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**THE DETERMINANTS OF THE PROPENSITY TO RECEIVE
PUBLICLY FUNDED HOME CARE SERVICES FOR THE ELDERLY
IN CANADA: A PANEL TWO-STAGE RESIDUAL INCLUSION
APPROACH**

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**The Determinants of the Propensity to Receive Publicly Funded Home Care Services
for the Elderly in Canada: A Panel Two-Stage Residual Inclusion Approach**

Abstract

Increases in Home Care (HC) services for the elderly have been a policy priority in recent decades. HC services include Home Health Care (HHC) and Homemaking/Personal Support (HM). We explored the interrelationship between receipt of publicly funded HM and HHC, and the determinants of the receipt of each type of services. A household home care decision model was extended, to develop an understanding of the demand for HHC and HM services separately and to include different household arrangements. Individual panel data for those aged 65 and over were derived from 9 biannual waves of the Canadian National Population Health Survey (1994-95 to 2010-11). A Panel Two-Stage Residual Inclusion method was used to estimate the likelihood of the receipt of HC services. Receipt of publicly funded HM is complementary with receipt of publicly funded HHC services after adjusting for functional and health status. Dependence on help with activities of daily living, health status, household arrangement, and income are determinants of the propensity to receive publicly funded HHC and HM services.

JEL Classification: I110; I120; I180

Keywords: home care; elderly; long-term care; public provision; complementary effect; Determinants

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I Introduction

The rising need for home care¹

One anticipated consequence of the aging of societies around the world is an increase in the prevalence of chronic conditions and disability among elderly populations and a higher demand for long-term care (LTC), including home care (HC) services. The shift from institutional care to services provided in the community setting has been a widespread phenomenon in many countries (Anderson, 1997; Bishop, 1999; Guerriere et al., 2001; Miller et al., 2006; Woodcock et al., 2011).

The need for LTC services, and particularly for more HC, is expected to dramatically increase worldwide, at least during the coming four decades (World Health Organization, 2000; Ovseiko, 2007). By 2050, the number of people around the world 80 years of age and older will increase fourfold, and the global dependency ratio for this age group, relative to the ratio for the population aged 15 to 64, will increase more than threefold (Ovseiko, 2007). The provision of social care services for the maintenance of health and lifestyle is likely to grow much faster as a result of populations' aging than the provision of medical treatments by hospitals and doctors (Payne et al., 2007; McGrail et al., 2000). Consequently, the role of HC services will be increasingly important in meeting populations' future needs for care.

The supply of home care services

Public expenditures for home- and community-based services have grown substantially during recent decades, in terms of quantity and as a proportion of health care expenditures. In the United States, Medicaid's HC spending increased from US \$4 billion in 1992 to US \$22 billion in 2007 and

¹The concept of need will be used to relate demand theory to specific aspects of health and health care, as has been done in extensive theoretical work by health economists. Specifically, the concept of need is used here with a more interpretative and value-based meaning, which has been more commonly used to relate economic theory to the health policy debate (Evans, 1984; Morris et al., 2007). This usage contrasts with a more instrumental, practical, or measurement-based concept of need (Culyer, 1995; Culyer, 1998) which is also referred to as the ability to benefit, and which will be used in Chapter 3: Conceptual Framework (p. 38).

grew from 14.5% to 31.6% of Medicaid's total LTC spending over this period (Grabowski et al., 2010). In the European Union, LTC expenditures are expected to grow from 1.3% of GDP in 2007 to 2.9% in 2050 (Scheil-Adlung & Bonan, 2012).

In Canada, inflation-adjusted per capita total spending on home care is estimated to have grown on average 6.1% annually from 1994-1995 to 2003-2004 (from \$54.75 to \$93.60 in constant 1997 Canadian dollars). However, public spending on home care has grown at an annual rate of about five percentage points more than the number of users during the same period (Canadian Institute for Health Information, 2007).

Home Care: An array of different types of services

It is important to note that HC does not imply a single type of service. In this study, the distinction between Home Health Care (HHC) services and Homemaking/Personal Support (HM) services is made. HHC services include nursing care, physiotherapy, nutritional counselling, and other health care services delivered by professional health care staff. In contrast, HM services help people with daily tasks, such as meal preparation, medication reminders, laundry, light housekeeping, shopping, and transportation, with the aim of delaying the provision of institutional LTC (Wilkins & Park, 1998; Kirby, 2002; Colombo, 2011). These are usually referred to as Activities of Daily Living/Instrumental-ADLs (ADL/IADLs). Most HHC services are provided by paid (formal) caregivers (e.g., community nurses), while HM services are provided by either paid or informal, unpaid caregivers (e.g., spouses, family members, or friends).

The distinction between HHC and HM services is fundamental to be considered in any description of the demand for HC services and also in any description of the interaction among HC services from different funding sources. The determinants of the demand for these two types of services may differ, or the importance of their effects may differ, especially considering that the first group in-

cludes health care services, while supports in the second group are primarily social services. The need for these services, access to them, subsidies, and the potential for substitution among public, private, and informal care are expected to show differences when the two types of HC categories are considered, but a high degree of homogeneity is expected within each group.

Despite the differences among home care services, distinctions are often not made in the literature, and particularly not in U.S.-based studies, which usually use the term “home health care” to refer to both health care services delivered at home and homemaking/personal support services. The main reason for this usage is that Medicare and Medicaid do not make a clear distinction between the types of services and fund both types of services for eligible users. However, the possibilities of substitution between formal and informal care are clearly different in the cases of HHC and HM services.

The Home Care System in Canada

At the beginning of the 2000s, estimates suggested that approximately 20% of formal HC services in Canada were privately financed, with the remaining 80% financed by the public sector (Coyte & McKeever, 2001; Laporte et al, 2007). The proportion of public HC funding in Canada devoted to HHC services rather than to HM grew from 43.3% in 1994-1995 to 48.6% in 2003-2004 (Canadian Institute for Health Information, 2007). Of all the care provided at home, an estimated 80% is provided by informal caregivers (Baranek et al., 2004; McGrail et al., 2008).

Under to the *Canada Health Act*, with the exception of physicians’ services, all services provided at the hospital without any cost to the patient are potentially subject to fees in ambulatory settings. This situation generates a conflict when services are transferred from hospitals to homes and community settings.

Across provinces, regional organizations provide a single access point where applicants’ needs

and eligibility criteria are assessed and matched to appropriate services, including home care, supportive living, or long-term care facilities (Canadian Home Care Association, 2008). Until April 2007, all provinces charged fees for HM services, while HHC services were provided with no charge. Consequently, there is an expectation that an income gradient in publicly funded HC receipt may be observed up to that date, but exclusively for HM services. After that, the governments of Ontario, Manitoba, Quebec, and PEI removed the co-pay requirement and currently do not charge any direct fees for HC services. The remaining six provinces, namely, British Columbia, Alberta, Saskatchewan, New Brunswick, Nova Scotia, and Newfoundland, have implemented income-testing procedures for the determination of HC fees. These testing procedures and corresponding differentiated fees may serve as disincentives to demand for services for higher income users and also remove barriers for low-income older adults.

The research objectives and general study design

The primary objectives of this study were to explore the interrelationship between publicly funded HM and HHC services in Canada in terms of potential for complementarity or substitution; and to examine the determinants of the receipt of each type of publicly funded HC services, and how the determinants vary according to the population's need for HC services. Specific research questions were: Are publicly funded home health care (HHC) and homemaking/personal support services (HM) complements or substitutes in the Canadian context? What are the determinants of the provision of publicly funded HC services for the elderly in Canada, including both HHC and HM services? How do socio-economic factors affect the likelihood of the receipt of HC services from different funding sources by older adults in Canada?

With these objectives in mind, in the following section, we first provide background through a scoping review of the national and international HC literature. Section three presents the concep-

tual framework for the study, including the corresponding research hypotheses to be empirically addressed in the current analysis. Section four contains data elements and methods, and is followed by the results presented in section five and discussion in section six. Finally, section seven discusses the main conclusions and implications of this research. The implications of the conceptual framework regarding the interrelationship among publicly funded, privately funded, and informal HC services will be addressed in a subsequent paper.

II Background literature

The Determinants of Home Care Receipt

Age, dependence in ADLs, and health status: The determinants of need for HC services

Certain variables have consistently been described as determinants of HC receipt in studies across different jurisdictions and time periods, while others have appeared to be more context-specific. Among the first group of variables, age and dependence on help with ADLs have been repeatedly reported as factors that increase the receipt of HC services of any type and from any source. Together with health status variables, age and dependence on help with ADLs are generally used to indicate users' need for HC services (Kemper, 1992; Ettner, 1994; Hoerger et al., 1996; Pezzin et al., 1996; Stoddart et al., 2002; van Campen C. & Woittiez, 2003; Van Houtven & Norton, 2004; Meinow et al., 2005; van Campen C. & van Gasteren E., 2005; Guerriere et al., 2008; Blomgren et al., 2008; Hammar et al., 2008; Van Houtven & Norton, 2008; Bonsang, 2009; Coyte et al., 2010).

In the case of health status, there is significant variation in the specific variables utilized in the literature. Among U.S.-based studies, Van Houtven and Norton (2004, 2008) and McAuley et al. (2009) used a self-rated health measure and a list of acute illnesses and chronic conditions, including

heart disease, stroke, diabetes, cancer, arthritis, and incontinence. In the Netherlands, van Campen and van Gameren (2005) included several dichotomous variables that represented the presence of chronic conditions, including physical and mental illness. Stoddart et al. (2002) analyzed survey data from a random sample of 2,000 seniors 65 years of age and older in Bristol, UK, and found that incontinence, problems with eyesight, depression, dementia, falls, and foot problems were significantly associated with more receipt of publicly and privately funded HC services.

Among studies that used Canadian data, Hall and Coyte (2001) analyzed the 1994-95 wave of the National Population Health Survey (NPHS) that was linked to the Ontario Home Care Administration System (OHCAS) database and found that restrictions with ADLs and self-assessed health status were significantly associated with the receipt of publicly funded HC services within a year. Coyte et al. (2006) and Guerriere et al. (2008), who used data from telephone interviews and from the eligibility assessments of recipients of HHC in Ontario between 2003 and 2004, reported a significant effect from the sum total of the number of chronic conditions and the presence of “four or more chronic conditions” on home and community-based private health care expenditures among adults in Ontario who received public HC services. Laporte et al. (2007) performed a population-based study in Ontario, using the 1998 roster of all Ontario residents eligible for provincial health insurance. Using a case-mix system to characterize each individual’s level of morbidity in terms of 12 clinical groupings, they reported that age and co-morbidity were among the best predictors of the probability and intensity of the receipt of publicly funded HC.

Sex as a determinant of HC receipt

The findings generally show that female seniors receive more publicly funded HC services than male seniors. Kemper (1992), who used interviews with disabled older adults with unmet needs for help with ADLs from the Channeling experiment in the United States, reported a higher intensity

of formal and informal HC among female seniors. Van Houtven and Norton (2004, 2008), who used U.S. data from the Asset and Health Dynamics Among the Oldest-Old Panel Survey (AHEAD) and the Health and Retirement Survey (HRS), reported higher Medicare HC expenditures among females. Using data from the 2003 Canadian Community Health Survey, Forbes et al. (2008) reported an increased receipt of publicly funded HC services for females among people with dementia.

Context-specific variations have also been reported. Meinow et al. (2005), studied those 65 years of age and older using the 2002 Swedish National Study of Aging and Care-Kungholmen (SNAC-K) and reported nonsignificant differences by sex in the amount of publicly funded HM services allocated. In a Dutch study, van Campen and van Gameren (2005) found higher publicly funded HM receipt among females and higher HHC receipt among males. In Finland, Blomgren et al. (2008) examined data from the 2000 Health Examination Survey and reported that there were nonsignificant differences by sex among seniors 70 year of age and older in terms of formal and informal HM receipt and intensity of services. Using nationally representative U.S. data from the 2002 and 2003 waves of the Medical Expenditures Panel Survey (MEPS), McAuley et al. (2009) reported no significant variation by sex in the receipt or intensity of formal HC use.

The effect of income on HC receipt

The effect of household income on HC receipt may be expected to vary considerably in the different contexts where studies are developed, for example, in the jurisdictions studied and in the relevant regulations, which change over time. Nevertheless, income has been consistently described as a significant determinant of HC receipt in research across countries, including the United States, European countries, and Canada.

Two U.S. studies by Kemper (1992) and Ettner (1994) reported higher income as being associated with a higher level of formal care and a lower level of informal care. The second study used

data from the National Long-Term Care Survey (NLTC). However, these studies were done at a time when average private payments constituted more than 50% of HC expenditures in the United States. More recently, Van Houtven and Norton, who used a sample of single seniors 70 years of age and older who had living children, reported nonsignificant differences in Medicare HC expenditures according to income or wealth. In this case, merged data from the 1995 wave of the AHEAD and the 1998 wave of the HRS was used (Van Houtven & Norton, 2004). The same authors subsequently reported lower Medicare HC expenditures for higher income seniors when they examined the 1993 and 1995 waves of the AHEAD survey (Van Houtven & Norton, 2008). In another study that used data from AHEAD and HRS, Golberstein et al. (2009) studied the effect of payment caps on Medicare HC programs in the late 1990s and reported that only low-income individuals increased informal care in response to increased restrictions on Medicare HC payments. Using data from the MEPS, McAuley et al. (2009) reported a nonsignificant difference in formal HC receipt in relation to income-related variables.

Among European studies, Kempen and Suurmeijer (1991) in the Netherlands reported higher utilization of publicly funded HC among lower income seniors, within a system that makes copayments proportional to income. In Finland, Blomgren et al. (2008) found an increased level of utilization of publicly funded HC services among higher income seniors, without copayments by users. In Sweden, Meinow et al. (2005) did not find a significant effect of income on allocation of HM hours, within a system that also has no copayments.

In Canada, in a study that used the 1998 roster of all Ontario residents eligible for provincial health insurance, Laporte et al. (2007) reported both higher receipt of and higher intensity of publicly funded HC services among adults with lower socio-economic status (SES). In the latter study, however, individual income data was not available, and a proxy measure was created on the

basis of the proportion of the population in the individual's neighbourhood who lived in low-income households.

The effect of living arrangements

In the literature, the living arrangement has been used both as a determinant of formal HC receipt and as a measure of informal care. In every study cited, living arrangement was used as a predictor of formal HC receipt, which was consistently found to have a significantly positive effect for seniors who lived alone (Kemper, 1992; Coughlin et al., 1992; Ettner, 1994; Forbes et al., 2008; Blomgren et al., 2008). In other cases, the variable selected was marital status, which was found to be negatively associated with receipt of publicly funded HC (Stabile et al., 2006) and with any formal HC receipt (McAuley et al., 2009).

Regarding the use of living arrangement as a measure of informal care, Meinow et al. (2005) found that coresiding seniors in Sweden were allocated significantly fewer hours of publicly funded HM than those who lived alone, according to the explicit allocation criteria for public services. In Finland, Hammar et al. (2008), who used interviews with HC clients in 2001, similarly reported higher levels of publicly funded HM and HHC receipt among seniors who lived alone. In a U.S.-based study among adults 70 years of age and older that used the 1993-2002 HRS, Weaver et al. (2009) studied the possible concentration of the utilization of formal HC and nursing home services at the end of life, and the effect of informal care on this relationship. They represented the availability of informal care by the variables marital status and coresiding with an adult child, and found that this availability of informal care significantly reduced the effect of proximity to death on the use of formal HC and nursing home admission. In addition, other studies recognized the possible differences in relationships between formal and informal HC that occur because of living arrangement, and decided to focus exclusively on single seniors with living children (Van Houtven

and Norton, 2004, 2008; Bolin et al. 2008; Bonsang, 2009; Golberstein et al., 2009).

Other socio-demographic variables

Education was found to be significantly positively associated with receipt of publicly funded HC in a study by Stabile et al. (2006) that used data from the NPHS. However, in other jurisdictions, no differences according to level of education were observed (Van Houtven & Norton, 2004; Larsson et al., 2006; Hammar et al., 2008; McAuley et al., 2009). Stoddart et al. (2002), who used survey data from the United Kingdom, reported that seniors with more years of education received privately funded HC more frequently, and the opposite was found for publicly funded HC, namely, that seniors with less years of education received it more frequently. The latter correlation was significant only among women. Bonsang (2009), in a European study that used the SHARE database, reported no significant effect of years of education on receipt of HHC and paid HM services. However, conditional on receipt, the years of education were found to significantly increase the intensity of the paid HM used.

In terms of ethnicity, Van Houtven, and Norton (2004, 2008) found no differences in Medicare HC expenditures in the United States in either of their studies. Living in a rural location was found to reduce Medicare HC expenditures, but not significantly. In the province of Ontario, Laporte et al. (2007) found a lower propensity for and intensity of publicly funded HC receipt among residents of regions with a higher proportion of recent immigrants. In addition, they reported that higher propensity for publicly funded HC services was associated with a rural residence, but only for long-term HC (17+ weeks) and not for short-term (<13 weeks) or intermediate-term HC. Their work was a multinomial probit analysis relative to the base case of no-HC. Stabile et al. (2006) reported significant differences in the receipt of publicly funded HC across several Canadian provinces. Their study did not explore immigration status, ethnicity, or the location of residence as either rural or

urban. McAuley et al. (2009) reported no significant differences in receipt of formal HC between urban and rural adults, but the intensity of services was significantly lower for rural clients in terms of both publicly and privately funded care. In this last study, ethnicity was not a significant predictor of HC.

The relationship between publicly funded HHC and HM services

As previously mentioned, U.S.-based studies generally do not make the distinction between home health care services and homemaking/personal support services, and they usually use the term “home health care” to refer to both health care and social services delivered at home. In contrast, several European studies acknowledge this distinction. For instance, a study in Sweden by Larsson et al. (2006) , which used two sequential community-dwelling interviews with seniors 80 years of age and older between 1994 and 1996 and also in 2000, reported an increased utilization of publicly funded homemaking services and an increased probability of institutionalization among recipients of informal care provided by noncoresident caregivers. Other studies already cited are Meinow et al. (2005) and Hammar et al. (2008) also conducted separated analysis for HHC and HM services.

The importance of making the distinction between these types of services is supported by findings in recent European research using the SHARE survey, which includes data from 18 European countries on adults 50 and older and their spouses. Two studies using cross-sectional data from 2004 reported that informal care is a substitute for paid domestic help and a complement to nursing HC (Bonsang, 2009) and to appointments with a doctor and hospital visits Bolin et al. (2008). However, the interrelationship between publicly funded HHC and HM services has not been directly explored.

In Canada, a number of studies have made the distinction between HHC and HM services only

for descriptive purposes (Wilson et al., 2005; Coyte et al., 2006; Laporte et al., 2007; Guerriere et al., 2008). Analysis of the separated implications of the receipt of these two types of HC services has not been conducted.

III Conceptual Framework

The Demand for Home Care Services

The demand for health care services is widely accepted as different from the consumption of other economic goods or commodities. This difference is based on four generally described characteristics: (1) the fact that demand for health care is derived from the demand for health, (2) the role of externalities, (3) information asymmetries, and (4) uncertainty with respect to both the need for and the effectiveness of health care (Hurley, 2000). The ascription of these characteristics, which is clearly appropriate in the case of HHC services, is questionable in many cases in relation to HM services, which are social services in their nature rather than health care services. The consumption of HM services generates a direct utility, has fewer information asymmetries than those for the usual health care services, and is less subject to uncertainty with respect to capacity to benefit and effectiveness. Patients use health care services for the sake of their anticipated effects on health status, rather than for their own sake (Evans, 1984). In contrast, all people may benefit directly from receipt of help with their household chores, and demand will be higher if this help is offered free of charge or at a highly subsidized price. Indeed, many households, with or without elderly members, regularly purchase a variety of private cleaning, food delivery, and other housekeeping services. At the same time, it is common for family members to support each other in completing these tasks. Therefore, it is difficult to differentiate between HM services provided informally and common day-to-day arrangements among family members to meet housekeeping requirements.

An additional consideration is that, while formal care, either private or publicly funded, may include HHC and HM services, informal care is limited almost exclusively to HM services. Informal care is generally provided by family and friends, who are not medically trained professionals. Therefore, informal care cannot fully substitute for qualified health care services delivered at home by nurses or therapists. Then there is the fact that HM services may be publicly funded, privately funded, or informally provided, but HHC services in Canada are almost exclusively publicly funded². In the Canadian context, people receive health care services 100% publicly funded under the CHA and cannot purchase them privately; even if HHC is not guaranteed, these services are available free of charge for eligible users (only 0.37% of seniors in the data set for the current study reported receipt of privately funded HHC services). Therefore, the analysis of the interrelationship among services from different sources in this framework will be exclusively focus on HM services.

Additional arguments that must be considered in the analysis of informal HM receipt arise from the existence of a certain quantity of care delivered by family members that will not be replaced by services delivered by third parties, even if these services are available free of charge. This is because of the utility generated by taking care of an ailing or frail family member. The financial and affective reasons for informal care of elders have been raised. The first group of reasons includes the promise of a larger bequest or an inter-vivos transfer of cash, while the second may include reciprocity for past caregiving from parents, a sense of duty, the provision of an example for the next generation, and simple altruism (McGarry & Schoeni, 1997; Norton & Van Houtven, 2006; Van Houtven & Norton, 2008). Brouwer et al. (2005) studied a large sample of Dutch informal caregivers and reported substantial utility in the process of providing care. Almost half of the caregivers reported that there would be a hypothetical reduction in happiness if informal caregiving tasks were handed over to someone else.

²Despite the lack of available information in this regard, the data in the current study supports this statement.

The Framework: Preliminary Considerations

Stabile, Laporte, and Coyte (SLC)'s (2006) family home care decision model, in which households allocate time and financial resources subject to resources and technology constraints, was extended in order to develop an understanding of the demand for HC services.

The first element added to this model is the differentiation between HHC and HM services. The second extension to the model is the consideration of different household living arrangements. The SLC model reflects only decisions made in a two-adult household that includes one care receiver and one caregiver. However, the population under study usually dwells in a variety of household settings. For instance, the NPHS datasets includes an important proportion of seniors who live alone or with other family members (Carriere, 2006; Sarma et al., 2009). Therefore, a lack of consideration of the utility and the constraints of alternative living arrangements will affect the testability of the model in usual data sets and the applicability of the conclusions to corresponding populations. The interrelationship among HM from different sources, as well as other elements in the demand function, will vary according to household arrangements.

In terms of this newly adapted model, for the sake of simplicity, only three scenarios of living arrangements will be considered. The first is a household where one dependent senior lives alone and is in need of support to remain at home (household scenario 1). The second is a household where one dependent senior lives with his or her partner, usually another senior, and the second person is able to provide care to a certain extent (household scenario 2). This scenario includes households where the couple lives with or without other family members. The third is a household where a dependent senior lives without a partner, but with other family members capable of providing informal care (household scenario 3). These are the three most frequent and relevant household arrangements in terms of this analysis. In the current model, when the care receiver lives together

with a partner and with other adult family members, the assumption is that the primary caregiver is the partner. Supporting this assumption, a report from the Health Council of Canada that used data from the Resident Assessment Instrument - Home Care (RAI-HC) obtained from seniors 65 years of age and older who were receiving publicly funded HC in five selected regions in Canada noted that, when a care receiver is married, the primary caregiver is the spouse in 74% of cases, and an adult child in 23% of the cases (Health Council of Canada, 2012). This assumption is also supported by descriptive data in a Dutch study by Brouwer et al. (2005), which found that 61.2% of informal care was provided by a partner and only 19.3% by a child. A partner is generally expected to be an age that is similar to the age of the care receiver, and usually will not need to forgo labour in order to provide care, due to his or her retirement. In the study by Brouwer et al. (2005), caregivers were on average only 6.3 years younger than care recipients. Therefore, in this model, when a partner is able to provide care, the partner will be assumed to be the primary caregiver. The assumption is made that, when both partners are too dependent to provide care to each other, the burden for the family rises significantly, and the probability of institutionalization is high. Therefore, only a reduced number of households will have two highly dependent seniors, either living alone or with other family members.

This framework explains the demand for HC services at the household level, and the implications at the level of population are also discussed.

A Model of a Household Home Care Decision

The utility function for any household where one person is a care recipient is as follows:

$$U(X, L, A, H|\tau) \tag{1}$$

where X represents market goods and services, L represents leisure time, A represents the ability of the care recipient to perform ADLs/IADLs, H represents the health status of the care recipient, and τ represents the household's preferences. A care recipient's performance ability is defined by the production technology:

$$A = A(M_1, M_2, C, N|H) \quad (2)$$

where M_1 is publicly funded HM up to a maximum allocation of \bar{M}_1 , M_2 denotes privately purchased HM at the full market price, C is caregiving time, N represents HHC services up to a maximum allocation of \bar{N} , and H is the care recipient's health status. Note that placing HHC services in the same production technology function as M_1 , M_2 , and C does not imply that they have an equivalent effect on A . A is the ability of the care recipient to perform ADLs, and M_1 , M_2 , and C directly affect ADLs, conditional on the care recipient's health status. In contrast, HHC services (N), that is, health care services delivered at home, will affect ADLs indirectly by affecting the care recipient's health status.

The model assumes that publicly funded HM (M_1) is the same service as privately funded HM (M_2), and the only difference between them is that one is publicly subsidized (by an amount s), while the other is entirely privately funded.

Time and financial constraints are in general satisfied if

$$P_x X + P M_2 + (P - s) M_1 + W C = V + W(T - C - L) \quad (3)$$

where P_x is the unit cost of X , P is the unit cost of private HM, M_2 , $(P - s)$ is the unit out-of-pocket cost of publicly funded HM, M_1 , s is the unit subsidy for public HM care, V is non-wage

income, W is the unit cost of time, and, finally, T is the total time for leisure, caregiving, and labour market work. N does not appear in the budget constraint because in Canada, Medicare provides HHC services free of charge.

The model to this point assumes that the caregiver earns income, and so the opportunity cost of caregiving time is the wage. In a case where the caregiver is retired (i.e., income equals pension plus savings) caregiving time comes entirely out of leisure (i.e., $L = T - C$), so that case is nested within the model. In a case where the household is composed only of a dependent senior living alone, $C = 0$, and there is exclusively a financial constraint.

The household's problem then is to maximize (1), subject to (2) and (3). This constrained optimization can be represented in the Lagrangian below:

$$\begin{aligned} \mathcal{L} = U(X, L, A, H|\tau) + \lambda_1[V + (T - L - C)W - P_X X - PM_2 - (P - s)M_1] \\ + \lambda_2[\bar{M}_1 - M_1] + \lambda_3[\bar{N} - N] \end{aligned} \quad (4)$$

Note that the constraints on M_1 can actually be thought of as Kuhn-Tucker conditions, where λ_2 indicates whether the constraint is binding. If λ_2 is positive, the constraint is binding. If the constraint is not binding, then λ_2 equals zero, and it must be the case that the marginal productivity of M_1 , A_1 , reaches zero at a value of M_1 , less than the constrained level, \bar{M}_1 . The same is valid for the constraint on N , where λ_3 indicates whether the constraint is binding.

The first order conditions for the problem are:

$$\frac{\partial L}{\partial M_1} : U_A A_1 - \lambda_1(P - s) - \lambda_2 = 0 \quad (5a)$$

$$\frac{\partial L}{\partial M_2} : U_A A_2 - \lambda_1 P = 0 \quad (5b)$$

$$\frac{\partial L}{\partial C} : U_A A_C - \lambda_1 W = 0 \quad (5c)$$

$$\frac{\partial L}{\partial N} : U_A A_N - \lambda_3 = 0 \quad (5d)$$

$$\frac{\partial L}{\partial X} : U_X - \lambda_1 P_X = 0 \quad (5e)$$

$$\frac{\partial L}{\partial L} : U_L - \lambda_1 W = 0 \quad (5f)$$

$$V + W(T - L - C) - P_X X - PM_2 - (P - s)M_1 = 0 \quad (5g)$$

$$\bar{M}_1 - M_1 = 0 \quad (5h)$$

$$\bar{N} - N = 0 \quad (5i)$$

The choice variables (M_1 , M_2 , C , N , X , L) are all functions of the exogenous variables in the system. A problem here is that \bar{M}_1 and \bar{N} are not observable, so the estimation will have to be made in terms of observable factors, more specifically, in terms of the actual receipt of the different types of HC services (M_1 , M_2 , C , N).

Implications of the model in Canada that will be addressed in this study

The relationship between publicly funded HM and HHC services

The relationship between publicly funded HM and HHC services is such that receipt of one is not expected to serve as a substitute for receipt of the other. The expectation is to observe that seniors receiving one kind of service also receive the other more intensively, given the fact that the main determinants of receipt of both HM and HHC services are similar and related mostly

to age, dependence on help with ADLs/IADLs, and health status, as described in section three. However, when they are adjusted by functional and health status, they will not necessarily be complementary in their effects. This represents the first testable hypothesis in the model. If receipt of publicly funded HM services and receipt of publicly funded HHC services are complements, then receipt of one will be positively associated with receipt of the other. Given the situation in Canada, namely, a single entry point of access to publicly funded HC services, and the consequently possible simultaneity of eligibility assessment, an observed complementary effect between these services is anticipated. In addition, some Canadian provinces bind the eligibility for homemaking services to the receipt of HHC or personal support services (Ontario Ministry of Health and Long-Term Care (MOHLTC), 2012), a link that is expected to favour the positive association between HM and HHC receipt.

- Research Hypothesis 1: The receipt of publicly funded HHC is complementary with the receipt of publicly funded HM services in the Canadian context; that is, adjusted for health and functional status, publicly funded HHC receipt increases the chances of receipt of publicly funded HM services and vice versa.

The effect of informal HM receipt on the likelihood of receiving publicly funded HM services

Assuming that households fully exhaust their allocation of publicly funded HC services, the effects of receipt of informal care on publicly funded HM receipt, after adjustment for variables reflecting need, will be driven by the impact of this care on supply rather than on demand. The availability of an informal caregiver may influence eligibility for publicly funded HM receipt. When the dependent senior lives with other family members, the observation may easily be made and the conclusion drawn that the need for HM services is lower. For example, if help is needed for meal preparation, the possibility of qualifying for a “meals on wheels” program is higher if a person lives

alone than if he or she lives with a functional partner. Eligibility for help with household chores is also lower if the dependent senior is coresiding with children. In contrast, the availability of informal care from noncoresidents is hard to outline specifically and may be assumed to be lower. Consequently, the availability of informal care from a coresident family member is expected to negatively affect the likelihood of receiving publicly funded HM services. If the receipt of informal care from a coresident family member is a substitute for publicly funded HM, there will be a negative effect of coresidence on the likelihood of receipt of publicly funded HM. These lead to the second testable hypothesis of the model.

- Research hypotheses 2: The availability of informal HM from a coresident family member is a substitute for publicly funded HM services.

A care receiver's living arrangement will be closely related to the availability of help with ADLs, and therefore to his or her performance ability, A. Therefore, household arrangement may be considered a proxy for informal care (C) from coresident caregivers. As previously described, assessments by public agencies of the need for help with ADLs will consider the availability of informal care from coresident caregivers, and this consideration will affect the allocation of publicly funded HM (\bar{M}_1). Therefore, household arrangement may be used to test hypothesis 2. If informal HM services from coresident family members substitute for publicly funded HM services, living in a shared household arrangement will be negatively associated with the likelihood of receiving publicly funded HM services.

Other determinants of the propensity to receive HC services

The allocation of publicly funded HC services is expected to be determined mostly by variables that reflect need (age, disability, dependence on help with ADLs, and chronic conditions), which are represented in this conceptual model by health status (H). However, certain additional factors

affecting the eligibility for these subsidized services are anticipated. First, and as was presented earlier as the first testable hypothesis, there is an expectation that publicly funded HHC will be a complement of publicly funded HM services, due mainly to simultaneous eligibility. Second, income is a constraint in the theoretical model, and so an effect of income on eligibility for publicly funded HM services is expected, due to scaled out-of-pocket contributions based on income assessments implemented in all Canadian provinces during the study period. In addition, the probability of using privately funded HM service is expected to be higher for higher income seniors who are better able to afford these private services and who face copayments for the public alternative. In contrast, HHC services are available free of charge in every Canadian province, so an effect of income is not expected to be observed.

- Research hypothesis 3: Age, dependence on help with ADLs, and health status are positively associated with the propensity to receive publicly funded HHC and HM services.

- Research hypothesis 4: Income is negatively associated with the receipt of publicly funded HM services, but not with the receipt of HHC services.

IV Methods

Data and study population

Data for this study were derived from the household component of the National Population Health Survey (NPHS) held by Statistics Canada. The NPHS is a nationally representative longitudinal survey that collected data biennially from the same cohort of individuals over time. It contains a comprehensive array of health status, socio-demographic, and health care utilization information, including HC services. A panel of approximately 17,000 people was followed for 18 years. Cycle 1 (1994-1995) was conducted primarily through personal interviews at the selected

dwellings. Data for subsequent cycles was collected mainly by telephone (Statistics Canada, 2010).

All nine waves of the NPHS were used for this study, covering the period from 1994-95 to 2010-11. The sample size ranged between 2,302 and 2,585 per wave, with an approximate total of 7,255 subjects included the study, and each one observed in 3.1 waves on average. A total of 22,490 observations were included in the analysis.

The study population was defined as people 65 years of age and older, who were residing in the community in one of the 10 Canadian provinces for at least one year during the study's time frame. Individuals who turned 65 years of age during the course of the 16 years of observation were included for the waves in which they met the inclusion criteria. Individuals with incomplete follow-up information or who died were included in the waves in which data were available. This was therefore an unbalanced panel data set.

Outcome Variables

The outcome variables of the study were dichotomous ones that indicated a report of the receipt of publicly funded HC services. The corresponding question in the NPHS questionnaire is as follows: *“Home care services are health care or homemaker services received at home. Examples are: nursing care, help with bathing or housework, respite care and meal delivery. Have you received any home care services in the past 12 months with the cost entirely or partially covered by government?”* (Statistics Canada, 2010).

Subsequently, the NPHS inquires about the type of services received and allows for more than one positive answer among the following eight categories: nursing care, other health care services, personal care, housework, meal preparation or delivery, shopping, respite care, or other. The following outcome variables were generated:

(a) *Receipt of publicly funded HHC services:* value = 1 if there was a report of the receipt of nursing

care and/or other health care services; value = 0 otherwise if not omitted.

- (b) *Receipt of publicly funded HM services*: value = 1 if there was a report of the receipt of personal care, housework, meal preparation, or delivery, shopping, and/or respite care; value = 0 otherwise if not omitted.

Explanatory Variables

Household arrangement

Household arrangement was used as a proxy for informal care, using a three-level categorical variable, for living “*alone*”, living with a “*partner*” (married, common-law, or long-term partner), and living with other adults, but not with a partner (*other_adult*). The cases when seniors were living with a partner and with other family members were included in the category “*partner*”. These categories were chosen on the basis of the conceptual model and according to frequency distribution.

Interaction terms between sex and living arrangement were tested. This step was taken on the basis of evidence that men receive more informal care from their partners than women do (Lilly et al., 2007), and on the basis of observed sex differences in social vulnerability and the associated risks for adverse health outcomes (Maxwell et al., 2009). Only an interaction term between “*sex*” and “*partner*” was included in the final model.

Income effect

Among the determinants of the propensity to receive HC services, there was a particular interest in observing a potential gradient of HC receipt according to household income. A categorical variable indicating income adequacy was included as a regression predictor. The variable considers the household income adjusted for the number of household members. A three-level category was used: low, middle, and high income adequacy. Grouping criteria were according to the frequency distribution of the survey variable³.

³The variable was created from the five categories of income adequacy in the variable INCnDIA5 of the NHPS (Statistics Canada, 2010) and collapsed into three categories: low income-adequacy (less than \$15,000 & 1-2 persons,

Trends of HC receipt over time

The “*wave*” variable included in each one of the adjusted panel data models was used to observe trends in the propensity to report receipt of HC of each type over the study time frame and the trend’s statistical significance, adjusted by covariates.

Health status and disability

Health status was measured using dichotomous variables for several chronic conditions that may have important impacts on health status and on the need for HC services: diabetes, arthritis, heart disease, stroke, Alzheimer’s disease or other dementia, emphysema, cancer, and urinary incontinence. The presence of multiple chronic conditions was considered through the inclusion of a binary variable if the individual indicated more than three chronic conditions. A dichotomous variable was created to indicate overnight stays in a hospital in the last 12 months.

The presence of disability was taken directly as a dichotomous variable from the NPHS survey, which asked if respondents had any long-term disabilities or handicaps.

Dependence on help with ADLs

The NPHS measures need for help with five different ADLs. A four-level categorical variable was created as follows:

- (a) *High-dependence*: need for help with preparing meals or with personal care (such as washing, dressing, or eating) and/or moving around inside the house.
- (b) *Middle-dependence*: no need for help with the previous two ADLs, but need for help with shopping for groceries or other necessities, and/or with doing normal, everyday housework.
- (c) *Low-dependence*: no need for help with the previously mentioned four ADLs, but need for help

or less than \$20,000 & 3-4 persons, or less than \$30,000 & 5 or more persons), middle income-adequacy, and high income-adequacy (\$30,000 or more & 1-2 persons, or \$40,000 or more & 3-4 persons, or \$60,000 or more & 5 or more persons). All values indicate annual income and Canadian dollars.

with heavy household chores.

(d) *No-dependence*: no need for help with any of the above-mentioned ADLs.

These categories were chosen from a number of competing approaches after data variation was considered.

Other independent variables

Additional explanatory variables included the following demographic variables: age, sex, member of an ethnic minority, identification as an immigrant, education, residence in an urban or rural location, and dummy variables for the province of residence at the point of inclusion in the sample. Age was defined in years, and other measures were dichotomous.

The ethnic minority dichotomous variable was created according to the definition contained in the *Canadian Employment Equity Act* (Canadian Minister of Justice, 1995) and utilized by Statistics Canada and other Canadian researchers in this field (Statistics Canada, 2003; Statistics Canada, 2005; Abada et al., 2007)⁴. Education was measured using a dichotomous variable for incomplete secondary education or lower vs. completed secondary education or higher.

The inclusion of variables in the model was guided by the elements contained in the conceptual framework. Alternative variable types and their different impacts on the model, and also interaction terms and collinearity were explored. For model selection criteria, an Akaike's Information Criterion (AIC) was used.

A variable measuring social support was included, with the objective of capturing some elements of emotional support and the strength of social networks provided by family and community

⁴In the Canadian Employment Equity Act (current to March 10, 2010) the category "members of visible minorities" includes "persons, other than aboriginal peoples, who are non-Caucasian in race or non-white in colour." Statistics Canada uses an operative definition of visible minority populations that includes Chinese, South Asian, Black, Filipino, Latin American, Southeast Asian, Arab, West Asian, Korean, Japanese, visible minority "not included elsewhere," multiple visible minority, and not a visible minority (Statistics Canada, 2008).

members, which are not defined as essential elements of informal caregiving, but which may affect the vulnerability of older adults and consequently increase or decrease the likelihood of the receipt of HM services. The social support variable included in the model was categorical, derived from a 16-category index in the NPHS data set, with *low social support* for categories 0 to 5 of the NPHS, *middle social support* for categories 6 to 10, and *high social support* for categories 11 to 16.

Regarding health status, one of the strengths of the NPHS is the availability of information about numerous diagnostics and health conditions, which allows this effect to be appropriately addressed in the adjusted model. Several approaches were considered and tested. Despite the use of self-assessed health status in the SLC paper (Stabile et al., 2006) among others, it was not the preferred approach here, because it represents the aggregated effect of chronic conditions that could be captured in a specific way in this case. In addition, self-perceived health status is affected by many other factors that were not of interest in this part of the analysis. For instance, social and emotional support from family and community members has an impact on health status, but such support was captured through other variables in this analysis. Self-assessed health status also showed considerable collinearity with dependence on help with ADLs. In addition, there is an expected retroactive positive effect of HC receipt on self-perceived health status, which creates the potential for endogeneity. Finally, self-assessed health status showed high collinearity with the number of chronic conditions, providing another reason not to include it. The primary selected approach was to use the diagnosis of specific chronic conditions that have a high impact on functional ability or that generate a need for health care services that may potentially be met at home. This list of selected diagnostics was also guided by the variables described in the literature review and their considered prevalence in the older population. It is important to highlight the particular importance of adequate adjustment for the effect of health status in an exploration of the interrelationship

among different sources of HC services. It is evident that sicker and more dependent seniors receive more care. If substantial components of the differences in health status are not captured by the model, the effect will be an overestimation of the complementary effect of different types and sources of care.

Although many of the individual chronic conditions showed nonsignificant coefficients, the model fit was superior, as compared to approaches that used only grouped chronic conditions. This situation increases the explanatory power and generates more accurate estimations of the interaction among the main variables in the analysis. At the same time, this approach also revealed a significant overall effect of health status on receipt of HC services, in accord with the expectations in hypothesis 3.

Statistical Analysis

In the basic model, first, receipt of HHC services was modelled as a function of HM services and other explanatory variables. Simultaneous eligibility for HHC and HM services may possibly produce a problem of endogeneity when modelling the effect of one over the other, causing biased results due to the correlation of these predictors with the error term. Given these concerns, an instrumental variable (IV) approach was tested, using lagged values of HM services and other IVs.

Given the presence of binary outcome variables in this analysis, usual two-stage least square methods are unsuitable. Instead, a Two-Stage Residual Inclusion method may be adopted. This approach has been used in health economics to address endogeneity issues through the use of IVs in nonlinear models (Rivers & Vuong, 1988; Terza et al., 2008; Van Houtven & Norton, 2008; Bonsang, 2009). In the present analysis, however, we applied these methods to the analysis of a panel data set. Under these conditions, the need to account for the time-invariant component of the error term made the use of these nonlinear regression models unsuitable. Panel nonlinear regression

models have the problem that they do not support two-stage methods, at least in the usual statistics packages, such as Stata. Van Houtven & Norton (2008) performed a two-stage residual inclusion model with repeated observations (only two waves) using instrumental variable probit (ivprobit) in Stata. If these authors' approach is chosen, the problem of an invariant component of the error term across repeated observations remains unresolved, especially in this case, with nine waves of panel data. In addition, "ivprobit" requires the endogenous variable to be continuous, which was not the case in the current study.

Panel Two-Stage Residual Inclusion

To address this problem, an original approach was used, referred to as the Panel Two-Stage Residual Inclusion model. We first specified a reduced form, first-step equation for each wave of the data set separately. Using logistic regression, we predicted the values of the endogenous variable, HM, as a function of its lagged values, Alzheimer's disease, social support, and other explanatory variables and, from that process, obtained the residuals predicted for each wave. Then, we predicted the values of the endogenous variable, HHC, as a function of its lagged values, cancer, hospitalization, and other explanatory variables, and obtained the residuals predicted for each wave. We used second lag values to avoid correlation with the error term in the second-stage equations.

The reduced form equations were as follows:

First-stage equations

For the receipt of HM services:

$$\hat{hm}_t = \gamma_1 + \gamma_2 hm_{t-2} + \gamma_3 alzheimer_t + \gamma_4 social_low_t + \gamma_5 social_high_t + \gamma_6 z_t$$

for $t =$ waves 3, 4, 5, 6, 7, 8, 9 of the NPHS⁵

where hm is receipt of publicly funded HM and z represents exogenous predictors (*age, sex, in-*

⁵The use of second lagged values in the first-stage equations requires missing waves 1 and 2 in the instrumented model.

come, education, minority, immigrant, urban, partner, other adult, province, emphysema, diabetes, heart disease, stroke, incontinence, arthritis, disability, dependence, over 3 chronic conditions). The instrumental variables used exclusively for HM were second lagged values of HM receipt, Alzheimer’s disease, and social support. The residuals may be defined as:

$$\hat{r}_t^{hm} = hm_t - \hat{hm}_t$$

for $t =$ waves 3, 4, 5, 6, 7, 8, 9 of the NPHS where \hat{r}^{hm} are predicted residuals of HM.

For the receipt of HHC services:

$$\hat{h}hc_t = \gamma_1 + \gamma_2 hhc_{t-2} + \gamma_3 cancer_t + \gamma_4 hospital_t + \gamma_4 z_t$$

for $t =$ waves 3, 4, 5, 6, 7, 8, 9 of the NPHS

$$\hat{r}_t^{hhc} = hhc_t - \hat{h}hc_t$$

where \hat{r}^{hhc} are predicted residuals of HHC.

Second-stage equation

For the second-stage equation, panel logistic regression (“xtlogit” in Stata) with random-effects was used to specify receipt of HHC as a function of HM and other explanatory variables, and the residuals were included to correct for the endogenous estimators. Standard errors were estimated by bootstrapping. The second-stage HHC equation estimated was as follows:

$$hhc_t = \beta_1 + \beta_2 hm_t + \beta_3 z_t + \beta_4 cancer + \beta_5 hospital + \beta_6 wave + \hat{r}_t^{hm} + \epsilon \quad (5)$$

$$hm_t = \beta_1 + \beta_2 hhc_t + \gamma_3 alzheimer_t + \gamma_4 social_low_t + \gamma_5 social_high_t + \beta_3 z_t + \beta_4 wave + \hat{r}_t^{hhc} + \epsilon \quad (6)$$

The significance of residual terms included in the second-stage equations was taken as a test for endogeneity (Hausman, 1978). To test the strength of the instrumental variables, nonlinearity

prevented us from observing the F-test statistics. Instead, we tested the combined effect of the instrumental variables on the endogenous variable in the reduced form equations through chi-square tests. We also checked the increase in standard error, as compared with the noninstrumented model. For model selection criteria, an Akaike's Information Criterion (AIC) was used. A Hausman test was used to select random over fixed-effects.

Testing alternative specification models

To assess the robustness of the model, all the results obtained from the second-stage panel logit specification were compared with an equivalent analysis using panel probit and Generalized Estimating Equations (GEE) specifications in the second-step equations. The GEE method (Zeger et al., 1988; Hanley et al., 2003) supports modelling the survey weights used for the sampling strategy, and therefore weights were included in that model. In addition, the results obtained from the Panel Two-Stage Residual Inclusion approach were compared with those obtained from a two-stage predictor substitution model. In a way that was similar to the operation of the selected model, predictors of the endogenous variables were generated from the reduced form equations in every wave and then used to substitute the endogenous variables in the second-stage panel logit equations. Finally, we compared the results with those obtained from a noninstrumented panel logit approach.

Although it was not the preferred approach for the reasons described above, an instrumental variable probit (ivprobit) model was tested for comparison purposes. This model allows direct inclusion of the lagged values instrumental variables, automatically calculating the two-stage residual inclusion model, although it is not suited for repeated measures in panel data sets.

In general, for all the analyses performed, results were reported if a 10% significance level was achieved.

Software and Ethics Approval

All statistical analyses were performed using STATA 12.0 (StataCorp, 2011). Ethics approval for this research was granted by the Health Sciences Research Ethics Board (REB) of the University of Toronto (Protocol Reference # 27512, April 5, 2012).

V Results

*Descriptive results*⁶

The following results are presented using the total number of observations as the denominator, after adjusting by survey weights. A summary of the descriptive results is presented in Tables 1 and 2.

Table 1: Receipt of publicly funded HC in Canada - Trends

1994 to 2011	Total	1994- 95	1996- 97	1998- 99	2000- 01	2002- 03	2004- 05	2006- 07	2008- 09	2010- 11	Average inter- wave variation
Any HC	10.7%	10.6%	10.2%	12.0%	11.5%	10.5%	10.1%	10.5%	10.2%	10.6%	-0.06%
HM	7.9%	8.2%	7.8%	9.2%	8.7%	8.3%	6.9%	6.5%	7.7%	7.5%	-0.06%
HHC	4.9%	3.1%	4.5%	5.4%	5.4%	4.8%	5.2%	5.8%	4.5%	5.4%	0.20%

The proportion of seniors in the sample who reported receipt of publicly funded HC services was 10.7%, with 7.9% receiving HM, 4.9% HHC, and 2.1% both (Table 1). Regarding living arrangement, 53.4% of the sample lived with a partner, 10.8% lived without a partner but with another adult, mostly children (*other_adult*), and 6.3% lived with both a partner and other adults. A total of 35.8% lived alone (Table 2). The proportion of seniors living alone was higher among those who received publicly funded HM services (54.3%), as compared with those not receiving HC (31.6%), whose coresidence with a partner or children or other family members was higher. An income gradient for HC receipt was evident in the univariate analysis, with higher proportions

⁶Descriptive results are presented weighted.

of low-income seniors among those receiving HM, and more high-income seniors among those not receiving publicly funded HC. Comparative descriptive statistics are detailed in Table 3.

The average change in the proportion of seniors reporting receipt of HC services from one wave to the next was calculated (Table 1). During the study's time frame, HM receipt showed an inter-wave reduction of 0.06 percentage points on average, while HHC receipt increased 0.20 percentage points on average. The total number of reported HC recipients dropped between waves 0.06 percentage points on average from 1994-95 to 2010-11.

The burden of disease and dependence on help with ADLs was observed as increasing during the study's time frame, and this increase may be interpreted as an increasing need for HC services. The proportion of seniors reporting a need for help with ADLs was 43.8% during the second half of the study (2002-03 to 2010-11), as compared with 36.3% during the first half (1994-05 to 2000-01), and the average number of chronic conditions rose from 2.26 during the first half to 2.85 during the second time period. Comparing the same subsamples, the mean age increased from 74.0 to 75.4 years.

Table 2: Descriptive statistics of the variables included in the adjusted analysis

Number of observations	22,490		
Number of subjects	7,255		
HC	10.7%	Social support	
HHC	4.9%	Low	4.7%
HM	7.9%	Middle	12.1%
HHC & HM	2.1%	High	83.2%
Age	74.8 ± 7.2	Need help	40.4%
Sex (male)	41.6%	Moving inside the house	6.0%
Urban	84.0%	Preparing meals	9.3%
Ethnic minority	15.4%	Personal care	8.9%
Immigrant status	24.4%	Shopping	15.7%
Living arrangement		Cleaning the house	17.0%
Living alone	35.8%	Heavy household duty	38.2%
Living w/partner	53.4%	Dependence	
only w/partner	47.1%	No	59.6%
with partner & other adult	6.3%	Low	18.2%
Living w/other adult	10.8%	Middle	10.7%
Secondary education completed or higher	55.7%	High	11.5%
		Health status variables	
Income adequacy		Any chronic condition	87.7%
Low	17.5%	Number of chronic conditions	2.6 ± 2.0
Middle	37.7%	0	12.7%
High	44.9%	1-3	59.6%
Province		> 3	27.7%
NF	1.6%	Hospitalization	11.8%
PEI	0.4%	Disability	29.6%
NS	3.1%	Diabetes	14.2%
NB	2.6%	Arthritis	46.9%
QC	23.1%	Heart Disease	18.0%
ON	39.7%	Stroke	5.0%
MA	3.8%	Alzheimer's	3.6%
SK	3.2%	Emphysema	5.9%
AL	8.5%	Cancer	5.0%
BC	14.0%	Incontinence	10.8%

Table 3: Comparative descriptive statistics by categories of HC receipt

		HM	No HM		HHC	No HHC	
Age		80.2 ± 0.17	73.9 ± 0.05	***	78.1 ± 0.23	74.2 ± 0.05	***
Sex (male)		32.9%	42.9%	***	40.6%	42.2%	
Minority		14.3%	15.6%		12.2%	15.6%	**
Immigrant		21.0%	24.8%	**	22.6%	24.6%	
Alone		54.3%	31.7%	***	43.9%	32.9%	***
Partner		36.0%	57.1%	***	43.5%	56.0%	***
Other_adult ^a		9.7%	11.2%		12.7%	11.0%	
Education ^b		50.0%	56.2%	***	47.6%	56.1%	***
Income ^c	Low	30.0%	15.3%	***	23.0%	16.1%	***
	Middle	43.2%	37.3%	***	47.3%	37.3%	***
	High	26.8%	47.4%	***	29.8%	46.6%	***
Urban		81.6%	83.9%	**	82.9%	83.7%	
Dependency	No	8.4%	64.0%	***	18.5%	61.7%	***
	Low	14.9%	18.5%	**	14.3%	18.4%	**
	Middle	25.6%	9.4%	***	19.7%	10.3%	***
	High	51.1%	8.1%	***	47.5%	9.6%	***
Over 3 chronic conditions		50.1%	25.8%	***	51.4%	26.6%	***
Disability		63.5%	25.1%	***	59.1%	26.6%	***
Diabetes		22.9%	13.2%	***	24.0%	13.5%	***
Heart disease		31.7%	16.2%	***	35.3%	16.5%	***
Stroke		13.6%	3.6%	***	13.4%	3.9%	***
Arthritis		64.0%	45.0%	***	61.2%	45.7%	***
Alzheimer's		7.0%	1.4%	***	6.4%	1.6%	***
Emphysema		12.4%	5.3%	***	11.7%	5.5%	***
Cancer		8.0%	4.7%	***	13.7%	4.5%	***
Incontinence		19.4%	8.3%	***	20.8%	8.5%	***
Hospitalization		39.3%	13.8%	***	58.4%	13.6%	***
Social support	Low	10.4%	5.5%	***	6.8%	5.8%	
	Middle	17.1%	12.6%	**	15.1%	12.8%	
	High	72.5%	81.9%	***	78.2%	81.4%	

* Significant at the 10 percent level. ** Significant at the 5 percent level. *** Significant at the 1 percent level.

^a Living without a partner but with other adult(s).

^b Secondary education completed or higher.

^c Household income adequacy (adjusted by household members).

Table 4: HM and HHC receipt - Second Stage Panel Logit Analysis

Dependent Variable →	HM		HHC		
	Panel 2SRI ^a		Panel 2SRI ^a		
	OR (SE)	P	OR (SE)	P	
HM	–	–	3.848 (.982)	0	
HHC	13.71 (5.24)	0	–	–	
Res. Pub. HM	–	–	1.130 (.074)	0.062	
Res. HHC	.944 (.103)	0.595	–	–	
Wave	.909 (.030)	0.004	.951 (.038)	0.212	
Income ^b					
	Low	1.230 (.222)	0.252	1.390 (.262)	0.08
	High	.541 (.099)	0.001	.635 (.107)	0.007
Education ^c		1.279 (.210)	0.133	1.001 (.163)	0.997
Age		1.107 (.017)	0	1.015 (.016)	0.328
Sex (male)		1.872 (.428)	0.006	1.550 (.314)	0.03
Partner		.805 (.215)	0.417	.854 (.227)	0.553
Other_adult		.399 (.122)	0.003	1.309 (.357)	0.323
Sex*partner		.232 (.085)	0	.820 (.304)	0.591
Minority		.718 (.208)	0.254	.720 (.188)	0.208
Immigrant		.545 (.121)	0.006	.929 (.193)	0.721
Urban		.765 (.139)	0.141	.846 (.201)	0.482
Province ^d					
	NF	.212 (.106)	0.002	.201 (.114)	0.005
	PEI	.704 (.234)	0.291	.277 (.157)	0.024
	NS	.856 (.281)	0.636	.273 (.092)	0
	NB	.986 (.275)	0.961	.299 (.116)	0.002
	QC	.428 (.112)	0.001	.970 (.240)	0.903
	MA	.676 (.203)	0.191	.464 (.186)	0.055
	SK	.748 (.225)	0.335	.595 (.209)	0.14
	AL	.546 (.175)	0.059	.699 (.197)	0.205
	BC	.979 (.285)	0.943	.282 (.109)	0.001
Dependence ^e					
	Low	3.870 (.640)	0	2.061 (.425)	0
	Middle	13.39 (2.817)	0	3.529 (.791)	0
	High	36.52 (9.27)	0	4.410 (1.126)	0
Disability		1.545 (.234)	0.004	1.186 (.190)	0.287
Over 3 chronic conditions		.910 (.157)	0.584	1.233 (.232)	0.266
Diabetes		1.351 (.329)	0.218	1.198 (.229)	0.345
Heart disease		1.183 (.201)	0.323	.987 (.201)	0.949
Stroke		1.292 (.300)	0.271	1.499 (.356)	0.088
Arthritis		1.172 (.196)	0.344	1.093 (.188)	0.606
Emphysema		1.191 (.285)	0.465	.701 (.176)	0.158
Incontinence		.908 (.186)	0.637	1.546 (.306)	0.028
Alzheimer's		.960 (.785)	0.96	–	–
Cancer		–	–	2.259 (.625)	0.003
Hospitalization		–	–	7.377 (1.368)	0
Social support					
	Low	.890 (.227)	0.649	–	–
	High	.837 (.144)	0.302	–	–

^a Panel 2SRI: Panel Two-Stage Residual Inclusion

^b Reference category: middle-income adequacy.

^c Secondary education completed or higher.

^d Reference category: Ontario.

^e Reference category: No dependency.

The relationship between HHC and HM services

In the panel logit two-stage residual inclusion analysis, the receipt of HM services significantly increased the likelihood of HHC receipt (OR=3.85, $p < 0.001$; Table 4). Evidence of endogeneity of the variable HM was observed, with a significant t-statistic on the included residuals ($p = 0.062$), meaning that receipt of HHC was endogenous to receipt of HM services. The strength of the instruments was tested, and the average value of the chi-square test was 29.54 ($p < 0.001$). In addition, the standard error of the correlation coefficient for the instrumented HM predictor was only 1.18 times larger than the noninstrumented variable. The instruments' strength was considered adequate. The panel logit two-stage residual inclusion model was also preferred over the two-stage predictor substitution approach, which showed a weaker model fit based on the AIC (2329.854 against 2225.4536 for the residual inclusion model), and the standard error for the instrumented coefficient was 2.51 times larger than the noninstrumented standard error.

There was a positive and significant association between HHC receipt and the propensity to receive HM services (OR=13.7, $p < 0.001$). However, the included residuals were nonsignificant at the 10% level ($p = 0.595$). Given the simultaneous effect between receipt of HM and HHC services, and the significant evidence of endogeneity in the previous model, the instrumented model was preferred in both cases. Comparative results between instrumented and noninstrumented models are analyzed further on. Regarding the strength of the instruments, the average value of the chi-square test was 47.13 ($p < 0.001$) and the standard error of the correlation coefficient for the instrumented HHC predictor was 0.91 times larger than the noninstrumented variable, which was considered adequate. The panel logit two-stage residual inclusion model showed evidence of being superior to the panel logit two-stage predictor substitution approach, which showed a weaker model fit based on the AIC (3387.528 against 3273.598 for the residual inclusion model), and the standard

error for the instrumented coefficient was 1.60 times larger than the noninstrumented standard error.

The effect of informal care on the receipt of publicly funded HC services

Household arrangement was a proxy for receipt of/availability of informal care in this analysis. In line with the hypothesis, living with other adult family members indicated a significant decrease in the likelihood of receipt of publicly funded HM services (“other_adult”: OR=0.40; $p < 0.003$; Table 4). Living with a partner was found to be nonsignificant in general (“partner”: OR=0.81; $p = 0.417$); however, the interaction term between sex (male) and living with partner was found to be significantly negative (“sex(male)*partner”: OR=0.23; $p < 0.001$), a finding that may be interpreted as a substitution effect in relation to informal care provision only by a female partner for a male dependent.

As expected on the basis of the conceptual framework, these variables indicating the availability of informal care were nonsignificant in affecting HHC receipt (“partner”: OR=0.85; $p = 0.553$; “other_adult”: OR=1.31; $p = 0.323$; “sex(male)*partner”: OR=0.82; $p = 0.591$).

Trends in the receipt of HC services over time adjusted by need

The proportion of seniors reporting receipt of public HM services decreased significantly over the study’s time frame in the adjusted analysis (OR=0.91, $p = 0.004$). Receipt of HHC, in contrast, did not show a significant variation (OR=0.95, $p = 0.212$; Table 4).

The effect of income on receipt of publicly funded HC services

The income variable had a significant effect on the propensity to receive publicly funded HM services, with significantly fewer services for higher-income people (OR=0.54, $p = 0.001$), as compared with the middle income-adequacy category, with no observed significant difference between low- and middle-income seniors. Unexpectedly, high-income seniors reported a significantly lower

likelihood of HHC receipt (OR=0.64, p=0.007), and low-income seniors reported a significantly higher likelihood of HHC receipt (OR=1.39, p=0.080; Table 4).

Other determinants of receipt of publicly funded HC services

As expected, age, disability, and dependency were strong predictors of a report of publicly funded HM receipt, while stroke, incontinence, cancer, dependency and hospitalization were associated with a higher likelihood of HHC receipt (Table 4).

The analysis showed an increased likelihood of HC receipt by male seniors, including HM and HHC services (HM: OR=1.87, p=0.006; HHC: OR=1.55, p=0.030). Immigrant status was found to be associated with a significantly lower likelihood of HM receipt (OR=0.55, p=0.006). The likelihood was lower in spite of the fact that the average time since immigration in our sample was 43.9 years, and 98% of the seniors immigrated more than 10 years before they were surveyed. In contrast, ethnic minority was not a significant predictor in any of the analyses.

Among other demographic variables, urban seniors did not report a significantly different likelihood of the receipt of HC services (HM: OR=0.77, p=0.141; HHC: OR=0.85, p=0.482). All provinces were associated with a lower likelihood of HC receipt as compared to Ontario. However, the sample sizes were limited for the small provinces. Among the four provinces that had higher representation in the sample, residents of Quebec and Alberta had a significantly lower likelihood of HM receipt in the adjusted analysis, as compared to Ontario. Residents of British Columbia had a significantly lower likelihood of HHC receipt, as compared to Ontario residents.

Sensitivity of results with and without instrumental variables and testing alternative models

The comparative results of the models predicting HM receipt and HHC receipt without IVs versus the use of Two-Stage Residual Inclusion with panel logit methods are shown in Table 5. Even though the trends in the association between predictors and HC receipt did not change after

the inclusion of residuals, there were some changes in the significance of variables that are worth noting. In the model predicting HHC receipt, for which the residuals were significant at the 10% level, the model not addressing endogeneity overestimated the receipt of HHC over time, showing a positive trend, and underestimated the income differences between low and middle-income seniors and the differences by sex. The noninstrumented model also changed the significance of stroke and incontinence to nonsignificant and overestimated the effect of age, disability and more than 3 chronic conditions after variable adjustment. In addition, Alberta showed significantly lower HHC receipt compared to Ontario.

Regarding HM receipt, the inclusion of residuals in this case was nonsignificant. The noninstrumented model overestimated the effect of living with a partner showing significantly lower HM receipt for any partner, male or female, although still significantly higher when the partner caregiver is female. The noninstrumented model also showed significantly lower HM receipt for urban seniors and changed the affect of diabetes to significant.

The results from the preferred panel two-stage residual inclusion model using second-stage panel logit analysis were entirely comparable in terms of the magnitude and direction of effects with those obtained using a panel probit model and weighted GEE analysis in the second-stage equation and using a one-stage instrumental variable probit model, although significance levels showed some differences, as compared with the preferred approach. These results are available upon request to the corresponding author.

Table 5: Comparison of the effect of residuals inclusion in modeling HM and HHC receipt - Panel Logit

Dependent Variable →	HM				HHC			
	With IV		Without IV		With IV		Without IV	
	OR (SE)	P	OR (SE)	p	OR (SE)	p	OR (SE)	p
HM	—	—	—	—	3.848 (.982)	0	4.850 (.566)	0
HHC	13.71 (5.240)	0	12.57 (2.509)	0	—	—	—	—
Res. Pub. HM	—	—	—	—	1.130 (.074)	0.062	—	—
Res. HHC	.944 (.103)	0.595	—	—	—	—	—	—
Wave	.909 (.030)	0.004	.912 (.030)	0.005	.951 (.038)	0.212	1.044 (.021)	0.033
Income ^a								
Low	1.230 (.222)	0.252	1.122 (.175)	0.459	1.390 (.262)	0.08	.969 (.117)	0.795
High	.541 (.099)	0.001	.551 (.094)	0	.635 (.107)	0.007	.678 (.084)	0.002
Education ^b	1.279 (.210)	0.133	1.209 (.187)	0.222	1.001 (.163)	0.997	.968 (.103)	0.763
Age	1.107 (.017)	0	1.113 (.012)	0	1.015 (.016)	0.328	1.012 (.007)	0.097
Sex (male)	1.872 (.428)	0.006	2.050 (.417)	0	1.550 (.314)	0.03	1.234 (.184)	0.158
Partner	.805 (.215)	0.417	.642 (.138)	0.039	.854 (.227)	0.553	.831 (.133)	0.246
Other_adult	.399 (.122)	0.003	.340 (.112)	0.001	1.309 (.357)	0.323	1.285 (.225)	0.153
Sex*partner	.232 (.085)	0	.257 (.083)	0	.820 (.306)	0.591	1.147 (.250)	0.529
Minority	.718 (.208)	0.254	.753 (.197)	0.278	.720 (.188)	0.208	.932 (.160)	0.681
Immigrant	.545 (.121)	0.006	.514 (.115)	0.003	.929 (.193)	0.721	.844 (.121)	0.237
Urban	.765 (.139)	0.141	.728 (.133)	0.082	.846 (.201)	0.482	.911 (.110)	0.436
Province ^c								
NF	.212 (.106)	0.002	.232 (.099)	0.001	.201 (.114)	0.005	.311 (.092)	0
PEI	.704 (.234)	0.291	.716 (.226)	0.29	.277 (.157)	0.024	.405 (.098)	0
NS	.856 (.281)	0.636	.825 (.251)	0.527	.273 (.092)	0	.284 (.070)	0
NB	.986 (.275)	0.961	1.072 (.317)	0.813	.299 (.116)	0.002	.384 (.089)	0
QC	.428 (.112)	0.001	.462 (.115)	0.002	.970 (.240)	0.903	1.123 (.172)	0.449
MA	.676 (.203)	0.191	.726 (.219)	0.288	.464 (.186)	0.055	.543 (.112)	0.003
SK	.748 (.225)	0.335	.676 (.197)	0.18	.595 (.209)	0.14	.697 (.134)	0.06
AL	.546 (.175)	0.059	.514 (.163)	0.036	.699 (.197)	0.205	.637 (.133)	0.031
BC	.979 (.285)	0.943	1.024 (.273)	0.928	.282 (.109)	0.001	.382 (.079)	0
Dependence ^d								
Low	3.870 (.640)	0	4.010 (.726)	0	2.061 (.425)	0	1.894 (.276)	0
Middle	13.39 (2.817)	0	13.36 (2.671)	0	3.529 (.791)	0	3.193 (.491)	0
High	36.39 (9.265)	0	38.28 (8.337)	0	4.410 (1.126)	0	4.286 (.668)	0
Disability	1.545 (.234)	0.004	1.631 (.222)	0	1.186 (.190)	0.287	1.291 (.136)	0.015
Over 3 chronic conditions	.910 (.157)	0.584	.878 (.136)	0.403	1.233 (.232)	0.266	1.253 (.150)	0.059
Diabetes	1.351 (.329)	0.218	1.447 (.268)	0.046	1.198 (.229)	0.345	1.124 (.145)	0.367
Heart disease	1.183 (.201)	0.323	1.152 (.178)	0.359	.987 (.201)	0.949	1.112 (.124)	0.34
Stroke	1.292 (.300)	0.271	1.308 (.342)	0.304	1.499 (.356)	0.088	1.242 (.202)	0.182
Arthritis	1.172 (.196)	0.344	1.253 (.182)	0.121	1.093 (.188)	0.606	1.044 (.110)	0.685
Emphysema	1.191 (.285)	0.465	1.221 (.285)	0.393	.701 (.176)	0.158	.849 (.143)	0.33
Incontinence	.908 (.186)	0.637	.992 (.178)	0.966	1.546 (.306)	0.028	1.225 (.162)	0.124
Alzheimer's	.960 (.785)	0.96	.931 (.592)	0.911	—	—	—	—
Cancer	—	—	—	—	2.259 (.625)	0.003	2.241 (.343)	0
Hospitalization	—	—	—	—	7.377 (1.368)	0	5.463 (.537)	0
Social support								
Low	.890 (.227)	0.649	.803 (.194)	0.364	—	—	—	—
High	.837 (.144)	0.302	.779 (.124)	0.116	—	—	—	—

^a Reference category: middle-income adequacy.^b Secondary education completed or higher.^c Reference category: Ontario.^d Reference category: No dependency.

VI Discussion

This study focused on the HC sector, an area of the health care system that has been identified worldwide as a priority in terms of increased utilization and that has been a focus of growing commitment from Canadian policy makers. The enormous diversity of systems among countries and within them complicates the efficient translation of evidence into effective policies and programs to increase support for fragile older adults in the community.

This research builds on existing theory regarding the decision of households to use HC services from different sources, and includes critical elements such as characteristics of the services and household arrangement; and second, it provides robust empirical evidence to confirm part of the statements in the conceptual model. The confirmation of these hypotheses translates into a number of important policy implications.

The importance of the distinction between HHC and HM services

Home health care and homemaking/personal support services are frequently treated as one homogeneous type of service, but they have important differences, as represented in this conceptual framework and supported by findings in the study. The HC literature up to this point most frequently does not acknowledge these differences, which are especially important in the process of exploring the possibilities for substitution by other sources of care. It is necessary to recognize the different needs and implications involved in the complex combination of services provided under the heading “home care” in order to increase the effectiveness and efficiency of programs and legislation. The same differences should be considered by the researchers when they are generating evidence to support and guide these policies.

The complementary effect between receipt of publicly funded HM and HHC services

The first research hypothesis was confirmed, where receipt of publicly funded HHC was found

to complement the receipt of publicly funded HM services; that is, adjusting for variables reflecting need for HC services, such as age, dependence on help with ADLs, health status, and living arrangement, receipt of one type of service increases the likelihood of receiving the other when the services are publicly funded in the Canadian context. This finding supports the assumption that, once a senior accesses the HC system, the probability of being deemed eligible or being offered additional services is higher. The receipt of a visit at home by a health care professional may facilitate the detection of unmet needs for homemaking or personal support services, or may facilitate the application or assessment process for receipt of these additional services. The same kind of process may occur in the case of health care needs that can be attended to at home. Such needs can possibly be detected easily by a personal support worker (PSW) or by a home aide who is providing HM services. In addition, the assessment process for receipt of institutional LTC, HHC, and HM services is usually performed simultaneously, and this simultaneous assessment increases the likelihood that a person will be deemed eligible for both HM and HHC. This last element would be a contributing factor to the endogenous relationship observed in the results. The eligibility in some provinces for publicly funded homemaking services only for seniors who receive HHC or personal support services may increase the positive predictive effect of HHC receipt on HM receipt.

The receipt of HM was also found to be a strong predictor of HHC receipt, although weaker than the effect of HHC as a predictor of HM receipt. This finding partially departed from the expectation that receipt of HM would be a weak predictor of HHC receipt. A certain level of qualification is required for assessment of the need for health services, and this type of care is specialized, as compared with HM services.

In terms of the theoretical model, receipt of publicly funded services will have a double effect. Receipt of publicly funded HM services (M1) directly increases the care recipient's performance

ability to perform ADLs (A), and complements the receipt of HHC services, which also improve A though their improvement of health (H). A similar double effect is predictable for seniors who receive publicly funded HHC services, which will increase seniors' performance ability through their effects on health and through their effect on publicly funded HM receipt.

In terms of patient care, the consequence of this complementary effect is an increased gap between care recipients and non-recipients, who are at equivalent levels of functional and health status. This element raises concerns about equitable access to HC services, especially given the characteristics of provincial HC programs. Home and community care agencies in Canada provide services within capped budgets set by the provinces, with the overall service volume constrained, such that only a limited number of hours of care can be provided, regardless of the assessed need (Williams et al., 2009a). In specific terms, the convenience and rationale for restricting access to publicly funded homemaking services only to seniors who are eligible for publicly funded HHC or personal support services should be revised.

Informal care as a substitute for publicly funded HC, with living arrangement used as a proxy for informal care

Confirming the third research hypothesis, the availability of informal care was a negative and significant determinant of the receipt of publicly funded HM services, when such care was included in the analysis through the use of household arrangement variables. However, living with a partner only significantly reduced the likelihood of receipt of HM when the caregiver partner was a female. Living with other adult family member significantly reduced the likelihood of receipt of HM. Living arrangement variables was not significant predictors of HHC receipt.

These observations were concurrent with the interactions in the conceptual framework. Informal care (C) is a direct substitute for publicly funded HM services (M1) in the function of the care

receiver's performance ability in terms of ADLs (A). However, informal care is less effective in improving health status, and, therefore, it not expected to be a substitute for publicly funded HHC services, which improve A only indirectly through their effect on H.

The trends of decreasing HC receipt over the study's time frame

The proportion of older adults in Canada reporting receipt of publicly funded HM services declined during the study's time frame in absolute terms. It was therefore not surprising to also observe a significant decrease in the corresponding adjusted analysis. In the case of HHC receipt, there was a slightly positive trend, though this increase was not significant in the adjusted analysis. These unexpected findings may reflect the reality that, even if the number of people receiving HC services increased in Canada from 23.9 in 1994-1995 to 26.1 per 1,000 inhabitants in 2003, which represents a 9.2% growth (Canadian Institute for Health Information, 2007), this increase may have been outpaced by growth in the members of the population who were 65 years or older during the same period, growth that is estimated to have reached 18.7% in the period from 1994 to 2003 (Statistics Canada, 2011). This difference may be even higher in the population considered for this study, which included only noninstitutionalized seniors. Another potential explanation is that the additional resources allocated to HC during the study's time frame may have been allocated mostly to HHC, rather than to HM services. The shift of resources from long-term HM and HHC to post-acute HHC has been previously described in Ontario (Williams et al., 2009a). HHC is expected to be aimed to a younger population group, as compared with HM recipients, and that aiming of HHC may have hidden part of this increase in the senior population studied. The mean age of HM recipients was 80.2 years, higher than the 78.1 years for HHC recipients (excluding users younger than 65 years of age). A significant reduction in the likelihood of HM services receipt, but not in the likelihood of HHC receipt, was observed. This reduction suggests a reallocation of resources

from social care to health care at home.

Even if recently implemented policies increase support for seniors in the community, such policies still need to deal with the effects of increasing needs for HC services. Furthermore, a considerable increase in the burden of disease and dependence on help with ADLs were observed in this age group.

The increasing need for HC services by the older adults

The proportion of seniors reporting need for help with ADLs substantially increased during the study's time frame, as did the proportion of people reporting chronic conditions and the average number of chronic conditions. There is a high probability that this development happened because of an aging cohort in the sample. Even if adults who reached the age of 65 in every wave of the study were included in the sample, the mean age in the period between 2002 and 2011 was 75.4 years, more than one year older than the average of 74.0 between 1994 and 2001. The sample excluded institutionalized seniors; therefore, the abrupt increase in age in the cohort may reflect a delay in institutional LTC home entry during that period. This accelerated increase in the mean age of the sample probably accounts for most of the abrupt increase observed in the burden of disease and the need for help with ADLs. However, it may also reflect the population's increased needs for chronic care over the almost two decades covered by the NPHS. In any case, the expected result in terms of HC receipt in the older sample should have been the observation of a bigger increase in the proportion of seniors reporting receipt of these services than the increase for the general population (or for the population of those 65 years of age and older). It is not surprising, therefore, that the drop in the likelihood of HM receipt over the study's time frame was significant in the adjusted analysis and that the increase in HHC receipt became nonsignificant after adjusting for variables reflecting capacity to benefit from (or need for) HC services.

These developments should be taken into consideration in the course of planning for the provision of public support for the growing cohorts of older adults. Unmet needs derive from the reduced availability of publicly funded HC within a scenario of increasing needs, and may translate in substantial increased costs for the system. Seniors without adequate support in the community may be admitted to more costly institutional LTC or rely on increased use of acute care in hospitals.

The income gradient in receipt of publicly funded HC services

Income was an important determinant of HM receipt, with fewer services for high-income seniors, as compared with those in the middle- and low-income categories. These findings were expected because all Canadian provinces charged copayments for HM services until 2007, payments that were graduated by income (Canadian Home Care Association, 2008). In addition, the probability of the substitution by privately paid HM was also hypothesized to be higher for higher-income seniors. Unexpectedly, differences according to income were also observed in the receipt of HHC services, services that are provided free of charge in every province, regardless of the ability to pay. The expected worse health status among lower-income people should have been accounted for by the comprehensive range of health and dependency variables included in the model. Wealthy individuals are generally better able to access health care services in Canada. In addition, the substitution by privately funded HHC is rarely observed in the Canadian context. However, wealthy seniors who are not eligible for institutional LTC may opt to pay for private residential care or assisted living facilities, as an alternative to receiving HHC in their homes (excluded from the household component of the NPHS). These more expensive care options, which are more affordable for higher-income families, potentially explain the reduced odds of HHC receipt in this income category. Even if, in some cases, these seniors may be eligible to receive publicly funded HHC services within those institutions, these cases were mostly excluded from the NPHS and therefore from the sample⁷. In

⁷Some seniors living in condominiums for the elderly with apartment-like independent units may have been

addition, since higher-income seniors receive fewer HM services, and they have been found to be complementary to HHC services, the expectation is that this situation will indirectly affect the likelihood of HHC receipt among higher-income seniors.

The observation of this income effect in the receipt of publicly funded HC services may raise additional concerns about equity in access. Although the provision of more publicly funded services to low-income users and less services to high-income seniors may be interpreted as fair and desirable in certain societies, the argument has been made that Canada's universal, publicly funded health insurance system (Medicare) should make no distinction in terms of ability to pay and should allocate services on the basis of likelihood of benefiting from care. In fact, several provinces have recently eliminated income assessments for HC services and have eliminated charges for HM services (Canadian Home Care Association, 2008). HM services may be interpreted as social support instead of health care, but the income gradient noted above was also observed for HHC services, which were provided free of charge across Canada during the study's time frame. These policies and their translation into effective eligibility assessment processes should be revised carefully, including explicit selection criteria and the equal availability of services to everyone who fulfills the requirements. That process could result in fewer public services per senior on average, however, unless greater investments are made in this sector.

Other determinants of the receipt of publicly funded HC services in Canada

Fewer immigrant seniors reported receipt of HM, difference that was not significant for receipt of HHC. It is possible that immigrants have stronger ties to their families and communities in Canada, or simply larger families, with increased access to informal HM, and which is not expected to importantly affect HHC. It is also plausible that immigrants are less informed about their eligibility for publicly funded HM services. This difference occurs despite the long time since immigration in

considered in the household component of the NPHS.

this sample of older adults, that is, 43.9 years on average. No differences in services were observed for seniors who reported that they belonged to an ethnic minority.

Contrary to most findings in the literature, male seniors in this sample showed a higher likelihood of receiving HC services, for both HM and HHC. A possible explanation is the lower level of autonomy of male seniors who live alone that arises for cultural reasons, especially in relation to household chores.

Regarding variation across Canadian provinces, Ontario residents were more likely to report HC receipt, both for HM and HHC services, compared to the rest of Canadian seniors, controlling for health status, dependence on help with ADLs, and socio-demographic characteristics. The performance of a comparative analysis of the changes in provincial HC receipt and corresponding policies across Canada is not the objective of this study and will be addressed in a subsequent paper.

Model sensitivity

The consistency of the study's findings with those obtained from the model using second-stage GEE and panel probit methods suggests that these results are robust to changes in the estimation method. The results were also consistent in comparing second-stage GEE with and without survey weights. This consistency should clear up concerns about a potential effect of the sampling strategy on the survey data set utilized.

Study Limitations

The study has several limitations, and most of these are related to the data source. First, the NPHS asks if subjects received services at home or not, but does not inquire about the intensity of services received. The lack of information regarding intensity of services does not allowed observing variations in the total amount of hours of care received by seniors during the study time frame.

Second, the NPHS includes questions regarding the receipt of HC services that are completely or partially publicly funded, but does not provide information about the value or amount of public contributions. This lack of information is not a problem for HHC services, which were provided at no charge in all Canadian provinces during the study's time frame. However, all provinces charged fees for publicly funded HM services until 2007 (Canadian Home Care Association, 2008), that is, until wave 7 of the NPHS. This limitation reduces the possibility of assessing the role of public funding and the comparative importance of private funding for HC services. Third, receipt of informal care from a coresident family member was only inferred from its availability in terms of living arrangement, since specific information on the actual receipt of informal care was not available at this point. As a final data limitation, despite the size of the NPHS cohort and the large number of variables in its questionnaire, this is not a survey that specifically targets HC users or the older populations. The reduced number of questions specific to HC receipt limited the scope of questions to be addressed with this data set.

Future research

Further research is needed to study the interrelationship of receipt of publicly funded HM and HHC services with privately funded and informally provided HC services. This issue will be address in a subsequent paper derived from this research study. In addition to income differences, other areas worth exploring further are possible inequities based on sex and immigrant status, and the considerable provincial variation observed in access to HC, which should raise concerns about equitable access to services for all Canadians. It might be also interesting to explore survey attrition in future research for these cohorts of seniors, assessing the role of institutionalization and death in loss to follow up, and the potential implications in terms of the analysis.

The present research focused on the provision of HC services for the elderly. The provision of

services to younger, disabled population groups may differ for many reasons including causes of disabilities, the time frame of care needs, caregiver availability, and availability of public programs. Therefore, the conclusions from this study are not intended to provide evidence about the provision of HC services to younger population groups.

Methodological contribution

In health services research, the problem of endogeneity of commonly used variables has been increasingly acknowledged, as has increased the use of econometric approaches to address these problems. The usual solution is the use of IVs. This approach is helpful for modeling continuous outcome variables. However, the presence of binary outcome variables, which is common in health care and medical research, imposes challenges in the use of traditional least squared equations and their variations. The use of Two-Stage Residual Inclusion methods has been proposed as a solution for health economic problems (Terza et al., 2008). However, this approach is not suitable to be used with panel data sets, which are increasingly available for the study of health care problems.

The original methodological approach proposed in this study, a Panel Two-Stage Residual Inclusion approach, yielded robust results, and seems to effectively address problems that are known to be a source of bias in the literature and have been less effectively dealt with using alternative methodological methods.

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