistic model to assess the effects of various socio-economic factors on self-assessed health status, including UHC, they find UHC to be positively associated with poor or fair self-assessed health status. By focusing on contemporaneous values for UHC and health in each period, they cannot assess the direction of causality between these two factors.

The impact of unmet health care needs on health care utilisation – rather than health outcomes – is the explicit focus of Ronksley et al. (2013), using data from the 2001 and 2003 cycles of the CCHS linked to national hospitalization data. They focus on individuals with chronic conditions, rather than considering the populace in general. The association between UHC, admissions to hospital, and the length of stay is estimated using a negative binomial regression model, and controls are included for socio-demographic indicators, health behaviors and health status. A logistic regression model estimates the association between UHC, re-admissions and in-hospital deaths. Their results show that, overall, UHC is not associated with higher rates of hospitalization for individuals who suffer from chronic conditions. Notably, individuals who report UHC for availability reasons – that is, problems such as limited resource availability or long waiting times–are found to have a slightly higher risk of hospitalization.

Rupper at el. (2004) use a three-year longitudinal data set for five counties in North Carolina, US, to determine whether self-reported delayed care increases mortality and functional decline among individuals aged 65 and older. They find that neither forgone care nor delayed care is a significant predictor of the three-year mortality rate or of functional decline (developing increased dependency in activities of daily living). In contrast, a more recent Canadian study by Bacchus et al. (2014) uses an ordinary least squares (OLS) model with fixed effects to analyze

aggregate data covering the years 1993 to 2009 and finds a positive association between waiting times for medically necessary treatment and mortality. Their results indicate that an increase of one extra week in the wait time from the date of referral by the general practitioner until receipt of treatment is associated with three extra female deaths per 100, 000 people.

Of related interest, Okumura et al. (2013) analyze the impact of delays in access to care on changes in self-assessed health status for young adults with special needs in the United States. Using data from 2001 and 2007 and focusing on individuals aged 14-17 years old with special needs, they find that those reporting either delayed or forgone care are more likely to experience a decline in their health status.

Little consensus exists in the very limited literature regarding how, or even if, UHC affects health outcomes. This may be attributable to differences in the study populations, to different measures of health outcomes, or to ignoring the endogeneity between health status and UHC. We try to provide a compelling answer to the question regarding the link between UHC and health status by using longitudinal data.

3. Methodology

In economic theory, health is treated as both a consumption good that yields direct satisfaction and utility, and as an investment good that yields satisfaction indirectly through fewer sick days, increase productivity and higher wages (Grossman, 1972). Accordingly, health is considered as a stock (or capital) that depreciates over time, and its rate of depreciation can be attenuated by re-investing in the production of health. Individuals combine time goods (doctor visits, exercise) and market commodities (diet) to produce "health" subject to time and budget constraints. In the theoretical framework, health care services are a form of investment in health.

If individuals are constrained in their ability to obtain needed health care, then UHC potentially reflects a 'negative' investment in health.

A potential consequence of UHC is a change in medication use. If medication use and health care utilization are substitutes, experiencing UHC may lead to a greater reliance on medication. Moreover, delays in receiving care may lead to an increase in anxiety that in turn may increase the future use of medication. If they are complementary, individuals reporting UHC may use fewer medications. Relatedly, the presence of drug insurance has been shown to affect the use of physician services (e.g., Devlin, et al., 2011), hence the negative impact of UHC on health would be larger for individuals without drug insurance compared to those with it, a point to which we return when discussing results.

Equation (1) describes the basic relationship between UHC and health outcomes:

$$h_{it} = \alpha + \delta(UHC)_{it} + \beta(X)_{it} + \varepsilon_{it} \qquad (1)$$

Where h_{it} is the health status of individual *i* at time *t*, UHC_{it} is a dichotomous variable that takes the value one if individual i has unmet health care needs at time t and zero otherwise, X_{it} is a vector of observable characteristics of individual i at time t, l, and ε_{it} is the error term. We consider five different outcomes: self-assessed health status, mental health (no severe psychological distress), the health utility index (HUI3), and two indicators of medication use. The vector X_{it} includes socio-demographic variables (gender, age, education level and marital status), as well as variables such as total household annual income, employment status, immigrant status, the presence of chronic condition, life style indicators (smoking, alcohol drinking and physical activity) and geographic location (urban or rural, and the province of residence).

A challenge in examining the link between UHC and health outcomes is endogeneity. The first potential source of endogeneity is simultaneity. A negative estimated coefficient on UHC does not necessarily mean that it *causes* poor health; poor health might cause UHC. For example, mobility problems might prevent individuals from accessing appropriate care, or individuals with a recently experienced change in health status (for example, the development of cataracts) may find themselves waiting for treatment, possibly for an extended period of time, and therefore report UHC. To address the potential of reverse causality, we use lagged UHC to predict current health: UHC reported in a previous period cannot be affected by health outcomes or the use of medications in the current period.

A second potential source of endogeneity is omitted variable bias. The presence of unobserved individual effects renders standard econometric procedures, like the pooled OLS, probit and Poisson models, inappropriate (Wooldridge, 2010). We expect unobserved individual effects, reflecting heterogeneity across individuals in the probability of being in or maintaining good health. These unobserved factors may arise because of differences in ability, personality, in community or group characteristics, family genetics or in health behaviours, resulting in some individuals in our sample being more or less prone to health deterioration than others. A particularly salient concern is family disease history, which means that some individuals are at an increased risk of developing a particular disease as compared to otherwise identical individuals without such a history. To address this issue, we use a random effects model that controls for time invariant unobserved individual effects along with the other explanatory variables. The random effects model is:

$$h_{it} = \alpha + \delta(UHC)_{it-1} + \beta(X)_{it} + u_i + \mu_{it} \qquad (2)$$

Where, u_i is an unobserved heterogeneity term that represents all other individual-specific effects on health outcome that are not otherwise captured. We employ a random effects OLS model when the health outcome is HUI3, a random effects probit model when the health outcome is the probability of reporting excellent or very good health, good mental health or the use of medications, and finally a Poisson model for the number of medications.

But this static random effects model ignores possible dynamic effects, including the fact that past health status may be an important predictor of current health status, other things being equal. To capture the dynamic effect of past health status on current health status, a lagged dependent variable (dynamic random effects model) approach can be used, whereby:

$$h_{it} = \alpha + \gamma\,(h_{it-1}) + \delta(UHC)_{it-1} + \beta(X)_{it} + u_i + \mu_{it} \qquad (3)$$

Where h_{it} is the health condition of individual *i* at time *t;* h_{it-1} is the health outcome of individual *i* in the previous cycle and γ measures the effect of health status last cycle on the likelihood of having the same health status in the current period); UHC, X, u and μ have the same interpretations as above.

To capture gender difference in the demand for health care, separate models are estimated for females and males. An additional concern is how to introduce appropriate controls for age: aging is associated with increasing morbidity rates and a general deterioration in health outcomes, resulting in lower probabilities of maintaining good health and a higher risk of UHC, particularly for the very elderly. Although we include a quadratic specification by including age and its squared in the models, the concern is that UHC has a different impact on the oldest individuals as compared to the younger ones. Thus, we re-estimate separate models for those younger than 65 years and those older than 65 years and examine the joint effect of UHC on both

the subjective and objective measures of health using both the random effects model and the dynamic random effects model discussed before.

Inadequacies of the public health care system – such as unavailable services, long waiting times, or language and cost barriers – may be important reasons for experiencing UHC (Sibley and Glazier, 2009). We use both the random effects model and the dynamic random effects model to examine further the health impact of UHC when it is due to accessibility reasons such as unavailable services in the respondent's area of residence (defined as urban or rural) or due to long wait times.[2] We also explore possible heterogeneity in the relationship between accessibility problems and health status by examining how the causal effect of accessibility problems varies by location of residence (urban and rural), household income and the availability of a family doctor.

4. Data and Variables

We employ eight cycles (1996/1997- 2010/2011) of the Canadian National Population Health Survey (NPHS), a longitudinal data set conducted by Statistics Canada that collects detailed information about health, health care use and socio-demographic variables from the same sample of households every two years. This survey targets individuals aged 12 or more in all ten provinces, excluding those living in the three territories, residents of health care institutions, Canadian Forces bases and those living on Indian reserves as well as in some remote areas. The panel started in 1994/1995 with 17, 276 participants who were followed for up to nine waves, but we could not use this first cycle because of the wording of some crucial questions.

[2] Accessibility reasons: unavailable in the area, unavailable at the time required, waiting times too long, cost, unable to leave the house because of health problems, and language barriers.

We restrict our attention to respondents aged 18 and older in the first cycle (1996) (lost 2,623 persons), to those who have no missing information on health outcomes and UHC (lost 61,537 person-year observations), and no missing information on all the explanatory variables considered in this analysis (lost 2,804 person-year observations). When we use self-reported health status, mental health, HUI3, and having used medication in the last month as our outcomes, the sample follows 10,346 persons, consisting of 52,638 person-year observations, each observed in an average of 5.1 waves. 3,855 persons (37% of the sample) are observed in all of the seven cycles following 1996/97. When we consider the number of medications used as an outcome, our sample has 9,335 persons, 40,461 person-year observations, each observed in an average of 4.3waves. Since not all respondents reported their household income, we coded those with missing income and kept them in the sample.

Of our five outcomes, three directly measure health: self–assessed health status (SAHS) is the respondents' own assessment of health based on the question: "In general, how would you say your health is?" Respondents assign a value from one to five (representing excellent, very good, good, fair and poor health) to the health status question. A value of one is assigned if the individual responds indicate that they are in fair or poor health and zero otherwise. For mental health, the NPHS uses the Comprehensive International Diagnostic Interview (CIDI) index to measure self-reported psychological distress. We assign a value of one to those with a CIDI score of less than four ('good mental health') and zero otherwise. Note that a CIDI score of four or above reflects psychological distress and is associated with a high probability of clinical depression (Curtis et al., 2009; Kessler et al., 1998; Kessler and Ustun, 2004). Our third health outcome indicator is the Health Utility Index (HUI3) score, a generic measure of health status and health-related quality of life widely used in population health surveys and clinical studies

(Horsman et al., 2003). Respondents evaluate their health along several dimension (hearing, vision, speech, ambulation, dexterity, cognition, emotion and pain) from which the HUI3 is constructed using weights derived from surveys of the general population. The HUI3 scale assigns a value of 1.0 to perfect health and 0.0 to death (http://www.fhs.mcmaster.ca/hug/). Observed HUI3 values will fall between -0.36 to 1.0 where negative values indicate health states which survey data have found to be worse than death (Feeny et al., 1999). Two indirect indicators of health are employed: the number of distinct medications taken in the last two days and a dichotomous indicator taking the value of one if the individual reports having taken at least one medication in the last two days, zero otherwise.

The unmet health care variable comes from the question: "During the past 12 months, was there ever a time when you felt you needed health care but you didn't receive it?" For each cycle, a dichotomous variable captures the individual's experience of UHC in that specific cycle. We focus on two alternative indicators of UHC: the lagged value of UHC (UHC (-1)) and, whether the individual experienced UHC in at least one previous cycle (PUHC). Using information regarding UHC in previous cycles to predict health outcomes allows us to address the problem of potential endogeneity due to simultaneity, and helps us establish causality (Dinca-Panaitescu et al., 2012).

We include a large array of explanatory variables commonly used in the empirical literature on health outcomes (Clark, 2003; Buckley et al., 2004; Buckley et al., 2006; Wang et al., 2010; McLeod, 2011; Sarma et al., 2015). Table 1 defines these variables. The data set provides a measure of household income with respect to the number of household members and provincial standards of living and income ratio deciles.

Table 2 presents some descriptive statistics for health outcomes and medication use in each cycle, for the full sample and then separately for those reporting UHC and those who do not. The first part of the table presents the trends in the main health outcomes over the period 1996 to 2010. One can see an increase in the proportion of individuals who report being in fair or poor health (from 8.5 percent in 1996 to 10.5 percent on 2010) as well as in medication use. The proportion of individuals reporting being in good mental health remained steady as did the HUI3 score over time. we see that individuals with UHC are, on average, more likely to be in fair or poor health, with a lower HUI score, are less likely to be in good mental health and are more likely to use medications in every year, compared to those who do not..

In terms of socio-economic characteristics (table suppressed for space reasons), the mean age in the pooled sample 51 years old. About 54 percent of the sample is female. The majority are married (70%), Canadian born (83%), employed (65%) have at least one chronic condition (71%). Just over half of the sample has completed post-secondary-education (54%) and is physically inactive (51%).

5. The impact of UHC on health outcomes

Table 3 summarizes the estimated impacts of reported unmet health care for 20 regressions: the random effects (OLS, probit or Poisson) and dynamic random effects (OLS, probit or Poisson) models for the five outcomes, including either UHC (-1) or unmet care at any point in the past (PUHC). We also report the estimated predicted probability for our reference individual (identified in table 1: among other things, he is male, aged 51 years, single, Canadian born, has less than high school, is employed, never smoked, is inactive and lives in Ontario). Two broad results stand out from table 3. All estimated impacts of UHC on outcomes, irrespective of how defined, are statistically significant at the 1% level; and the impact of UHC

on our five outcomes is adverse: it negatively affects the three direct measures of health, and it positively affects the two measures of medication use.

For our reference person, individuals reporting UHC in the previous cycle are between 25 percent (0.030/0.12*100: random effects model) and 27 percent (0.032/0.12*100: dynamic random effects model) more likely to be in fair or poor health than an individual who did not report UHC in the previous cycle.[3] The impact of having reported UHC in any previous cycle (PUHC) on the probability of reporting being in fair or poor health is between 35 percent (dynamic random effects model) and 36 percent (random effects model). Reporting UHC in the previous cycle (UHC (-1)) reduces the probability of reporting good mental health by between 1.5 percent (random effects model) and 1.8 percent (dynamic random effects model); it reduces the HUI3 score by between 3.8 percent (dynamic random effects model) and 4.3 percent (random effects model); and UHC (-1) increases the probability of using medications by 1.7 percent (dynamic random effects model) and 1.9 percent (random effects model). UHC (-1) increases the expected number of medications used by between 5.3 percent (IRR=1.053) (dynamic random effects Poisson model) and 6.7 percent (IRR=1.067) (pooled Poisson model) in comparison to those without UHC in the previous period. Similar results arise when we use reporting UHC at least once in any previous cycle (PUHC) in the models.

Table 4 summarizes the estimated impacts of reported unmet health care for 40 regressions: the random effects (OLS, probit or Poisson) and dynamic random effects (OLS, probit or Poisson) models for the five outcomes, for four subsamples. Column one reports the results for females, column two for males, column three for those younger than 65 years and the fourth column presents the results for those aged 65 years and older. Except for the medication

[3] As shown in parentheses, to calculate the percentage change in probit models, we divide the marginal effects by the predicted probability of the reference individual and multiply by 100.

used, the impact of UHC is about the same for females and males. And by comparing the results in the last two columns of table 4, we note that except for HUI3 and number of medications used, the effect of UHC is about the same for both those younger than 65 years and those older than 65 years. The results show that the effect of unmet health care on HUI3 is larger for those aged 65 and older compared to those younger than 65 years. On the other hand, the effect of UHC on the number of medications used does not matter statistically for those aged 65 years and older.

To understand better the channels by which UHC adversely affects health outcomes, we investigate the effect of accessibility barriers to health care. We redefine our unmet health care variable to take on the value one if it was present in the previous cycle *and* it was due to accessibility reasons, and zero if no UHC. The impact of this redefined Accessibility Barriers (-1) variable on health outcomes is reported in the top of table 5, for comparison purposes the effects arising when we use UHC (-1) are reported in the bottom half of that table. These results are largely comparable to the earlier ones except that the adverse consequences from experiencing unmet health care due to accessibility reasons are slightly larger than the consequences arising from reporting UHC for any reason.

Several robustness checks are undertaken. The first two large rows of table 6 examines the sensitivity of our results to sample attrition. We parse the sample into those in all seven cycles following the initial cycle (balanced sample: n= 26,985), and those observed in fewer than seven cycles (unbalanced sample), and re-estimate the models with these subsamples. The impact of UHC is about the same in these two samples, suggesting that our results are not being unduly influenced by people exiting (usually dying or moving abroad) the sample.

Up to now, we have focused on how the current health outcome is affected by UHC in the previous cycle (UHC (-1)) or in any past cycle (PUHC). To examine how health outcomes

are affected by changes in UHC, we include a measure of the change in UHC between two consecutive periods (*t-1, t*) using the random effects and dynamic random effects models. The results are presented in the bottom of table 6. Again, adverse consequences from UHC persist across all five outcomes. We find that compared to those who continue to not experience UHC, the adverse consequences from unmet health care is largest for who continue to experience UHC (UHC (1,1), this is followed by the impact of UHC (0,1) and then by UHC (1,0). This means that while individuals may report UHC while waiting to receive treatment, even after their health needs are met, their health is still, on average, lower than those who never reported UHC.

Table 7 reports three other robustness checks. We split the sample into the top and bottom income groups; those with and without a regular family doctor; and urban-rural dwellers. For space reasons, we present only the impact of Accessibility Barriers (-1) on the probability of reporting fair or poor health using the random effects approach. We find that it is much larger for those in the bottom four deciles of the income distribution when compared to those in the higher deciles. Those without regular family doctor are also affected more by UHC (accessibility) when compared to those who have one. However, whether an individual lives in an urban or rural area, does not seem to affect the link between UHC and health.

Earlier, we mentioned that it was possible that individuals without prescription drug insurance may be in worse health relative to those with insurance. To examine this possibility, and to see whether drug insurance affects the link between unmet health care and our outcomes, we took advantage of information on drug insurance available in the 1996, 1998, 2000 and 2002 cycles of the data set. We parsed the data from these four cycles according to whether or not the individual was insured, and ran the models on these two groups. Table 8 presents the results of the impact of UHC in general and UHC (accessibility) on the probability of being in fair or poor

health in the years 1998, 2000 and 2002, using a Random Effects model. Two points are important. Firstly, UHC and UHC (accessibility) are still an important determinants of reported health; secondly, it is a much more important contributor to health for those without prescription drug insurance than for those with it. We leave pushing further on this question to future research.

6. Conclusions

The media have drawn attention to excessive delays for patients seeking medical care. Not only is there a paucity of research examining whether these delays or the experience of UHC affects health outcomes, but no consensus exists among the handful of studies on this problem. We discern the causal effect of unmet health care on self-assessed health, mental health, HUI and medication utilization, using the longitudinal National Population Health Survey over a 16-year time span (1996-2010).

Irrespective of how we capture unmet health care needs, how we measure health outcomes, or the empirical approach taken, our findings are robust: unmet health care in the past has an adverse impact on current health outcomes, *ceteris paribus*. So now what? These findings mean that measures to combat the presence of unmet health-care needs could have a positive impact on health. In a publicly provided primary health care system as exists in Canadian jurisdictions, however, a certain amount of unmet needs is inevitable and reflects the frictions associated with the system doing its job. But, if there is too much delay for care or not enough access to health-care providers, then our paper shows that adverse health outcomes will arise.

To gain more insight into the problem, we paid close attention to individuals who reported unmet health care needs arising from 'accessibility' problems. This was instructive. For one thing, several policy levers emerge from a careful look at the factors underlying accessibility –

like availability of physicians, wait times and language barriers. We found that the adverse effects from accessibility-related UHC were not distributed evenly across the population: the low-income group were more adversely affected than their high-income counterpart, likewise for those who do not have a regular family doctor relative to those who have one and for those without drug insurance compared to those with drug insurance. From a policy perspective, identifying these heterogeneous effects may help direct measures to particular populations.

Our empirical investigation reveals potential cost savings to the health care system from reducing unmet health care needs – cost savings associated with improved health and reduced medications. Whether or not policy makers 'should' go down this path, however, is a different matter entirely. Several important questions need to be addressed: what is the appropriate wait time for a publicly provided system? How many physicians per capita is ideal? How should we deal with language barriers in a country like Canada with large immigrant communities? Nevertheless, unmet health care needs lead to poorer health outcomes, so addressing these questions is essential.

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Table 1- Variable definitions	
Health outcomes	
Fair or Poor Health (HFP)	Self-assessed health status is measured by the question: "In general, how would you say your health is?" Respondents assign a value from one to five to the health status question, corresponding to excellent, very good, good, fair and poor self-assessed health status. SRH-Fair or Poor =1 if the individual reports fair or poor health status, 0 = otherwise.
Good Mental Health (GMH)	For Mental Health (MH), the NPHS uses the Comprehensive International Diagnostic Interview (CIDI) index to measure self-reported psychological distress. The value one - reflecting 'good mental health' (GMH) - is assigned to those individuals with a score of less than four in this index, indicating that they are not experiencing severe psychological distress; zero denotes those with a score of four or above, reflecting severe psychological distress and a high probability of clinical depression.
Health Utility Index (HUI3)	The observed value is between -0.36 to 1.0: 1.0 indicates perfect health, 0 indicates death, a negative value indicates health states that are worse than death.
Using Medication	1 = individual used any medications in the previous month, 0 = otherwise
Number of Medications	Number of different medications used by the individual in the previous two days.
Unmet Health Care Needs	
Unmet health care (UHC)	Dichotomous variable derived from the question: "during the past 12 months, was there ever a time when you felt you needed health care but you didn't receive it?"
UHC (-1)	1 = individual reported unmet health care in the previous cycle, 0 = otherwise.
PUHC	1 = individual reported unmet health care in any previous cycle, 0 = otherwise.
Accessibility	1= individual reported UHC in the previous cycle and indicated that this was due to a lack of services in their community, due to long waiting time, cost, unable to leave the house because of health problem or due to language barriers, 0= reported no unmet health care
Change in UHC	This variable is measured the change in UHC between adjacent cycles
Remains with UHC	1= if UHC (t-1) =1 and UHC (t)=1
Goes into UHC	1= if UHC (t-1) =0 and UHC (t)=1
Comes out of UHC	1= if UHC (t-1) =1 and UHC (t)=0
Remains no UHC	1= if UHC (t-1) =0 and UHC (t)=0: **Reference**
Demographic	
Age	age in completed years
Age Squared	age squared
Female	1 = female, 0 otherwise.
Married	1 = married or in common relationship, 0 = otherwise
Widow/Separated	1 = widowed, separate or divorced, 0 = otherwise
Single	1 = single never married, 0 = otherwise: **Reference**
Immigrant	1 = individual is immigrant, 0 = otherwise
Canadian Born	1= individual is Canadian born, 0=otherwise: **Reference**
Highest Level of Education	
Less than High School	1 = less than secondary, 0 = otherwise. **Reference**
High School	1 = secondary school diploma, 0 = otherwise
Some Post-Secondary	1 = some post- secondary diploma, 0 = otherwise
Post-Secondary	1 = post-secondary diploma, 0 = otherwise
Household Income Decile	
from lowest, 2^{nd} …,9^{th}, Highest	Nine income ratio dummy variables. The highest income ratio is used as the reference. The household income ratio represents the total household income in relation to the total number of members in the household and standards of living in the province. For more details on household income ratio methodology, see the documentation available at http://www.statcan.gc.ca/imdb-

	bmdi/ocument/3225_D10_T9_V3-eng.pdf.
Not Stated	1= income not stated
Employment Status	
Employed	1 = full or part time employed in the last year, 0 = otherwise: **Reference**
Not-Employed	1 = unemployed in the last year, 0 = otherwise
Not-in Labor Force	1 = not looking for work in the last year, 0 = otherwise
Chronic Condition	
Has Chronic Condition	1 = has a health chronic condition, 0 = otherwise
Health Behaviours	
Drink-Never	1= never drinks alcohol, 0 otherwise: **Reference**
Drink-Regularly	1 = drinks regularly, 0 = otherwise. Regular drinking means the consumption of at least one alcoholic beverage per month in the last 12 months.
Drink-Occasionally	1 = drinks occasionally, 0 = otherwise. Occasional drinking means the consumption of an alcoholic beverage less than once per month (consume less than a bottle) in the last 12 months
Drink-Formerly	1 = drinks formerly, where former drinkers are those who have previously consumed alcohol but did not do so in the previous twelve months, 0 = otherwise.
Smoke-Never	1 = never smokes, 0 = otherwise: **Reference**
Smoke-Daily	1 = smokes daily, 0 = otherwise
Smoke- Occasionally	1 = smokes occasionally, 0 = otherwise
Physically-Active	1 = physically active, 0 = otherwise.
Physically-Moderate Active	1 = moderately active, 0 = otherwise.
Physically-Inactive	1 = physically inactive, 0 = otherwise: **Reference**
Geographic location	
Urban	1= urban; 0 = otherwise
Rural	1 = rural, 0 = otherwise: **Reference**
Newfoundland	1 = Newfoundland, 0 = otherwise
Prince Edward Island	1 = Prince Edward, 0 = otherwise
Nova Scotia	1 = Nova Scotia, 0 = otherwise
New Brunswick	1 = New Brunswick, 0 = otherwise
Quebec	1 = Quebec, 0 = otherwise
Manitoba	1 = Manitoba, 0 = otherwise
Saskatchewan	1 = Saskatchewan, 0 = otherwise
Alberta	1 = Alberta, 0 = otherwise
British Colombia	1 = British Columbia, 0 = otherwise
Ontario	1 = Ontario, 0 = otherwise: **Reference**

Table 2: Mean health outcomes and medication use by UHC- for the full sample over the years (1996-2010)

		1996/97	1998/99	2000/01	2002/03	2004/05	2006/07	2008/09	2010/11	Pooled (1996-2010)	Pooled (1998-2010)
Full Sample	Fair or Poor Health	0.085	0.116	0.115	0.116	0.112	0.106	0.106	0.105	0.105	0.108
	Good Mental Health	0.949	0.944	0.942	0.941	0.951	0.948	0.949	0.946	0.946	0.946
	HUI	0.898 (0.173)	0.892 (0.184)	0.876 (0.201)	0.871 (0.202)	0.863 (0.219)	0.847 (0.240)	0.848 (0.236)	0.877 (0.203)	0.877 (0.203)	0.873 (0.208)
	Using Medications	0.821	0.832	0.861	0.870	0.880	0.893	0.893	0.770	0.850	0.850
	Number of Medications	1.250 (1.546)	1.341 (1.644)	1.580 (2.001)	1.744 (2.044)	1.880 (2.166)	2.045 (2.160)	2.215 (2.409)	2.616 (2.741)	1.897 (2.184)	1.986 (2.255)
UHC=1	Fair or Poor Health	0.254	0.243	0.228	0.229	0.245	0.203	0.216	0.251	0.232	0.230
	Good Mental Health	0.808	0.842	0.843	0.846	0.832	0.862	0.877	0.831	0.842	0.848
	HUI	0.774 (0.281)	0.787 (0.271)	0.790 (0.258)	0.771 (0.277)	0.776 (0.268)	0.776 (0.281)	0.737 (0.299)	0.729 (0.304)	0.765 (0.281)	0.767 (0.280)
	Using Medications	0.912	0.902	0.927	0.925	0.924	0.943	0.899	0.827	0.909	0.910
	Number of Medications	1.608 (1.950)	1.831 (1.872)	1.616 (2.132)	1.954 (2.490)	2.220 (2.512)	2.119 (2.720)	2.479 (2.790)	2.779 (2.670	2.011 (2.421)	2.317 (2.634)
UHC=0	Fair or Poor Health	0.079	0.074	0.106	0.101	0.102	0.102	0.094	0.091	0.095	0.096
	Good Mental Health	0.954	0.956	0.953	0.954	0.952	0.961	0.955	0.960	0.952	0.956
	HUI score	0.906 (0.168)	0.905 (0.162)	0.902 (0.173)	0.888 (0.186)	0.881 (0.191)	0.872 (0.209)	0.858 (0.230)	0.860 (0.226)	0.883 (0.193)	0.883 (0.196)
	Using Medications	0.809	0.816	0.844	0.861	0.861	0.880	0.891	0.762	0.830	0.845
	Number of Medications	1.117 (1.448)	1.215 (1.568)	1.423 (1.873)	1.604 (1.922)	1.741 (2.053)	1.945 (2.313)	2.116 (2.294)	2.527 (2.695)	1.562 (1.980)	1.951 (2.207)

Weighted mean values reported, standard deviation in parentheses.

Table 3: The effect of reporting UHC in previous cycle (UHC (-1)) or at any time in the past (PUHC) on different health outcomes and medication use – all persons

Health outcome, for each methodology	UHC in previous cycle (UHC (-1))	UHC at any time in the past (PUHC)
Random effects model		
Prob. of fair or poor general health (probit)	0.030***	0.043***
	(0.004)	(0.004)
Predicted probability	0.12	0.12
Prob. of good mental health (probit)	-0.014***	-0.017***
	(0.002)	(0.002)
Predicted probability	0.95	0.95
HUI3 (OLS)	-0.037***	-0.054***
	(0.003)	(0.003)
Predicted mean	0.87	0.87
Prob. of using medication (probit)	0.016***	0.019***
	(0.005)	(0.004)
Predicted probability	0.85	0.85
Num. of medications used (poisson)	1.067***	1.114***
	(0.015)	(0.018)
Dynamic random effects model		
Prob. of fair or poor general health (probit)	0.032***	0.042***
	(0.004)	(0.003)
Predicted probability	0.12	0.12
Prob. of good mental health (probit)	-0.017***	0.019***
	(0.002)	(0.002)
Predicted probability	0.95	0.95
HUI3 (OLS)	-0.033***	-0.045***
	(0.003)	(0.002)
Predicted mean	0.87	0.87
Prob. of using medication (probit)	0.014***	0.019***
	(0.005)	(0.004)
Predicted probability	0.85	0.87
Num. of medications used (poisson)	1.053***	1.089***
	(0.015)	(0.015)

Notes: Controls for all variables previously described suppressed for brevity. Robust standard errors are in parentheses. * indicates significant at 10% level. ** at 5% level. *** at 1% level. The average marginal effects are reported (exponential (coefficients) when the outcome is number of medication).

Table 4: The effect of reporting UHC in previous cycle UHC (-1) on different outcomes and medication use – when the sample is parsed by gender and age.

Health outcome, for each methodology	Female	Males	Younger than 65 years	Older than 65 years
	UHC (-1)	UHC (-1)	UHC (-1)	UHC (-1)
Random effects model				
Prob. of fair or poor general health (probit)	0.030***	0.030***	0.022***	0.052***
	(0.005)	(0.006)	(0.003)	(0.016)
Predicted probability	0.13	0.11	0.09	0.22
Prob. of good mental health (probit)	-0.019***	-0.008***	-0.016***	-0.010***
	(0.003)	(0.002)	(0.002)	(0.003)
Predicted probability	0.93	0.96	0.94	0.97
HUI3 (OLS)	-0.036***	-0.038***	-0.030***	-0.074***
	(0.004)	(0.004)	(0.003)	(0.009)
Predicted mean	0.85	0.88	0.89	0.78
Prob. of using medication (probit)	0.006	0.036***	0.016**	0.020**
	(0.005)	(0.011)	(0.006)	(0.010)
Predicted probability	0.90	0.79	0.84	0.90
Num. of medications used (poisson)	1.068***	1.062**	1.071***	1.012
	(0.019)	(0.025)	(0.018)	(0.026)
Dynamic random effects model				
Prob. of fair or poor general health (probit)	0.031***	0.033***	0.026***	0.046***
	(0.006)	(0.006)	(0.004)	(0.015)
Predicted probability	0.13	0.11	0.09	0.22
Prob. of good mental health (probit)	-0.021***	-0.010***	-0.019***	-0.015***
	(0.004)	(0.003)	(0.003)	(0.004)
Predicted probability	0.93	0.96	0.94	0.97
HUI3 (OLS)	-0.031***	-0.035***	-0.026***	-0.059***
	(0.004)	(0.004)	(0.003)	(0.009)
Predicted mean	0.85	0.88	0.89	0.78
Prob. of using medication (probit)	0.006	0.030***	0.013**	0.022*
	(0.005)	(0.011)	(0.006)	(0.012)
Predicted probability	0.90	0.79	0.84	0.90
Num. of medications used (poisson)	1.058***	1.039	1.055***	0.989
	(0.018)	(0.025)	(0.018)	(0.029)

Notes: Controls for all variables previously described suppressed for brevity. Robust standard errors are in parentheses. * indicates significant at 10% level. ** at 5% level. *** at 1% level. The average marginal effects are reported (exponential (coefficients) when the outcome is number of medication).

Table 5: Comparing the effect of UHC in the previous cycle attributed to accessibility barriers, on health outcomes - for each methodology- random effects approach (RE) and dynamic random effects approach (DRE)

Variables	Prob. of fair/poor health		Prob. of good mental health		HUI3 score		Prob. of using medication		Total number of medications used	
	RE	**DRE**	**RE**	**DRE**	**RE**	**DRE**	**RE**	**DRE**	**RE**	**DRE**
Accessibility barriers (-1)	0.032*** (0.005)	0.035*** (0.005)	-0.015*** (0.002)	-0.018*** (0.003)	-0.041*** (0.003)	-0.038*** (0.003)	0.018*** (0.007)	0.017** (0.007)	1.082*** (0.019)	1.063*** (0.018)
Predicted probability/ mean	0.12	0.12	0.95	0.95	0.87	0.87	0.85	0.85		
The effect of Accessibility (-1) barriers in %	27%	29%	1.6%	1.9%	4.7%	4.4%	2.1%	2%		
UHC (-1)	0.030*** (0.004)	0.032*** (0.004)	-0.014*** (0.002)	-0.017*** (0.002)	-0.037*** (0.003)	-0.033*** (0.003)	0.016*** (0.005)	0.014*** (0.005)	1.067*** (0.015)	1.053*** (0.015)
Predicted probability/ mean	0.12	0.12	0.95	0.95	0.87	0.87	0.85	0.85		
The effect of UHC (-1) in %	25%	27%	1.5%	1.8%	4.3%	3.8%	1.9%	1.7%		

Notes: Controls for all variables previously described suppressed for brevity. Robust standard errors are in parentheses. * indicates significant at 10% level. ** at 5% level. *** at 1% level. The average marginal effects are reported (exponential (coefficients) when the outcome is number of medication). RE refers to random effects model and DRE is dynamic random effects model.

Table 6: The effect of UHC on Health Outcomes – robustness tests

		Prob. fair or poor health		Prob. of good mental health		HUI3		Prob. of using medication		Total number of medications used (IRR)	
		RE	**DRE**	**RE**	**DRE**	**RE**	**DRE**	**RE**	**DRE**	**RE**	**DRE**
Observed in all cycles	**UHC (-1)**	0.019***	0.023***	-0.010***	-0.012***	-0.032***	-0.028***	0.016**	0.014**	1.074***	1.059***
		(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.007)	(0.007)	(0.020)	(0.020)
	Predicted Probability	0.09	0.09	0.95	0.95	0.88	0.88	0.86	0.86		
	The effect in %	21%	26%	1.1%	1.3%	3.6%	3.2%	1.9%	1.6%		
Not observed in all cycles	**UHC (-1)**	0.039***	0.038***	-0.019***	-0.022***	-0.043***	-0.038***	0.017**	0.015*	1.061***	1.046**
		(0.007)	(0.007)	(0.003)	(0.004)	(0.004)	(0.004)	(0.008)	(0.008)	(0.023)	(0.023)
	Predicted Probability	0.16	0.16	0.94	0.94	0.84	0.84	0.85	0.85		
	The effect in %	24%	24%	2%	2.3%	5.1%	4.5%	2%	1.8%		
Full sample	**UHC (-1)**	0.030***	0.032***	-0.014***	-0.017***	-0.037***	-0.033***	0.016***	0.014***	1.067***	1.053***
		(0.004)	(0.004)	(0.002)	(0.002)	(0.003)	(0.003)	(0.005)	(0.005)	(0.015)	(0.015)
	Predicted Probability	0.12	0.12	0.95	0.95	0.87	0.87	0.85	0.85		
	The effect in %	25%	27%	1.5%	1.8%	4.3%	3.8%	1.9%	1.7%		
Change in UHC (t-1, t)	**Remain No UHC (Ref)**										
	Goes into UHC	0.061***	0.069***	-0.028***	-0.033***	-0.069***	-0.072***	0.036***	0.037***	1.100***	1.114***
		(0.004)	(0.004)	(0.002)	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.017)	(0.018)
	Remains with UHC	0.081***	0.084***	-0.035***	-0.040***	-0.104***	-0.094***	0.038***	0.036***	1.176***	1.144***
		(0.007)	(0.007)	(0.003)	(0.004)	(0.005)	(0.005)	(0.010)	(0.010)	(0.036)	(0.028)
	Comes out of UHC	0.033***	0.028***	-0.015***	-0.015***	-0.041***	-0.031***	0.018***	0.014**	1.070***	1.063***
		(0.004)	(0.005)	(0.002)	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.017)	(0.017)
	Predicted probability	0.12	0.12	0.95	0.95	0.87	0.87	0.85	0.85		
	The effect in %	51%	57%	3%	3.5%	7.9%	8.3%	4.2%	4.4%		
	The effect in %	67%	70%	3.7%	4.2%	12%	11%	4.5%	4.2%		
	The effect in %	27%	23%	1.6%	1.6%	4.7%	3.6%	2.1%	1.6%		

Notes: Controls for all variables previously described suppressed for brevity. Robust standard errors are in parentheses. * indicates significant at 10% level. ** at 5% level. *** at 1% level. The average marginal effects are reported (exponential (coefficients) when the outcome is number of medication). RE refers to random effects model and DRE is dynamic random effects model.

Table 7: The average marginal effect of UHC in the previous cycle when attributed to accessibility barriers on the prob. of reporting fair or poor health for different groups-random effects approach

Variables	(1)		(2)		(3)	
	Bottom 4 deciles of income	Deciles 5-10 of income	No regular family doctor	Has regular family doctor	Rural	Urban
Accessibility barriers (-1)	0.076***	0.019***	0.027***	0.036***	0.033***	0.034***
	(0.011)	(0.004)	(0.008)	(0.005)	(0.011)	(0.005)
N	18962	32836	5461	46337	9074	42724
Predicted probability	0.19	0.08	0.06	0.13	0.12	0.12
The impact in %	40.0%	23.7%	45%	27.7%	27.5%	28.3%

Notes: Robust standard errors are in parentheses. * indicates significant at 10% level. ** at 5% level. *** at 1% level. A random effects probit is used to estimate the probability of reporting fair or poor health. Accessibility =1 if (UHC is due to accessibility reasons) and 0= if no UHC. All other controls suppressed for brevity. Similar results are obtained when using the dynamic random effects model to estimate (1) and (2), however, the dynamic random effects model does not converge when the sample is parsed by the presence of a regular family doctor.

Table 8: The average marginal effect of UHC (-1) and when UHC attributed to accessibility reasons on the probability of reporting fair or poor health by the presence of drug insurance (using three cycles: 1998, 2000, 2002)- random effects approach

Variables	(1)		(2)	
	No drug insurance	With drug insurance	No drug insurance	With drug insurance
UHC (-1)	0.041**	0.024***	--	--
	(0.019)	(0.006)		
Accessibility barriers (-1)	--	--	0.041*	0.022***
			(0.023)	(0.007)
N	2358	13143	2340	13103
Predicted probability	0.12	0.10	0.12	0.10
The impact in %	34.2%	24.0%	34.2%	22.0%

Robust standard errors are in parentheses; all other controls suppressed for space reasons. * indicates significant at 10% level. ** at 5% level. *** at 1% level. Information on drug insurance is only available for the years: 1996, 1998, 2000 and 2002. Accessibility =1 if (UHC is due to accessibility reasons) and 0= if no UHC.