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Needs-based Funding for Home Care and Community Support Services in Ontario: A New Approach Based on Linked Survey and Administrative Data

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EXECUTIVE SUMMARY

1.0 Background

Since 1994, the Ontario Ministry of Health and Long-term Care (MOHLTC) has used an equity funding formula to allocate new funding for the delivery of long-term care (LTC) community services, which includes home care services and community support services in the province.[Ontario Ministry of Health 2000] The objective of the formula is to reduce historical disparities in funding among Community Care Access Centre (CCAC) regions by allocating new funds on the basis of the relative need for home care and community support services of the populations living in each CCAC region. Since May 1998, the Ministry of Health and Long-Term Care (MOHLTC), in consultation with CCAC regions and service providers, has been reviewing the equity funding formula to identify possible improvements to the current formula, which is based on only age and sex adjustment. This work was initially conducted by the Long-Term Care Community Equity Funding Formula Review Committee [Ontario Ministry of Health 2000], and since June 2000 by the Community Funding Review Committee (CFRC). The CFRC engaged the Centre for Health Economics and Policy Analysis (CHEPA) as a consultant to carry out research required to develop a modified funding formula.

CHEPA's work has focussed on technical aspects of developing a needs-based funding formula. The formal funding formula that links a CCAC region's funding to the characteristics of its population cannot address all the issues required to fairly allocate funds to CCAC regions. Additional issues that must be addressed by the CFRC include out-of-CCAC region use, defining clearly the set of services, programs and activities funded through the formula, and the approach to the transition from the current funding approach to new needs-based funding allocations.

2.0 Guiding Principles

CHEPA's work in developing the funding formula was guided by the following principles:

a) Develop a population, needs-based funding formula that represents, as accurately as possible, the *relative* need for home care and community care resources among CCAC regions. The intent of the approach is to determine a region's relative need for resources in a way that does not depend upon the past level of resources received by the region.
b) Seek consensus from the Community Funding Review Committee regarding a set of adjusters to be evaluated for possible inclusion in a needs-based formula. In generating a set of possible adjusters, there should be a sound conceptual relationship between each adjuster and expected need for home care and community support service resources in a CCAC region.
c) Seek consensus from the Committee regarding the best way to represent these factors empirically given the available data.
d) Include health care system variables as adjusters only when the variable under consideration is not under the control of a CCAC.
e) Adjust for costs beyond the control of a CCAC.
f) Adjust for out-of-area use through a mechanism other than the funding formula.

3.0 The Analytic Strategy for Developing the Funding Model

The richest source of data currently available upon which to base the development of a needs-based funding formula for home care and community support services is the 1996/97 Ontario component of the National Population Health Survey (NPHS). The survey provides detailed demographic, economic, health and related information on a random sample of Ontario residents and, for a sub-sample of individuals, this information can be linked to the administrative files from the Ontario MOHLTC, which document utilization of a wide range of services, including home care, hospital services and physician services. For the sub-sample of individuals for which survey information is linked from MOHLTC administrative data, therefore, we have detailed information on individuals and their health care utilization. (All information is anonymized so that it is not possible to identify any of the individuals surveyed.)

The development of the funding formula included four distinct types of analyses.

1. *Estimation of a Model for the Need for Home Care Among Individuals Under Age 12*

   The need for a separate model for those under and over age 12 arises because the sample size among those less than 12 in the Ontario Health Survey is too small to provide a valid basis for formula development. We therefore use the existing equity funding formula to allocate funds to CCAC regions for individuals under 12.

2. *Estimation of a Model of the Need for Home Care Among Residents of Ontario Aged 12 or Over*

   The goal of this part of the analysis is to estimate a provincial-level model of the determinants of need for home care among residents aged 12 or over. This model is estimated based on an individual's use of home care, his/her characteristics (e.g., age, sex, health status) and the characteristics of the area in which the person lives.

3. *Determining CCAC Region Budget Shares for Those Aged 12 or Over*

   The Ontario Health Survey is a representative sample of the population of Ontario. Therefore, from the model estimated as per above, which is based on this survey information, it is possible to estimate the needs-based budget share for each CCAC region in Ontario based on the characteristics of each region's population.

4. *Adjustment for Factors Not Included in the Formula*

   Funding to a CCAC region must be adjusted for factors that cannot be incorporated into the formula. We analyzed the appropriateness of such an adjustment for two factors. The first was whether there are differences in the average cost of providing home care services between CCAC regions with low population density and those with high population density, and between high-population CCAC regions and small-population CCAC regions. The second was to assess whether it would be appropriate to adjust the funding to those CCAC regions that experience an influx of temporary summer residents.

4.0 Results

1. Using data from the Ontario component of the NPHS, which includes detailed information on the demographic, health-related, and socio-economic characteristics of a representative sample of Ontarians, linked to administrative data from the MOHLTC, we were able to construct a statistical model that accounted for substantially more of the variation in the relative need for home care services across CCAC regions than does a model based on age and sex adjustment alone.

2. This model can provide a valid basis for a needs-based allocation formula that incorporates adjustment for a wide variety of needs-related characteristics of the population

3. Estimates of the 43 CCAC region needs-based resource shares (of the overall budget for home care and community support services) indicate that substantial reallocation from current funding is required to achieve an equitable sharing of the budget in line with relative need for resources across CCAC regions.

4. The sample size available in the 1996-97 Ontario component of the NPHS is too small to provide estimates for needs-based resource shares with the desired degree of precision. for all 43 CCAC regions.

5. Adjustment of CCAC region resource shares to reflect differences across CCAC regions in the average cost of providing home care services is not necessary.

6. Adjustment of CCAC region resource shares for regions that experience seasonal fluctuations in the number of residents is not necessary.

5.0 Conclusions

Home care and community support services are becoming an increasingly important component of our health care system as the population ages and as changes in health care technologies and treatment patterns shift care out of traditional care settings. Both efficiency and equity objectives call for resources to be allocated in line with the relative needs for such care across the province.

1. The concerns that motivated the work of the CFRC are valid. The current age-sex adjusted equity formula fails to capture the substantial variation in need for home care across CCAC regional populations beyond that associated with differences in the age-sex distribution of the population.

2. This variation is highly correlated with demographic, health status and socio-economic characteristics measured in Canadian health surveys. This supports the contention that it is possible to develop a formula that adjusts for needs beyond those captured by age and sex adjustment. It also supports the potential of an approach based on individual, population-based data available in health surveys.

3. Because home care use is a relatively rare event among the general population, the sample size associated with the 1996 Ontario component of the NPHS provides estimates of needs-based

resource shares for some CCAC regions that are less precise than might be desired. This issue can be addressed through a larger sample buy-in by Ontario of on-going regular national health surveys conducted in Canada. The benefits of doing this extend beyond the application to allocating funds for home care and community support services; such data can support a wide variety of population-based planning activities to improve the efficiency and equity of the Ontario health care system.

4. In the intermediate and short-term it is possible to develop funding approaches based wholly on the population-based health survey data or on an integration of such data with the traditional equity approach that can begin the process of better allocating home care and community support service resource in Ontario in line with relative needs across CCAC regions.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

Since 1994, the Ontario Ministry of Health and Long-term Care (MOHLTC) has used an equity funding formula to allocate new funding for the delivery of long-term care (LTC) community services, which includes home care services and community support services in the province.[Ontario Ministry of Health 2000] The objective of the formula is to reduce historical disparities in funding among Community Care Access Centre (CCAC) regions by allocating new funds on the basis of the relative need for home care and community support services for the populations living in each CCAC region.

CCACs provide residents of Ontario with a coordinated, single access point to community-based services, long-term care placement and information and referral services in their region. CCACs are non-profit organizations which enable people of all ages to access health care and personal support services, to help them live independently or with their families in the community. They also serve as a central source of information and referral to other community health agencies and support groups. CCACs are transfer agencies that purchase all in-home services including professional (i.e., nursing and therapy) and home support services (i.e., personal care, house cleaning and meal preparation) through a competitive contracting process within a capped budget determined by the provincial government. The ministry funds 43 Community Care Access Centres and more than 1200 agencies that provide services that include homemaking/personal support, personal care, community support services and in-home professional health services.

In May 1998, the Ministry of Health and Long-Term Care (MOHLTC), in consultation with CCACs and service providers, established the Long-Term Care Community Equity Funding Formula Review Committee.[Ontario Ministry of Health 2000] The Committee's mandate was to identify possible improvements to the equity funding formula, which is currently based on only age and sex adjustment. In its March 1999 report,[Ontario Ministry of Health 1999] the committee summarized its progress in assessing possible additional adjusters, but concluded that it required more time for a fuller assessment and that it did not have the requisite analytic capabilities to carry out a full analysis. In June 2000 the Committee was reconstituted (under a new name, the Community Funding Review Committee (CFRC)), and it engaged the Centre for Health Economics and Policy Analysis (CHEPA) as a consultant to carry out research required to develop a modified funding formula.

2.0 APPROACHES TO FUNDING HOME CARE AND COMMUNITY SUPPORT SERVICES IN JURISDICTIONS OUTSIDE ONTARIO

As the first phase in this work, we carried out a study[1] to determine the approaches currently being used or that have been proposed for allocating funds for home health care and community support services in jurisdictions outside Ontario. Information was collected from Canada's ten provinces and three territories, the United States, Denmark, Sweden, the United Kingdom and Japan. We focussed the review on funding methods used by governments to allocate funds to health regions (e.g., Prince Edward Island's 5 Regional Health Boards, Alberta's 17 Regional Health Authorities, the U.K.'s 100 Health Authorities)[2]. Because no public program in the U.S. allocates funds for home care to geographical areas, and the multi-payer system of financing makes it impossible to present a comprehensive picture, we limited our consideration of funding in the U.S. to Medicare at-risk HMOs.

Appendix A provides details regarding the search strategy used to obtain relevant information, as well as a detailed description of the services included in the home care funding envelope for a number of jurisdictions. In the next section we examine how funding envelopes for home care services are determined in these jurisdictions.[3]

2.1 Home Care Funding Envelopes

The funding envelope into which home care services fall varies across jurisdictions (Table 2.1).[4] Home care services are sometimes bundled with a broad range of other services. Under British Columbia's proposed population-based funding formula for its health regions, for example, home care funding is bundled with inpatient and outpatient hospital services.[British Columbia Ministry of Health and Ministry Responsible for Seniors 1996] In Quebec, home care funds are included with mental health, primary care, laboratory and health promotion services.[Anctil H and Belanger L 2000; Quebec Ministère de la Santé et des Services sociaux 2000] More commonly, however, funding for home care is included in a smaller budget envelope. A number of jurisdictions have separate funding envelopes that include only long-term care and home care. Finally, some jurisdictions, including the majority of Canadian provinces, have distinct funding envelopes for home care services.

One suspects that the patterns observed are as much an inadvertent result of historical and institutional

[1] The study was completed at the end of 2000; some of the information may now be dated.
[2] Special programs such as Health Canada's First Nations and Inuit Home and Community Care Program or arrangements for home care service delivery to veterans are not dealt with in this paper.
[3] As Appendix A documents, the bundle of services included under the label "home care services" varies across jurisdictions.

factors as deliberate design. In recent years there appears to be a trend toward separate home care funding envelopes. This may reflect the growing importance of home care services within the health care system. In Ontario, between fiscal years 1991-92 and 1997-98 publicly funded home care grew from 3.02% to 5.30% of total public health expenditures.[Health Canada 1998] Many factors account for this growth, among them an aging population, hospital restructuring, increased accessibility of home care services, technological change which has encouraged shorter lengths of hospital stay, and the priority that provincial and federal governments have given to the increase of funding for home care relative to other services.[Government of Ontario 2000]

2.2 Funding for Home Care Programs

Among those jurisdictions that fund home care through separate budgets, two funding approaches are commonly used (Table 2.2):

- historical budget
- capitation funding.

Home care and community support services in Ontario, Nova Scotia, Prince Edward Island, non-professional home care services in Newfoundland and Labrador and home care services covered by the New Brunswick Family and Community Social Services Division (FCSS) are funded on an historical basis. That is, this year's budget is the previous year's (inflation-adjusted) budget plus changes to reflect additional allocations to home care funding and/or changes in a region's perceived needs for home care services. To determine a region's relative needs for home care and community support services, many provinces use approaches that approximate a formal population needs-based funding methodology, but stop short of using a funding formula. A common scenario is one in which each region puts forth their requests for funding on the basis of relative changes in the population's age-sex structure, increased utilization and changes in the health care system that can have an impact on home care and community support service needs (for example, the closing of an institutional home). Such a process is used by Home Care Nova Scotia, for example, to allocate funds to its 4 Regional Health Boards[5] and also by the FCSS Division of New Brunswick to allocate funds across its 7 regions for the provision of personal support, homemaking and other community support services.

Although capitation-based home care funding is not traditional in Canada, there appears to have been a shift in interest toward this funding approach in the last decade. Two Canadian provinces – Alberta and

[4] In the last 3-4 years, two Canadian provinces -- British Columbia and Manitoba -- have developed but not implemented an alternative funding formula for selected health care services that are currently funded on the basis of historical patterns. Therefore these provinces are listed twice in Table 2.1, once in regard to their current funding arrangements and a second time in regard to their proposed funding methodology.

[5] As of April 1, 2000 Nova Scotia has 9 District Health Authorities, but the administration structure for home care is still based on the old system consisting of four RHBs.[Nova Scotia Department of Health. 2000]

Saskatchewan – and the Northwest Territories[6], have implemented capitation for the allocation of home care funding since fiscal years 1994-95 and 1997-98 respectively.[Saskatchewan Health 1993; Alberta Health and Wellness 2000; Northwest Territories Health and Social Services 2000] Ontario has used a capitation-based approach since 1994-95 to allocate incremental funding for home care and community support services.[Ontario Ministry of Health 1999] Manitoba has developed a capitation funding approach that is not yet implemented.

With the exception of age and sex, there is no consistency across jurisdictions regarding the adjusters used in calculating home care capitation rates (Table 2.3). This variation reflects a number of factors, including: data availability[7], restrictions imposed by the broader funding context[8], characteristics of the populations being served (e.g., large aboriginal population), and, more generally, a lack of good evidence as to the best predictors of relative need for home care (and community support services) across populations. Indeed, this is perhaps the strongest message from this table: beyond age and sex, there are no consistently accepted, validated adjusters for need for home care and community support services. Therefore, research is warranted to develop and validate adjusters that can be used to support needs-based home care funding allocations.

[6] A population needs-based formula was developed and implemented for fiscal year 1997/98. Subsequently and for the past 4 fiscal years, the informal methodology used is historical funding i.e., the home care funding amounts for the Regional Health Boards have been frozen to the 1997/98 levels.[Northwest Territories Health and Social Services 2000]

[7] For example, Manitoba's Needs-based Funding Methodology initially considered self-assessed health status as an adjuster for the health status of the population, but excluded it from further consideration because its use requires obtaining such data from large-scale surveys.[Mustard C and Derksen S 1997]

[8] Alberta's Population-based Funding model, for example, was designed so that all six capitated service pools (acute inpatient hospital care; hospital based ambulatory care; continuing care; home care; protection, prevention and promotion; and private clinics) make use of the same adjusters: age, sex, and socio-economic characteristics, which combined generate a total of 124 population cells for each of the six service pools.[Alberta Health and Wellness 2000]

Table 2.1: Funding Envelopes ☆

Home care and long-term care in broader funding envelope	Long-term care and home care services in joint funding envelope	Home care (and some community support services) in separate envelope
British Columbia (proposed funding methodology) [British Columbia Ministry of Health and Ministry Responsible for Seniors 1996]	British Columbia	Alberta
Nunavut [Nunavut Health and Social Services 2000]	Manitoba	Manitoba (proposed funding methodology) [Mustard C & Derksen S 1997]
Quebec [Quebec Ministère de la Santé et des Services sociaux 2000]	New Brunswick (FCSS)	Saskatchewan [Saskatchewan Health 1993]
Yukon [Yukon HSS 2000]	Denmark ▲	New Brunswick (EMP)
United Kingdom [National Health Service 1999]	Japan** ▲	Newfoundland and Labrador ¤
United States (Risk-contract Health Maintenance Organizations) ♢ [Murtaugh C, Sparer MS, Hollander Feldman P, Lee JS, Basch A, Sherlock A, and Clark AL 1999; Kaiser Permanente 2000]	Sweden ▲	Northwest Territories [Northwest Territories Health and Social Services 1997; Northwest Territories Health and Social Services 1999]
		Nova Scotia
		Ontario
		Prince Edward Island

Notes:

☆ In some jurisdictions the separation between different service pools and funding envelopes is not clear, especially when a broad range of services are administered by the same management.

[] Numbers in square brackets indicate the reference.

♢ Because of the complexity of funding and multiplicity of providers in the U.S. home health care system, only the example of risk-contract HMOs is included in this report.

▲ Information from some international jurisdictions was provided from reviews of long-term care service delivery.[Organization for Economic Co-operation and Development 1996; Health Affairs (Special Edition) 2000] The authors were not able to confirm whether home care services are included in the broad LTC funding pool (as appears to be the case from the written documents), or whether, home care services have their own separate funding pool.

** Funding formula based on population and income adjustments.[Campbell JC. and Ikegami N 2000]

¤ Refers to non-professional home care services (i.e., homemaking, personal support and respite services only).

Table 2.2: Jurisdictions that Have Separate Funding Envelopes for Home Care Services

Budgets based on historical funding	Capitation
New Brunswick (EMP)	Alberta
Newfoundland and Labrador ¤	Manitoba (proposed funding methodology)
Nova Scotia	Northwest Territories *
Ontario	Ontario (incremental funds only)
Prince Edward Island	Saskatchewan

Notes:

* A population needs-based formula was developed and implemented for fiscal year 1997/98. Subsequently and for the past 4 fiscal years, the informal methodology used is historical funding, i.e., the home care funding amounts for the Regional Health Boards have been frozen to the 1997/98 levels.[Northwest Territories Health and Social Services 2000]

¤ Refers to non-professional home care services (i.e., homemaking, personal support and respite services only).

Table 2.3: Capitation Funding for Home Care Services – Adjusters *

	AB	MB (proposed funding formula)	NWT	ON (incremental funds only)	SK
Age	✓	✓	✓	✓	✓
Sex	✓	✓	✓	✓	✓
Aboriginal	✓				
Welfare	✓				
Subsidy ▲	✓				
Other ♧	✓				
Premature mortality index		✓			
Mean value of owner occupied dwellings		✓			
Education level ❍		✓			
Female single parent household		✓			
Female employment ■		✓			
Unemployment rate ages 15-24		✓			
Unemployment rate ages 45-54		✓			
Disability pension □			✓		
Cost of living			✓		
AIDS/HIV				✓†	
Living arrangements					✓
Region size					✓
Population density					✓

Notes:

* Although the cross-boundary flow adjustment is listed in some provincial documents as another adjuster (Alberta, Ontario), calculations for out-of-area use are made separately from the population-based formula and should therefore not be considered as a capitation formula adjuster.

▲ Individuals under age 65 with subsidized health care premiums. [Alberta Health and Wellness 2000]

♧ Non premium subsidy under age 65 – this represents the majority of Albertans and all persons aged 65 and over. [Alberta Health and Wellness 2000]

❍ Proportion of population aged 25-34 with a high school diploma.[Mustard C & Derksen S 1997]

■ Proportion of women aged 15+ in the labour force.[Mustard C & Derksen S 1997]

□ Percentage of the population with access to disability pension.[Northwest Territories Health and Social Services 2000]

† For one year only, outside the equity formula.

3.0 PURPOSE AND ROLE OF A FUNDING FORMULA WITHIN A FUNDING SCHEME

Before we describe our approach to developing a funding formula for home care and community support services, it is important to place this work and the resulting formula in the context of an overall funding scheme. The formal funding formula that links a CCAC region's funding to the characteristics of the CCAC region and its population is only one part of the funding scheme. Such a formula cannot address all the issues required to fairly allocate funds to CCAC regions. Some additional issues that arise include the following.

Out-of-CCAC region use. The formula cannot adjust for out-of-CCAC region use.[9] The funding issues associated with such utilization must be addressed outside the funding formula itself. There are a number of options for handling such utilization within population-based funding approaches, such as systems in which the "home" region of the individual is charged by the out-of-area CCAC that provided the service or systems of holdbacks with end-of-year reconciliation across regions.

The formula covers only an explicit, clearly defined set of services, programs and activities. It is essential that the services, programs and activities funded through the formula be explicitly defined. Funding for any services, programs or activities falling outside this defined basket must be through an alternative mechanism.

Exceptional circumstances. A funding formula is built on systematic relationships -- that is, averages and central tendencies. It is important to recognize that circumstances can arise that are genuinely unusual and which are not well represented by a funding formula. Such circumstances should be rare, but neither should they be denied. Therefore, it important to have a process for dealing with legitimate exceptional circumstances. The burden of proof should be placed on those making the claim to demonstrate its legitimacy, and any funds that flow to CCAC regions in response to such claims should be kept separate from those that flow through the formula so that adjustments can easily be made if circumstances change. An example may be a transition period after the closure of an important facility in a region. The formula will not immediately capture such an event and it may be appropriate to recognize this in the overall flow of funds to a CCAC region during the transition. This arrangement, however, should be temporary as the formula is able to

[9] By out-of-CCAC region use, we mean a situation in which the resident of the CCAC region receives services from another CCAC region.

capture the effects of this modified cost pattern in the long-run.[10]

Transition from historically-based to formula-based funding allocations. The formula is not able to determine an approach for the transition from historically-based funding allocations to needs-based funding allocations. It is the responsibility of policy-makers and committee members to determine how to carry out such a transition.

[10] It is important to emphasize that such adjustment are temporary. Adjustment for more permanent factors such as differing average costs associated with CCAC region characteristics are explored as part of the formula development.

4.0 ANALYTIC STRATEGY FOR DEVELOPING THE FUNDING FORMULA

In this section we outline the analytic strategy CHEPA used to develop a funding formula that can serve as a basis for allocating the provincial budget for home care and community support services to CCAC regions in Ontario.

4.1 Guiding Principles

CHEPA's work in developing the funding formula was guided by the following principles:

a) Develop a population, needs-based funding formula that will represent, as accurately as possible, the *relative* need for home care and community care resources among CCAC regions. The intent of the approach is to determine a region's relative need for resources in a way that does not depend upon the past level of resources received by the region.

b) Seek consensus from the Community Funding Review Committee regarding a set of adjusters to be evaluated for possible inclusion in a needs-based formula. In generating a set of possible adjusters, there should be a sound conceptual relationship between each adjuster and expected need for home care and community support service resources in a CCAC region.

c) Seek consensus from the Committee regarding the best way to represent these factors empirically given the available data.

d) Include health care system variables as adjusters only when the variable under consideration is not under the control of a CCAC.

e) Adjust for costs beyond the control of a CCAC.

f) Adjust for out-of-area use through a mechanism other than the funding formula

4.2 The Analytic Strategy for Developing the Funding Model

The richest source of data currently available upon which to base the development of a needs-based funding formula for home care and community support services is the 1996/97 Ontario component of the National Population Health Survey (NPHS) (hereafter referred to as the Ontario Health Survey). The survey provides detailed demographic, economic, health and related information on a random sample of Ontario residents and, for a sub-sample of individuals, this information was linked to the administrative files from the Ontario MOHLTC, which document utilization of a wide range of services, including home care, hospital services and physician services. For the sub-sample of individuals for which survey information was linked from MOHLTC

administrative data, therefore, we have detailed information on individuals and their health care utilization.[11] Even this database, however, has important limitations and so it must be supplemented with additional data to do the full analysis.

The development of the funding formula includes four distinct types of analyses. We discuss each element in detail below, but we first want to provide a brief overview of the overall approach.

4.2.1 Estimation of a Model for the Need for Home Care and Community Support Services Among the Population Under Age 12.

The need for a separate model for those over age 12 and for those aged 0 to 11 arises because the sample size among the latter sub-set of the population in the Ontario Health Survey is too small to provide a valid basis for formula development. We therefore will use the existing equity funding formula to allocate funds to CCAC regions for the population under 12. We discuss this component in detail in Section 8.

4.2.2 Estimate a Model of the Need for Home Care and Community Support Services Among Residents of Ontario Aged 12 or Over

The goal of the first part of the analysis is to estimate a provincial-level model of the determinants of need for home care and community support services among the population of age 12 or over in Ontario. We discuss this component in detail in Section 5. This model is estimated based on an individual's use of home care, his/her characteristics (e.g., age, sex, health status) and the characteristics of the area[12] in which the person lives.

4.2.3 Determining CCAC Region Budget Shares Residents Aged 12 and Over

The Ontario Health Survey is a representative sample of the population of Ontario. Therefore, from the model estimated as per above, and using survey information, it is possible to estimate the needs-based budget share for each CCAC region in Ontario based on the characteristics of each CCAC region's population. We discuss this in Section 9.0.

4.2.4 Adjustment for Factors Not Included in the Formula

Funding to a CCAC region should be adjusted for factors that cannot be incorporated into the formula. We analyzed the appropriateness of such an adjustment for two factors. The first was whether there are differences in the average cost of providing home care services between CCAC regions with low population density and those with high population density, and between high-

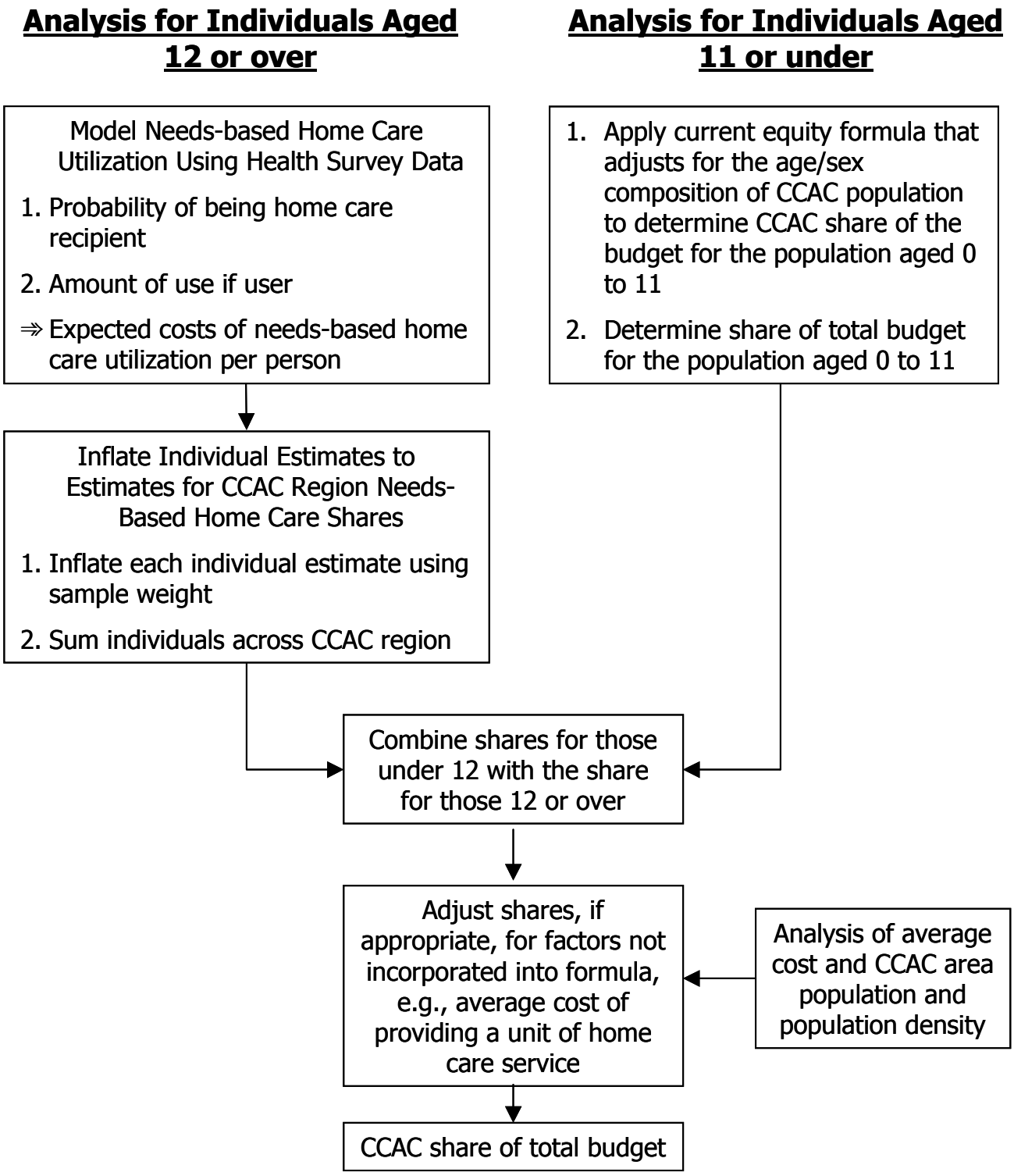
[11] All information is, of course, anonymized so that the researchers cannot identify any of the individuals surveyed.

population CCAC regions and small-population CCAC regions. The second was to assess whether it would be appropriate to adjust the funding to those CCAC regions that experience an influx of temporary summer residents. We discuss this component in detail in Sections 10 and 11.

The complete flow of the analysis is depicted in Figure 4.1.

[12] In some cases this was characteristics of the individual's CCAC region; in other cases it was characteristics of the individual's county (or census (sub)division).

Figure 4.1: Flow of the Analysis



5.0 MODELLING THE HOME CARE AND COMMUNITY SUPPORT SERVICE NEEDS OF ONTARIANS AGED 12 OR OVER

The objective of the analysis is to estimate the expected dollar value of needed home care services for a resident of Ontario aged 12 or over. As noted above, the analysis is based primarily on data contained in the 1996-97 Ontario Health Survey, linked to MOHLTC administrative claims files, and supplemented with additional data as required.

The framework guiding the analysis is Andersen and Newman's Behavioral Model of Health Service Utilization [Andersen R and Newman J 1973] and subsequent enhancements.[Phillips KA, Morrison KR, Andersen R, and Aday LA 1998; Aday LA and Andersen R 1974; Andersen R 1995] This model posits four types of factors that affect utilization of a health care service:

a) Need (i.e., variables that represent, or are correlated with, need for home care services in a region);
b) Enabling resources (i.e., those conditions within the family or community that influence the individual's ability or the means to secure such services);
c) Predisposing factors (i.e., factors that predispose an individual to use or not to use home care services);
d) Environmental factors, particularly characteristics of the health care system and communities in a region.

The framework and these categories were drawn upon solely for their usefulness in guiding our identification of potential adjusters and in thinking about the relationship among adjusters and between adjusters and home care use/need.[13]

The unit of analysis used to develop the provincial model is an individual person. An individual's use of publicly funded home care is used as a proxy for need for home care. There are three potential limitations of this measure for our analysis. First, utilization is admittedly an imperfect measure of need; but, it is the best currently available. Because the analysis is based on a province-wide sample with the goal of estimating a provincial-level model, variations in home care use induced by current inequities in funding across CCAC regions will not directly affect the estimated model (more on this below). In addition, as we describe below, in our model we attempt to identify separately need-related and non-need-related factors that influence use of home care, and

[13] The same variable may at times be seen to fall within more than one category. Our concern was not with refining the categories but in using them to ensure that we were comprehensive in our approach.

to base the funding formula on variation only of need-related drivers of utilization. The second limitation is that although the funding formula will be used to allocate funds for both home care and community support services, this measure of need excludes the utilization of community support services because comprehensive individual-level data on utilization of community support services are not currently available. If the need for community support services is proportional to the need for direct home care services, this limitation will not lead to systematic bias in the formula. To the extent that the needs for the two types of services are not proportional, however, the formula will be unable to fully reflect the need for both.[14] A third limitation is that the data exclude CCAC case management and overhead costs, which are not allocated to individual clients.

The expected home care expenditure on person i living in CCAC region j is:

Expected Home Care Expenditure$_{ij}$ = f(characteristics of person i in region j, characteristics of CCAC region j)

A major task in implementing this approach is to identify the full set of individual and regional factors that may influence home care utilization, and to categorize each factor as need-related and non-need-related.

5.1 Identifying Potential Adjusters

The following principles guided the process of identifying potential adjusters:

- Identify the adjusters from each of the above noted four categories: need, predisposing, enabling and environmental factors.
- Do not be limited initially by data availability — identify all those factors thought to be important and worry about measurement problems later.
- Include factors beyond the control of the CCAC that affect the cost of delivering home care services in a region.
- Include health care system measures only where that facet of the health care system is beyond the control of CCACs and is related to need/demand for home care and/or community support services.
- Include only adjusters for which there is an identified plausible relationship between the adjuster and home care need for a person or region.

[14] The current equity funding formula based on age-sex adjustment is also based on utilization of only direct home care services. As better data on community support services become available, this limitation can be at least partially addressed in future revisions to the formula.

Three basic sources were used to identify adjusters:

- Literature on needs-based funding
- Investigator experience
- Members of the CFRC

An extensive literature search of funding methods/approaches used for home care health services and, more specifically, of adjusters for the need for home care was performed (see section 2 above and Appendix A for the literature search strategy). Reference lists of 'key' publications were scanned to identify additional documents that may not have been captured by the computerized search. This first phase identified adjusters documented in the literature to be correlated with the utilization of home care services or that predict future need for home care services.

CHEPA investigators identified a number of other reports and journal articles that analyzed candidate adjusters for the need for home care services and conducted a series of "brainstorming" sessions to identify additional possible adjusters.

Finally, CHEPA investigators consulted with CFRC members and with other CCAC leaders. The consultations with the CFRC took place at regular meetings of the Committee at which CHEPA presented its work. Consultations with CCAC leaders took place at a single meeting at which CHEPA presented its approach (September 8, 2000). These consultations generated a number of potential adjusters beyond those identified in the literature or by the CHEPA investigators. Table 5.1 provides a list of the potential adjusters (or type of factor) identified. Below we will discuss how we represented these in the analysis.

5.2 The Statistical Model

The vast majority of individuals do not use home care in a given year, and among those who do use home care the distribution of expenditures tends to be highly skewed, with a small number of individuals having very high expenditures. The statistical techniques employed to estimate the model must be robust to these types of data. We employ what is commonly referred to as the two-part utilization model.[Jones A 2000] The two-part model divides the utilization process into one part that examines the yes/no question of whether an individual uses any home care services, and a second part that examines the expected amount of use given a positive answer in the first part. That is, the expected home care expenditure for person i in CCAC region j is as follows:

$$\text{Expected Home Care Expenditure}_{ij} = \text{Prob}(\text{use}_{ij}) * E(\text{amount of use}_{ij} | \text{some use}_{ij})$$

Each part of the two-part model can be estimated separately and then combined to obtain the

expected home care expenditure for each individual.

The dependent variable for the first part, the use/no-use analysis, is a discrete variable that takes on the values of 0 for those who do not use any services and 1 for those who do. It is estimated by using a discrete choice model (most commonly either a logit or a probit model) applied to the full study sample (i.e., both users and non-users).

The second part is applied only to those who used home care during the period under analysis. The dependent variable is the dollar value of the home care services an individual received. As noted above, these data tend to be highly skewed. The most common approach to deal with this is to transform the dependent variable to be the natural logarithm of expenditure.

This often corrects the underlying skewness, but it introduces an additional problem. Because the dependent variable is the logarithm of expenditure, the value predicted from the equation must be transformed back into the original dollar scale to obtain an estimate of expected expenditures. This process is not always straightforward and under certain conditions the retransformation process can introduce bias in the calculation of expected home care expenditures. The problem arises if the variance of the residuals of the regression equation is not constant. A second approach is therefore sometimes recommended. This alternative approach is to estimate the second-part using a general linear model (GLM), which allows one to estimate the model using the untransformed expenditure data while still taking into account the underlying skewness of the expenditure data. The approach that produces estimates with the least bias and greatest precision depends on the structure of the variance in expenditures among individuals in the sample. In estimating the model we tested which approach was most appropriate. Details regarding the statistical model can be found in Appendix B [Manning and Mullahy 2001; Jones A 2000; Mullahy 1998; Manning 1998; Duan 1983].

5.3 The Data

The key data source for the study is the Ontario Health Survey with linked individual-level utilization data for home care services, (Ontario Home Care Administration System -OHCAS-database), hospital services (CIHI Discharge Abstract Database), and physician services (OHIP claims data and HSO Encounter data). These data have been supplemented with 1996 Census data, data on the health care system from the Ontario Ministry of Health and Long-Term Care (e.g., physician supply, hospital chronic bed supply, long-term care bed supply), and miscellaneous other

data as were required.[15]

The 1996-97 Ontario Health Survey was part of the National Population Health Survey and was designed to collect information related to the health of Ontarians. The total sample size for the Ontario component was 36,892. The sample was selected so as to "get sufficient sample size to provide reliable cross-section estimates at the sub-provincial (health area) level".[Statistics Canada 1998] There are 23 Ontario health regions. The survey data were linked to MOHLTC utilization data for a sub-sample of 23,402 individuals.

Information collected in the health survey includes the following: an individual's age, sex, marital status, self-assessed health status, chronic conditions, activities of daily living for which they require assistance, functional status, social support, living arrangements, household income, as well as the respondent's use (yes/no answer for each) of various health care services (e.g., having been an overnight patient in a hospital or nursing home in the last 12 months; use of home care and type of home care, i.e., nursing care, personal care, housework services, respite care, and meal preparation and delivery).

5.4 Variable Specification

5.4.1 The Dependent Variable

The dependent variable for the overall model is defined as the dollar value of direct publicly financed home care services received from a CCAC during the 32-month period surrounding the respondent's survey interview date (i.e., 16 months before and 16 months after the interview date). The utilization data are obtained from the OHCAS administrative claims file. There are a number of things to note about these data.

a) The survey interviews took place between May 1996 and August 1997. Therefore, for the earliest person interviewed, the 32 months runs from January 1995 to September 1997; for the last person interviewed, the 32 months runs from April 1996 to December 1998.

b) The direct services included in OHCAS Service Advice data file are as follows:

- Nursing care
- Physiotherapy
- Occupational therapy
- Speech and language therapy

[15] We obtained data defined at a number of jurisdictional levels such as census divisions, counties, health regions, CCAC regions, public health units, and so forth. We developed a mapping among all of these variously defined geographic areas to allow us to integrate data collected at these various levels.

- Dietetic services
- Social work
- Personal support
- Personal support/homemaking
- Laboratory services
- Respiratory technology
- Enterostomal therapy
- Meals on wheels

The measure of home care expenditures therefore excludes case management services, administrative expenditures, medical supplies and equipment, palliative care[16] and community support services.

c) Although the formula to be developed will be used to allocate both home care and community support service resources, the analysis will be based only on the above mentioned direct home care services and activities. The validity of the analysis therefore depends on whether needs for community support services are proportional to needs for home care and whether excluded CCAC expenditures are proportional to direct service expenditures.

d) The OHCAS Service Advice database does not include expenditure information. It includes information on the number of units of each type of service received by an individual. We therefore combined this information with data on the provincial average cost per unit of each type of service to generate an estimate for the total home care expenditure for each person. The data on the average cost per unit of each type of service were obtained from this Community Support Service (CSS) data file.[17] That is:

[16] Palliative care services are often coded as nursing care and homemaking/personal support services but not identified as palliative.

[17] Because neither the OHCAS nor the CSS databases distinguish shift nursing services from visit nursing services, we measure both nursing services and the average cost of nursing services with some error (as does the current equity formula). Some bias may result to the extent that the relative use of shift and visit nursing services varies across CCAC regions. Attempts to collect data regarding the relative importance of these two types of nursing services and their average costs did not yield data to provide a basis on which to judge what bias, if any, is introduced because of this measurement problem.

Home care expenditures for person i = $\sum_k U_{k,i}$*$ACPU_k$

where: $U_{k,i}$ = Number of units of service k received by individual i during the 32-month period surrounding i interview date

$ACPU_k$ = Provincial average cost of providing a unit of service k in 1998-99 and 1999-00 as calculated from the MOHLTC Community Support Service (CSS) database[18]

As Table 5.2 indicates, of the 23,062 people in the survey with linked data, 1484 used home care in the 32-month period surrounding their interview date. The average expenditure on home care across the full sample was $242; the average expenditure among those who used home care was $3755.

The vast majority of records (18,275) had complete information on all variables used in the analysis. The variable with the most number of missing values was, not surprisingly, income. When a record was missing values for two or fewer variables, we imputed values that were missing. Appendix C documents the missing values and the methods used to impute values when there were two or fewer missing values for an observation.

5.4.2 The Adjuster Variables

Table D1 in Appendix D provides information on all of the adjusters considered and the rationale for their inclusion or exclusion. Table 5.2 presents the variables included in the utilization analysis along with descriptive statistics on them.

5.4.2.a Need Adjusters

Nearly all needs-based funding models for home care adjust for a respondent's age and sex. Use of home care is strongly correlated with a person's age, and we expect a positive relationship between age and both probability of home care use and the total cost of home care services received. In order to capture non-linear aspects of the age-home care relationship we experimented with two types of specifications for the age variable. In one specification both age and its square (age^2) are included in the model. In a second specification we created a series of categorical variables to indicate a person's age (the omitted reference category in estimation was age less than 19).[19] The

[18] That is, we used for average value for the two year period 1998-99 and 1999-2000. Using the average reduces the chance of basing estimates on a value that may reflect temporary fluctuations in average costs for one or more of the services.

[19] These allow the impact of aging five years on the probability and amount of home care utilization to be different between ages 30-35 than it is between ages 75-80 (other things equal, we would expect the latter to have a larger impact on home care use).

average age of respondents was 44.8, with a range of 12 to 102. In part because they live longer, females receive more home care services than males, but it is not obvious *a priori* if females have a higher likelihood and amount of use once we control for age and a number of dimensions of a respondent's health and social status. Hence, we have no strong prior expectations for the sign of the independent impact of sex on home care utilization. 53% of the sample were female (the omitted reference category in estimation was male).

We include two health status measures to represent likelihood of long-term use of home care. The first is the respondent's self-assessed health status (sahs), which is a general health status measure rated on a 5-category scale from excellent to poor and which has been widely validated as the best single-question measure of health status [Friedsam HJ and Martin HW 1963; Maddox GL and Douglas E 1973; LaRue A, Bank L, Jarvik L, and Hetland M 1979; Linn BS and Linn MW 1980; Linn MW, Hunter KI, and Linn BS 1980; Tissue T 1972; Nagi SQ 1976; Fillenbaum GG 1979; Kaplan GA and Camacho T 1983; Mossey JM and Shapiro E 1982; Davies AR and Ware JE Jr. 1981]. The person's health status enters as a series of binary dummy variables (e.g., sahs1 takes on a value of 1 if the person rates their health as excellent, and a value of 0 otherwise; sahs2 takes on a value of 1if the person rates their health as very good and 0 otherwise, etc.). Again, this allows for non-linearities in relationship between health status and use of home care.[20] The distribution of sample respondents across health status categories was as follows: excellent health, 24%; very good health, 39%; good health, 25%; fair health, 9%; and poor health, 3%. The omitted reference category in estimation was excellent health. The second measure of health status is the number of chronic conditions from which the individual suffers. Survey respondents were asked if they suffered from any of a set of specified chronic conditions.[21] We expect the number of chronic conditions to be positively related to home care use. The variable again enters the model as a series of binary dummy variables, to allow for non-linearities in its relationship to home care use.[22] The mean number of chronic conditions per respondent was 0.56, with a range of 0 to 7. The omitted reference category in estimation was fewer than 4 chronic conditions.

[20] The impact on use of home care of a one-category change, for example, from excellent health to very good health may be different than a one-category change from fair to poor health status.

[21] We do not include all such conditions as some would not be expected to be related to home care. The nine conditions included in our measure were: arthritis or rheumatism, back problems excluding arthritis, chronic bronchitis or emphysema, diabetes, heart disease, cancer, effects of a stroke, urinary incontinence, Alzheimer's Disease or other dementia.

The demand for home care is increasingly driven by those with short-term needs following an acute illness or injury, most commonly subsequent to hospital discharge. To capture this source of home care use, we include a measure of a respondent's hospital separations during the study period. Specifically, as we are attempting to explain home care use in the 32-month period surrounding the survey interview date, we include a series of dummy variables to indicate whether the respondent had zero, one, or two or more hospital discharges during this same 32-month period. The separations could have been for either an in-patient stay or a day procedure. Approximately 69% of the sample had no hospital separations, 18% had one, and 13% had two or more. The omitted reference category in estimation was no hospital admissions.

We include one measure of functional status, the number of five activities of daily living (personal care, shopping for groceries, everyday housework, preparing meals, and moving about in the house) for which the respondent requires assistance. We again specified this as a series of dummy variables to indicate the number of activities of daily living for which the respondent required assistance. We expect such needs to be positively related to home care use. The average number of activities for which respondents needed help was 0.15, with a range of 0 to 5. The omitted reference category in estimation was do not need assistance with any ADLs.

Our final "direct need" adjuster is whether the respondent is an aboriginal. Aboriginals are, in general, marginalized in our society and, other things equal, often have higher health and social service needs. This leads us to expect a positive relationship between aboriginal status and home care use. At the same time, because they are marginalized they may have reduced access to the home care system, which would tend to reduce the extent of the expected positive relationship. Less than 1% of the sample was aboriginal. The omitted reference category for estimation was non-aboriginal status.

5.4.2.b Enabling and Predisposing Adjusters

Use of home care depends in part on the presence of other individuals in one's life who may be able to assist with homemaking, personal care and minor health care. Marital status is included because a spouse can help with such needs. Other things equal, we expect those who are presently married to use less home care. The variable is specified dichotomously as "not currently married," which includes those who never married as well as those who are widowed, separated or divorced,

[22] In this case, a change from none to one chronic condition may have a different impact on home care use than a change from seven to eight chronic conditions.

versus those who are currently legally married or living with a common-law spouse. Approximately 54% of the sample was married (legal or common law). The omitted reference category in estimation was "married." Based on the same type of reasoning, we include three additional variables that indicate the extent to which an individual may have a network of others who may be able to assist them, thereby lessening the use of home care. The first is a variable that indicates whether the respondent is living alone or living with one or more people (omitted reference category is living with someone). The second is an index of the individual's perceived level of social support (the omitted reference category in estimation was positive level of social support).[23] The third is a variable indicating the respondent's frequency of contact with neighbours (omitted reference category in estimation was daily contact). The latter two are specified as a series of dummy variables to represent multiple levels of support or contact respectively.

We include two measures of the respondent's socio-economic status. The first is his/her highest level of formal education attained. There are two plausible reasons why home care use may be related to a person's educational attainment. The first is the well-established positive relationship between education level and health status.[Grossman and Kaestner 1997] To the extent that we imperfectly measure health status with the variables noted above, education level may pick up some residual health status effects. The second is the notion that those with higher education may have better knowledge of the services available and/or may be able to gain better access to services. These effects work in opposite directions: the former leads to a negative relationship between educational attainment and home care use; the latter leads to a positive relationship. The sign will depend on which effect dominates. Education enters the model as a series of dummy variables to capture differing effects of increments in education. Approximately 11% of the sample had less than grade 9; 22% had some secondary school or some trade school education; 27% were high school graduates, had some trade school or other post-secondary education; and 41% had some community college or university education, a bachelor's degree, MA, MSc, MD or PhD.

The second socio-economic measure included is the household's income per capita (i.e., total household income divided by the number of individuals in the household). Like education, there are two plausible reasons why use of publicly financed direct home care services would be related to household income. The first is the well-established positive relationship between income level and

[23] This variable is derived by Statistics Canada from a series of social support questions in the health survey (e.g., Do you have someone you can really count on for help?)

health status. [Marmot 1997; Evans and Barer 1994] To the extent that we imperfectly measure health status with the variables noted above, income level may pick up some residual health status effects. The second is the fact that those with higher incomes are more able to purchase private home care services outside the public system, lessening demand for publicly financed home care. These two effects work in the same direction: both lead us to expect a negative relationship between use of publicly financed home care and household income. Income enters as a series of dummy variables (again allowing for a non-liner relationship) indicating the quartile (e.g., lowest 25%, second highest 25%, etc.) of the income distribution into which the respondent's household income per capita falls (omitted category was higher income level).

The individual's number of visits to a GP/FP during the 32-month period of the analysis is included as a predisposing factor. The number of visits potentially reflects some residual health status effect, but we include it primarily to represent: (a) the individual's general proclivity to use health care services; and (b) the fact that those with regular GP contact may have better access to home care services through the efforts of their GP. All of these reasons lead us to expect a positive relationship between the number of GP visits and home care use. Once again, we experimented with including this as a continuous variable and as a series of dummy variables to allow for a non-linear relationship (omitted category in this case was no visits). The average number of visits over the 32 month period surrounding each respondent's interview was 15.3 and the median number of visits was 10; the range was 0 to 273.

The last enabling factor is the respondent's language abilities. Respondents who cannot speak English may face greater barriers to accessing home care services than those whose can speak English. The variable is specified as a series of dummy variables indicating if the respondents could speak English, speak French only, or speak only a language other than French or English (omitted reference category was speaks English). Over 99% of the sample could speak English.

5.4.2.c Environmental Factors

We include a series of variables related to the health care system in a respondent's region that may affect use of home care. The variables and their descriptive statistics are listed in Table 5.3.

As noted above, a growing demand for home care services emanates from the acute-care hospital sector, where in general the demand is for a short-term use of home care while recuperating from acute illness or injury. We therefore include a measure of "acute-hospital-induced home care

days per capita" in each CCAC region. Details of its construction are provided in Appendix E. Briefly, we calculated the provincial mean number of days of short-term home care utilization per discharge (inpatient or day procedure) for each ICD-9 three digit code.[24] We then applied this ICD-9 specific number of home care days to each CCAC region's profile of hospital discharges (i.e., the number of discharges in the CCAC region for each ICD-9 category) *for its residents* (i.e., the discharge was attributed to a patient's home CCAC region, regardless of where the hospital service was received). This provided us with an estimate of the number of days of home care in each CCAC region generated by the activity of the acute care hospital sector in the CCAC region. We then divided this by the population of the CCAC region to obtain the number of days of acute care induced home care per capita. We expect a person's use of home care to be positively related to this regional-level variable. The mean of acute-hospital-induced home care days was 0.24 with a range of 0.15 to 0.37 across CCAC regions. It is important to highlight that, in order to construct this variable, we did not use data on a sample of individuals; instead we were granted access to data on the total population of Ontario.

We include two measures of the supply of long term institutional care that could influence home care utilization. The first is the number of hospital-based chronic care beds per 10,000 residents by county.[25] Individuals admitted to a chronic care bed tend to: (a) be discharged to a long-term care facility; (b) remain in the chronic care hospital facility until death; or (c) for a minority, be discharged to home, most likely requiring home care support. Other things equal, we expect the number of chronic care beds will be positively related to home care use. The mean number of chronic care beds per 10,000 residents ranged from 2 to 19 and had an average of 9.8. The second measure is the number of long-term care beds, including nursing homes and homes for the aged, per 10,000 residents. Other things equal, such beds are potentially substitutes for home care, so this variable should be negatively correlated with home care use. To the extent that we cannot fully control for the underlying health and health care needs of residents, however, the two could be positively correlated as CCAC regions whose population have a higher need for assistance could have both more long-term care beds and use more home care services. The mean number of

[24] A home care episode was classified as being induced by an acute care hospital event if the admission to the home care program occurred within 7 days of discharge from hospital. A home care episode was defined as "short-term" if the total number of days admitted to the home care program was less than 90. See Appendix E for details.
[25] There are 49 counties in Ontario (they are identical to census divisions). In a number of cases, counties and CCAC regions coincide.

long-term care beds per 10,000 residents was 62, with a range of 19 to 98 across counties.

Because the availability of GP/FPs may facilitate access to home care, we include the supply of GP/FPs per 10,000 residents. Other things equal, we expect home care use to be positively related to GP/FP supply. The mean number of GPs/FPs per 10,000 residents was 9.5 with a range from 6 to 16.

The last variable included in the model is a measure of the degree of generosity of historical funding in the CCAC region. We use the ratio, for the 1996-'97 fiscal year, of the actual home care funding received by the CCAC region to the amount of funding the age-sex adjusted equity formula indicated the CCAC region needed. The ratio has been rescaled by multiplying the ratio by 10. The mean value of the raw scale ratio is 1.02 with a range from 0.91 to 1.44 across CCAC regions.

5.4.3 Classification of Adjusters as Need-related vs. Control Variables for Development of the Funding Formula

Our goal is to develop a needs-based funding formula that will allocate funds to the CCAC regions in keeping with the relative need for home care among the CCAC regions. However, we include in the utilization model a number of variables which, although posited to be related to home care use, are not need related.[26] They may influence demand for and utilization of home care, but give rise to potentially inappropriate utilization. Non-need, control variables that influence home care utilization must be included in the model of the utilization of home care services if we are to obtain valid estimates of the effect of true need-related variables. But they should not influence the allocation of funds. Therefore, at the stage at which the parameter estimates from the utilization model are used as a basis for determining the CCAC region budget shares, we do not include the influence of variation in the non-need control variables. The funding formula is to be based only on variation in need-related factors that are beyond the control of a CCAC. This includes, for instance, health status indicators as well as health system factors beyond the control of a CCAC that influence

[26] Language is a bit confusing here. The Newman and Anderson model includes "needs" variables as a category in their framework. By this they mean direct need characteristics of an individual (e.g., health status). We have used this concept in describing the variables above. In this section we use the term "need-related" in a broader sense to mean a variable that is legitimate to include in a need-based funding formula because it influences the utilization of home care in a way that makes it appropriate to compensate a CCAC region given the policy goals for home care.

the need for home care among CCAC region residents.[27]

This analytic strategy therefore requires that we categorize each of the variables included in the utilization model as either a "needs-related" variable, whose variation across individuals and CCAC regions will be included in the calculation of needs-based funding, or a "control" variable, whose variation across individuals and CCAC regions will not be included in the calculation of needs-based funding. We classify the variables as either: (1) clearly needs-related; (2) clearly non-need control; and (3) uncertain, meaning that some rationales posit it as control and others as need-related. In categorizing the variables we tried always to err on the side of adjusting for a potential need rather than under-adjusting. A fuller explanation for the rationale for each variable's classification is provided in Appendix F.

5.4.3.a Needs-related Variables for Inclusion in the Funding Formula

The following variables were judged to be definitely need-related, and were included in the development of the funding formulae: age, sex, marital status, aboriginal status, self-assessed health status, number of chronic conditions, number of activities for which individual requires help, living arrangement, social support index, contact with neighbours, number of GP/FP visits, number of hospital separations, the number of acute-care-induced home care days per capita in the individual's CCAC region, the number of chronic beds and the number of long-term care beds per 10,000 residents in the region.

5.4.3.b Control Variables that will be Excluded from the Funding Formula

The following variables were judged to be definitely not need-related; language, total GP/FP supply per 10,000 residents, relative CCAC region funding level in 1996/97.

5.4.3.c Variables for which the Classification was Uncertain

There was uncertainty as to the most appropriate classification of the following variables. *Education*. As noted above, the respondent's highest education level attained may be related to home care use for one or both of two reasons: it is correlated with unmeasured aspects of health status or it reflects the respondent's knowledge of and ability to gain access to services. The former

[27] An example of the latter is activity in the acute care hospital sector. CCAC regions with a disproportionately high number of hospital beds per resident may have a higher rate of hospital procedures, many of which will result in need for home care. Such hospital activity is beyond the control of the CCAC, however, and even if the initial hospital procedure was unnecessary, once the procedure is provided the home care following it is necessary. However important reducing the rate of inappropriate hospital activity is to improving overall health care system effectiveness and efficiency, this is a larger health system issue and the residents and community care organizations within a CCAC region should not be penalized for a factor beyond their control.

is a needs-related influence; the latter is a non-needs-related, control influence. If the observed relationship between education level and home care use is positive, it suggests that the latter influence dominates and education level should be treated as a control variable; if the observed relationship is negative, it suggests that the former dominates and education should be treated as a needs-related variable.

Household Income per Capita. Again, as noted above, household income per capita may be related to home care use for one or both of two reasons: it is correlated with unmeasured aspects of health status or it is correlated with access to private home care services, thereby decreasing need for publicly funded services. Both influences would lead to a negative relationship between income level and use of public home care services, so it is impossible to identify which may dominate. The former effect is clearly needs-related; the latter is more tricky. The public system's mandate is to meet the needs of all residents, not just those who cannot afford private services. Hence, to the extent this latter influence is operative, other things equal, it would not be in keeping with the mandate of the program to provide fewer funds to CCAC regions with higher income per capita. This would call for classifying the variable as a control and excluding it from the formula development. However, to the extent income represents either unmeasured aspect of health status or the fact that for a given health level lower-income individuals require more resources, treating it as a control would penalize low-income CCAC regions. For this reason, we lean toward classifying it as a need variable, again, admitting some uncertainty.

Number of Chronic Beds per 10,000 Residents: To the extent to which chronic care beds act as a substitute for home care, the relationship between home care use and number of such beds in a county will be negative. It would therefore be appropriate to adjust a region's funding to reflect the number of such beds. Historically, resource-regions may have both more home care and more chronic and long-term care beds, inducing a positive empirical relationship between the supply of such beds and home care use. In this case, it would be appropriate to treat the supply of such beds as a control variable.

Number of Long-term Care Beds per Capita: Same reasoning as for chronic care beds.

5.5 Finalizing Empirical Model Specification

Our approach to model specification began with a broad, comprehensive specification of the variables, including a number of age and sex interaction terms. We then proceeded to eliminate variables using explicit criteria. The criteria reflected the fact that, among the variables, there are differing degrees of both evidence and conceptual foundation for the expected relationship between a variable and need for home care. Our goal was to develop a relatively parsimonious model that nonetheless retained substantial explanatory power. The key criteria were as follows.

1. Tests of statistical significance:
    a. Groups of variables: if tests of significance for groups of related variables indicated that they were jointly not statistically significant at the 5% level, they were dropped from the model. This was used primarily to eliminate groups of interaction terms for which we had no strong prior hypotheses.
    b. Individual variables: if the t-statistics on an individual variable was less than 1.0 (which corresponds to a p-value of greater than 0.32), we dropped the variable from the model.[28] This criterion was used as a rule of thumb because, in a standard regression context, variables for which the t-stat is less than 1.0 essentially add no explanatory power to the model.
2. Plausibility of the Suggested Relationship: because the model is to serve as a basis for allocating resources to CCAC regions, even if a variable specification met the above statistical criteria, if it generated coefficient estimates with implausible implications for resource allocation we experimented with alternative specifications that retained desirable statistical properties but were more plausible. The issue arose primarily for variables with a number of possible levels for which it was necessary to collapse some categories.

There were two exceptions to the statistical criteria. First, when a variable that represented an intermediate level of a factor did not meet the t-test criterion, but the surrounding levels of the factor did, the intermediate level was nonetheless retained. Second, we retained all the 5-year age and age-sex interactions terms. This is because we will examine alternative funding approaches that integrate information from the models based on survey data with actual population-level age-sex

[28] An exception to this was the age variables, which we specified to match the age-categories used in the current equity formula. The desirability of this specification arose from a funding option explored later in the report related to an "adjusted equity formula".

data (see chapter 12 below).

Where multi-collinearity is present among variables, the final specification can be sensitive to the order in which variables are eliminated from the model. This is not a serious problem in the present context both because multi-collinearity was in general not severe in our data and because the goal of our analysis is not to test the causal relationship between one or more variables and home care use. Rather, the goal of this analysis is to develop a model that balances parsimony and ease of interpretation against the desire to achieve maximum explanatory power. We acknowledge that in some cases, correlation among independent variables may cause the measured relationship with home care use to reflect more than just the effect of the variable itself.

Because we do not use ordinary least squares regression methods, commonly used and easily interpretable measures of model fit such as the R^2 statistics are not available. Assessing fit is further complicated by the fact that some of the measures used for unweighted regression models are not available for weighted regressions (which must be used to capture the effects of the design of the health survey). We therefore rely on a series of alternative measures to assess model fit, looking for convergence across the set of indicators. For both the logistic regression in part 1 of the model and the part 2 analysis we used unweighted models (for which more diagnostic options are available) for aspects of the model building exercise, and checked results against weighted models. In all cases final parameter estimates and share calculations are based on weighted regression models. For the unweighted logistic model we assessed explanatory power using summary measures of goodness-of-fit, including of pseudo-R^2, Hosmer-Lemeshow goodness-of-fit statistics, ROC-curve analysis, likelihood ratio tests. For the weighted regression models we rely on Wald tests of significance, measures of bias and mean squared error in predicted probabilities, and differences in the mean predicted probability of use among users and non-users. For part 2 we performed basic model building using an unweighted OLS specification with a log-transformed dependent variable, and relied on adjusted-R^2 measures and F-tests. For the weighted GLM specifications we relied on Wald tests of significance and the Akaike Information Criteria.

Table 5.1: Candidate Adjusters for Utilization Analysis

	Variable	Rationale
INDIVIDUAL-LEVEL NEED INDICATORS		
Demographic Characteristics	Age, sex	Arguably the most important adjuster for home care services; commonly used adjusters that capture need for a wide range of health care services
	Ethnicity, language	May be linked to reduced access to home care services
Health Status Measures	Self-assessed health status	The simplest and the best indicator of general health status
	Presence of chronic conditions	Clear link between presence of chronic conditions and need for home care, especially long-term use of services
	Acute illness events, particularly hospitalizations	Captures short-term need for home care, a growing and changing component of home care need
	Physician visits	May be linked to need for services as well as ability to access health care system
ENABLING AND PREDISPOSING INDICATORS		
	Need help of another person in activities of daily living (ADL)	Clear link between need for help with ADL and need for home care services
	Marital status	Other things equal, presence of spouse may reduce need for home care
	Availability of social support	Other things equal, individuals with less social support require more home care services
	Living arrangements	Other things equal, those living alone are more likely to need home care

Table 5.1: Candidate Adjusters for Utilization Analysis, cont'd.

	Variable	Rationale
	Contact with neighbours	Similar in rationale to that for social support
	Education level	An individual's education level may influence whether he/she has knowledge to seek home care services and/or whether the individual needs such services
	Income	May influence individual's need for home care as well as access to private care
ENVIRONMENTAL INDICATORS		
	Level and pattern of hospital-based acute care activity in the individual's CCAC region	Other things equal, an individual's use of home care services may be influenced by the level of home care inducing hospital activity in the region
	Supply of chronic care and long-term care beds	These can function as substitutes for home care, therefore their supply may influence use of home care
	Supply of specialized health care facilitators such as children's treatment centres and acquired brain injury treatment centres	Strains on home care system will be influenced by the presence of such centres
	Supply of GP/FPs in region	May facilitate access to home care services
	Relative generosity of CCAC region's historical home care budget	Individuals in "overfunded" CCAC region may be more likely to use home care than those in "underfunded" CCAC regions
	Cost of providing home care	Costs beyond the control of CCACs may vary across CCAC regions

Table 5.2: Variable Specifications

Variable Description	Variable Name	Values	Source Data	No. of obs.*	Mean	S.d.	Range
Dependent Variables							
Did individual receive direct public home care service in 32 months surrounding interview date	hc_use	0 = No home care use 1 = Home care use	OHCAS Service Advice File	23062	0.06	0.25	0 – 1
Cost of home care services received	exp_hc	Continuous	• OHCAS Service Advice File • CSS data file	1484	$3755.05	$6334.97	$20.33 – $52430.3
Independent Variables **Demographic Variables**							
Age							
Age	age	Continuous	Registered Persons Database	23062	44.82	19.01	12 – 102
Age less than 19	agelte_19	0 = No 1 = Yes	Registered Persons Database	23062	0.09	0.29	0 – 1
Between the ages of 20 and 24	age20_24	0 = No 1 = Yes	Registered Persons Database	23062	0.07	0.25	0 – 1
Between the ages of 25 and 29	age25_29	0 = No 1 = Yes	Registered Persons Database	23062	0.08	0.27	0 – 1
Between the ages of 30 and 34	age30_34	0 = No 1 = Yes	Registered Persons Database	23062	0.11	0.31	0 – 1
Between the ages of 35 and 39	age35_39	0 = No 1 = Yes	Registered Persons Database	23062	0.11	0.31	0 – 1
Between the ages of 40 and 44	age40_44	0 = No 1 = Yes	Registered Persons Database	23062	0.09	0.28	0 – 1

Variable Description	Variable Name	Values	Source Data	No. of obs.*	Mean	S.d.	Range
Age (cont'd)							
Between the ages of 45 and 49	age45_49	0 = No 1 = Yes	Registered Persons Database	23062	0.08	0.27	0 – 1
Between the ages of 50 and 54	age50_54	0 = No 1 = Yes	Registered Persons Database	23062	0.07	0.25	0 – 1
Between the ages of 55 and 59	age55_59	0 = No 1 = Yes	Registered Persons Database	23062	0.06	0.24	0 – 1
Between the ages of 60 and 64	age60_64	0 = No 1 = Yes	Registered Persons Database	23062	0.06	0.24	0 – 1
Between the ages of 65 and 69	age65_69	0 = No 1 = Yes	Registered Persons Database	23062	0.06	0.24	0 – 1
Between the ages of 70 and 74	age70_74	0 = No 1 = Yes	Registered Persons Database	23062	0.06	0.23	0 – 1
Between the ages of 75 and 79	age75_79	0 = No 1 = Yes	Registered Persons Database	23062	0.04	0.19	0 – 1
Between the ages of 80 and 84	age80_84	0 = No 1 = Yes	Registered Persons Database	23062	0.02	0.15	0 – 1
Between the ages of 85 and 89	age85_89	0 = No 1 = Yes	Registered Persons Database	23062	0.01	0.1	0 – 1
Age greater than or equal to 90	agegte90	0 = No 1 = Yes	Registered Persons Database	23062	0	0.06	0 – 1
Other demographic variables							
Sex of respondent	sex	0 = Male 1 = Female	Ontario Health Survey	23062	0.53	0.5	0 – 1
Marital status	marital	• 0=Married, common law or living with partner • 1=Single, widowed, separated or divorced	Ontario Health Survey	23050	0.46	0.5	0 – 1

Variable Description	Variable Name	Values	Source Data	No. of obs.*	Mean	S.d.	Range
Socioeconomic Variables							
Household income per capita							
Household income per capita	hipc_cat	• 1=$0 to $11,199 • 2=$11,200 to $15,999 • 3=$16,000 to $23,999 • 4=$24,000 or over	Ontario Health Survey	18883	2.59	1.14	1 – 4
$0 to $11,199	inc1	0 = No 1 = Yes	Ontario Health Survey	18883	0.24	0.43	0 – 1
$11,200 to $15,999	inc2	0 = No 1 = Yes	Ontario Health Survey	18883	0.23	0.42	0 – 1
$16,000 to $23,999	inc3	0 = No 1 = Yes	Ontario Health Survey	18883	0.24	0.43	0 – 1
$24,000 and over	inc4	0 = No 1 = Yes	Ontario Health Survey	18883	0.29	0.46	0 – 1
Education level							
Education level	edu_lvl	1 = Less than grade 9 2 = Some secondary or trade school 3 = Secondary grad., other post-secondary, diploma 4 = Some college, some univ'ty, BA, MA, MSc, MD, PhD	Ontario Health Survey	22887	2.97	1.03	1 – 4
No schooling or elementary (less than grade 9)	educ1	0 = No 1 = Yes	Ontario Health Survey	22887	0.11	0.31	0 – 1
Some sec. or trade school	educ2	0 = No 1 = Yes	Ontario Health Survey	22887	0.22	0.41	0 – 1
Sec. grad/ Other post-sec/Diploma	educ3	0 = No 1 = Yes	Ontario Health Survey	22887	0.27	0.44	0 – 1
Some college/ Some university/BA/MA/MSc /MD/PhD	educ4	0 = No 1 = Yes	Ontario Health Survey	22887	0.41	0.49	0 – 1

Variable Description	Variable Name	Values	Source Data	No. of obs.*	Mean	S.d.	Range
Self-assessed Health Status							
Self Assessed Health Status	sahs	1 = Excellent 2 = Very good 3 = Good 4 = Fair 5 = Poor	Ontario Health Survey	23062	2.28	1.02	1 – 5
Excellent Health	sahs1	0 = No 1 = Yes	Ontario Health Survey	23062	0.24	0.43	0 – 1
Very good health	sahs2	0 = No 1 = Yes	Ontario Health Survey	23062	0.39	0.49	0 – 1
Good health	sahs3	0 = No 1 = Yes	Ontario Health Survey	23062	0.25	0.44	0 – 1
Fair health	sahs4	0 = No 1 = Yes	Ontario Health Survey	23062	0.09	0.28	0 – 1
Poor health	sahs5	0 = No 1 = Yes	Ontario Health Survey	23062	0.03	0.17	0 – 1
Number of seven possible chronic conditions							
Number of seven possible chronic conditions	chronic	0 to 7	Ontario Health Survey	23062	0.56	0.88	0 – 7
No chronic conditions	chron0	0 = No 1 = Yes	Ontario Health Survey	23062	0.63	0.48	0 – 1
1 chronic condition	chron1	0 = No 1 = Yes	Ontario Health Survey	23062	0.23	0.42	0 – 1
2 chronic conditions	chron2	0 = No 1 = Yes	Ontario Health Survey	23062	0.09	0.29	0 – 1
3 chronic conditions	chron3	0 = No 1 = Yes	Ontario Health Survey	23062	0.03	0.17	0 – 1

Variable Description	Variable Name	Values	Source Data	No. of obs.*	Mean	S.d.	Range
Number of seven possible chronic conditions (cont'd)							
4 chronic conditions	chron4	0 = No 1 = Yes	Ontario Health Survey	23062	0.01	0.1	0 – 1
5 chronic conditions	chron5	0 = No 1 = Yes	Ontario Health Survey	23062	0	0.05	0 – 1
6 chronic conditions	chron6	0 = No 1 = Yes	Ontario Health Survey	23062	0	0.02	0 – 1
7 chronic conditions	chron7	0 = No 1 = Yes	Ontario Health Survey	23062	0	0.01	0 – 1
Number of ADLs requiring assistance							
Number of ADLs requiring assistance	needhelp	0 to 5	Ontario Health Survey	23062	0.15	0.68	0 – 5
0 ADLs	needh0	0 = No 1 = Yes	Ontario Health Survey	23062	0.93	0.25	0 – 1
1 ADL	needh1	0 = No 1 = Yes	Ontario Health Survey	23062	0.03	0.16	0 – 1
2 ADLs	needh2	0 = No 1 = Yes	Ontario Health Survey	23062	0.01	0.12	0 – 1
3 ADLs	needh3	0 = No 1 = Yes	Ontario Health Survey	23062	0.01	0.11	0 – 1
4 ADLs	needh4	0 = No 1 = Yes	Ontario Health Survey	23062	0.01	0.08	0 – 1
5 ADLs	needh5	0 = No 1 = Yes	Ontario Health Survey	23062	0.01	0.09	0 – 1

Variable Description	Variable Name	Values	Source Data	No. of obs.*	Mean	S.d.	Range
Social Support Index							
Social Support Index (SSI)	socsupp	0=No social support; 1=2nd lowest level of support; 2=Medium level of support; 3=2nd highest level of support; 4=Highest level of support	Ontario Health Survey	22393	3.79	0.66	0
Lowest level of support	soc0	0 = No 1 = Yes	Ontario Health Survey	22393	0.01	0.1	0 – 1
2nd lowest level of support	soc1	0 = No 1 = Yes	Ontario Health Survey	22393	0.02	0.12	0 – 1
Medium level of support	soc2	0 = No 1 = Yes	Ontario Health Survey	22393	0.03	0.16	0 – 1
2nd highest level of support	soc3	0 = No 1 = Yes	Ontario Health Survey	22393	0.07	0.25	0 – 1
Highest level of support	soc4	0 = No 1 = Yes	Ontario Health Survey	22393	0.88	0.32	0 – 1
Contact with Neighbours							
Frequency of contact with neighbours	contneib	0 = Daily contact 1 = Some, but less than daily 2 = No contact	Ontario Health Survey	22477	0.89	0.61	0 – 2
Daily	contact0	0 = No 1 = Yes	Ontario Health Survey	22477	0.25	0.43	0 – 1
Some, but less than daily	contact1	0 = No 1 = Yes	Ontario Health Survey	22477	0.61	0.49	0 – 1
None	contact2	0 = No 1 = Yes	Ontario Health Survey	22477	0.14	0.35	0 – 1

Variable Description	Variable Name	Values	Source Data	No. of obs.*	Mean	S.d.	Range
Other socio-economic variables							
Living arrangement	dlivarr	0 = With someone 1 = Alone	Ontario Health Survey	23061	0.22	0.41	0 – 1
Aboriginal status	aborig	0 = No 1 = Yes	Ontario Health Survey	23034	0.01	0.09	0 – 1
No. of activities which respondent needs help	needhelp	0 to 5	Ontario Health Survey	23060	0.15	0.68	0 – 5
Language spoken							
Language Spoken	speaks	0 = Speaks English 1 = Speaks French only 2 = Does not speak English nor French	Ontario Health Survey	23055	0.01	0.15	0 – 2
Speaks English	lang0	0 = No 1 = Yes	Ontario Health Survey	23055	0.99	0.09	0 – 1
Speaks French only	lang1	0 = No 1 = Yes	Ontario Health Survey	23055	0	0.06	0 – 1
Does not speak English nor French	lang2	0 = No 1 = Yes	Ontario Health Survey	23055	0	0.07	0 – 1
Health Care Utilization Variables							
Total number of GP/FP visits in 32 month period surrounding interview date							
Number of GP/FP visits	visits	continuous	OHIP claims and HSO encounter data	23062	15.33	17.76	0 – 273
No visits	visit0	0 = No 1 = Yes	OHIP claims and HSO encounter data	23062	0.05	0.22	0 – 1
Between 1 and 5 visits	visit1_5	0 = No 1 = Yes	OHIP claims and HSO encounter data	23062	0.25	0.43	0 – 1
Between 6 and 12 visits	visit6_12	0 = No 1 = Yes	OHIP claims and HSO encounter data	23062	0.28	0.45	0 – 1

Variable Description	Variable Name	Values	Source Data	No. of obs.*	Mean	S.d.	Range
Total number of GP/FP visits in 32 month period surrounding interview date (cont'd)							
Between 13 and 19 visits	visit13_19	0 = No 1 = Yes	OHIP claims and HSO encounter data	23062	0.16	0.37	0 – 1
Number of visits greater or equal to 20	visitgte20	0 = No 1 = Yes	OHIP claims and HSO encounter data	23062	0.26	0.44	0 – 1
Hospital admissions in 32 months surrounding interview date							
Number of hospital admissions	hospadm	0 = 0 admissions 1 = 1 admission 2 = 2 or more admissions	CIHI Inpatient and Day Procedure files	23062	0.44	0.72	0 – 2
None	hospadm0	0 = No 1 = Yes	CIHI Inpatient and Day Procedure files	23062	0.69	0.46	0 – 1
One	hospadm1	0 = No 1 = Yes	CIHI Inpatient and Day Procedure files	23062	0.17	0.38	0 – 1
Two or more	hospadm2	0 = No 1 = Yes	CIHI Inpatient and Day Procedure files	23062	0.13	0.34	0 – 1
Health Care System Variables							
Acute home care induced home care days per capita in individual's CCAC region	acihc	continuous	CIHI Inpatient and Day Procedure data linked to OHCAS Registration Master file	23052	0.24	0.05	0.15 – 0.37
Number of chronic care hospital beds per 10,000 population	bed_chr	continuous	PDST database	23052	8.8	3.99	1.95 – 19.09
Number of GP/FPs per 10,000 population	phys_no	continuous	MOHLTC	23052	9.43	2.39	5.90 – 16.27

Variable Description	Variable Name	Values	Source Data	No. of obs.*	Mean	S.d.	Range
Health Care System Variables (cont'd)							
Number of beds in homes for the aged and nursing homes per 10,000 population	bed_ltc	continuous	MOHLTC	23052	55.55	18.26	19.15 – 98.07
Ratio of CCAC region actual funding to equity funding, times 10	ae_ratio	continuous	MOHLTC	23052	10.23	1.18	9.13 – 14.41

* The total number of observations is 23,062. Therefore, the number of missing values can be calculated as 23,062 minus the number of observations for any given independent variable. For example, there were 12 observations with a missing value for marital status: 23,062 - 23,050 = 12.

Table 5.3: Health Care System Variables Included in Our Analysis, by CCAC region

CCAC region	Long-term care beds per 10,000	Chronic care hospital beds per 10,000	GP/FP supply per 10,000	Actual-equity funding ratio times 10	Acute care - induced home care days per capita
Algoma	51.275	8.825	8.749	11.052	0.271
Brant	60.267	10.530	7.695	11.515	0.279
Chatham and Kent	77.247	4.084	7.281	10.107	0.329
Cochrane	64.563	19.087	9.596	11.685	0.305
Durham Region	43.236	4.357	6.367	9.234	0.195
Elgin	85.787	14.134	5.899	9.502	0.270
Grey-Bruce Counties	80.644	12.163	8.616	10.638	0.194
Haldimand-Norfolk	75.940	9.045	6.407	11.293	0.266
Haliburton/Northumberland/Victor	63.001	9.388	7.144	9.921	0.300
Halton	24.445	3.998	9.681	9.652	0.185
Hamilton-Wentworth	51.440	10.072	10.238	10.221	0.214
Hastings/Prince Edward	86.487	6.240	8.722	9.879	0.294
Huron	95.400	11.014	7.937	9.925	0.340
Kenora/Rainy River	48.936	17.516	10.181	9.980	0.293
Kingston,	64.463	12.505	16.268	13.668	0.225
Lanark, Leeds, Greenville	82.332	9.785	8.788	9.753	0.280
London and Middlesex	60.191	13.059	12.588	9.917	0.202
Manitoulin and Sudbury	55.494	5.636	8.237	11.773	0.256
Muskoka and East Parry Sound	56.550	8.848	11.733	13.353	0.306
Niagara	60.202	7.419	8.313	9.178	0.250
Nipissing	85.204	5.167	9.301	13.728	0.317
Ottawa-Carleton	39.342	11.252	13.688	10.176	0.181
Oxford	79.793	8.310	6.107	9.408	0.290
(West) Parry Sound	58.702	15.589	9.012	9.455	0.339
Peel	19.154	1.951	7.383	9.134	0.145
Perth	98.072	10.792	8.229	9.466	0.276
Peterborough	71.965	6.786	10.021	9.665	0.278
Press. Russ., Stormont, Glengarry,	86.782	9.127	10.274	13.057	0.248
Renfrew	78.890	12.493	9.068	14.410	0.318
Sarnia and Lambton	58.084	10.356	6.079	9.595	0.304
Simcoe	52.364	3.236	8.502	9.576	0.251
Timiskaming	93.369	18.313	10.833	10.092	0.356
Thunder Bay	56.766	15.404	9.021	10.519	0.280
Toronto Etobicoke	47.415	11.277	12.971	9.327	0.194
Toronto East York	47.415	11.277	12.971	9.327	0.224
Toronto North York	47.415	11.277	12.971	9.327	0.371
Toronto (City of)	47.415	11.277	12.971	9.327	0.193
Toronto Scarborough	47.415	11.277	12.971	9.327	0.180
Toronto York (former City of)	47.415	11.277	12.971	9.327	0.198
Waterloo	41.235	11.116	8.127	9.610	0.196
Wellington-Dufferin	70.689	9.981	7.619	9.878	0.220
Windsor and Essex	55.105	5.397	7.362	10.829	0.250
York region	29.477	2.044	8.583	9.262	0.162
Provincial Mean	61.567	9.830	9.476	10.374	0.256

6.0 RESULTS FOR MODEL OF HOME CARE UTILIZATION

6.1 Part 1: Predicting the Use of Any Home Care

The results of the weighted logistic regression are summarized in Table 6.1, which summarizes the overall explanatory power of the model, and in Table 6.2, which presents the odds ratios associated with the factors that affect the probability that an individual used publicly funded home care in the 32 months surrounding (i.e., 16 months before and 16 months after) her survey interview. The final specification includes demographic characteristics, self-assessed health status, measures of chronic illness and need for assistance in the activities of daily living, extent of social support, education and income, the number of GP/FP visits and hospitalizations during the period, the supply of long-term care beds in the individual's CCAC region, and the historical level of funding to the individual's CCAC region. There is a strong interaction between a person's age and a number of these factors. We begin our discussion with an assessment of the overall model fit and then examine the policy and statistical significance of individual variables.

6.1.1 Goodness-of-fit

Table 6.1 lists a number of indicators of goodness-of-fit, or explanatory power, for the model. The model has substantial explanatory power. For the unweighted logistic model, a likelihood ratio test of the hypothesis that all of the estimated variable coefficients (other than the constant term) are 0 is rejected (Chi-sq stat = 4289.6, p = 0.000). This indicates that, as a group, the variables included are able to explain a statistically significant amount of the variation in the receipt of home care. A second indication of fit is the c-statistic from an ROC curve analysis, which is a measure of the model's predictive power that ranges in value between 0 and 1 (1 being perfect predictive power). In our case, the value is 0.92, which indicates high predictive power. A third indication is the pseudo-R^2 measure, which is 0.4, which again indicates important explanatory power.

A primary purpose of this work is to develop an approach that reflects need for home care beyond that captured by age and sex alone. We therefore compared this specification against a model that includes only age, sex and age-sex interaction terms. The simple age-sex model captures an important amount of the variation in receipt of home care, but the full model explains substantially more variation than does the model with age and sex adjusters alone. The ROC-curve statistics for the full model versus the age-sex model are 0.92 vs. 0.81; the pseudo-R^2 statistics are

0.40 vs. 0.20, a likelihood ratio test indicates that the age-sex model provides substantially less explanatory power (CHI-sq(44) = 2124.8, p = 0.000).[29] For the weighted analysis, an analogous Wald test also rejects the hypothesis that the additional variables in the full model have no statistically significant explanatory power. Finally, a comparison of the weighted logistic regressions reveals that bias and mean squared error in the predicted probability of use are smaller for the full model than for the age sex only model, and further that the difference in the mean predicted probability of use between users and non users is nearly 2.5 times larger for the full model that it is for the age-sex model, indicating substantially better ability to predict variations in likelihood of use.

In summary, the full model provides important explanatory power in its own right and, what is most pertinent in the context of the analysis, offers a statistically and policy significant increase in explanatory power over a model that includes only age and sex adjusters.

6.1.2 Part1 Logistic Regression - Individual Variable Parameter Estimates

Returning to Table 6.2, which presents the parameter estimates associated with each variable included in the model, the first column of numbers presents the adjusted odds ratio for each variable in the model. The odds ratio estimates allow us to assess the "policy" importance of each variable, i.e., the impact each variable has on the probability that a person uses home care. For dummy variables, the odds ratio indicates the odds that a person with the characteristic used home care relative to a person without the characteristic (the "omitted category"). Hence, the values for sahs4 and sahs5 indicate that, holding all else constant, a person in fair health (sahs4) is 1.74 times more likely to use home care than is a person in excellent health (sahs1, which is the omitted category), while a person in poor health (sahs5) is 2.92 times more likely to be a home care user than is a person in excellent health.

The model includes a number of age and sex interaction terms. The interaction terms allow us to capture the fact that, for example, the effect of living alone on the probability of using home care for an elderly person may be different than it is for a younger person, or that it is different for a male than for a female. It is difficult to assess the overall effect of a variable with interaction terms on the probability of home care use simply by inspecting the coefficient estimates. When discussing the results below, we therefore illustrate graphically the effect of each variable on the probability of

[29] The test is that the coefficients on all of the variables in the full model not included in the age-sex model have odds ratio of 1.0.

home care use. To graph the relationships, we must assume values for all model variables. Our base case for all graphs is an individual with the following characteristics:

- Good health;
- Married;
- Suffers from 1 chronic condition;
- Requires assistance with 1 activity of daily living;
- Lives with others;
- Social support index = 4 (maximum social support);
- High school graduate (level 3 of 4, second highest);
- Household income per capita: 2nd quartile ($11,200 to $15,999);
- No hospital admissions;
- GP/FP visits = mean calculated across our sample;
- GP/FP supply = mean calculated across our sample;
- Number of chronic care beds = mean calculated across our sample;
- Number of long-term beds = mean calculated across our sample;
- Actual/equity ratio = mean calculated across our sample;
- Acute care-induced home care days = mean calculated across our sample.

We then alter the variable of interest to illustrate its effect on the probability of home care use.[30]

The third and fourth columns of numbers lists the t-statistic and p-values associated with each estimated odds ratio, which allows us to assess the statistical significance of each variable (i.e., that the odds ratio statistically is different from 1.0, a value which would indicate no systematic relationship between the variable and receipt of home care).[31] As a general rule, variables with t-stat > 1.96 (p-value < 0.05) are considered statistically significant, i.e., they are estimated with sufficient precision that we can have confidence that the association between the variable and use of home care is non-zero. The closer the t-stat to 0 (or p-value is to 1.0), the less confident we can be that the variable is systematically associated with the use of home care.

In the model, age affects the probability of home care use in two ways, directly and through a series of interaction terms with other variables. As expected, the direct effect of age is positively

[30] We estimated both models with a categorical age specification and models with a continuous age specification, using age and age-squared. The overall explanatory power and the coefficients on the other variables were similar across both specifications. Because the effect of age is easier to assess in a table of coefficients when age is specified categorically, we present that specification in Table 6.2. But when graphing the relationship, the continuous specification is better. Hence, all of the figures are based on a model with a continuous age variable. The qualitative nature of the relationships depicted is identical across the models with age specified categorically and age specified continuously. The graphs are meant merely to illustrate the qualitative nature of the depicted relationship. The exact position of the line in the graph also depend on the assumptions we make about a person's characteristics other than the one being depicted in the graph.

correlated with receipt of home care. We observe a gradient in the effect of age on receipt of home care, though these coefficients do not become consistently statistically significant until above age 65. The gradient is relatively flat between the ages of 30 and 64, and then rises steadily with each age grouping. Other things equal, a person aged 65-69 is 3.38 times more likely, and so on, up to those aged over 90, who are more than 27 times more likely to be a home care user than is a person aged 12-19 (again, even after adjusting for health status and all other factors in the model). To determine the effect of sex on a person's chance of being a home care user, one must consider both the main effect, which indicates that, other things equal,[32] females are only 47.9% as likely as males to use home care, and the positive interactions with age, which indicates that older females have a higher probability of use. This changing relationship over the life cycle is illustrated in Figure 6.1. We see from Figure 6.1(a) that at young ages both males and females have a very low probability of using home care, though males have a higher probability than females. However, at older ages females have a higher predicted probability of using home care, and the difference grows with age.

The results for a person's marital status indicate that single individuals have a higher probability of being a home care user at younger ages than do married persons, but that this relationship reverses later in life. The crossover point occurs later for males than for females (Figure 6.1(b-2)). This pattern is somewhat unexpected. One possible explanation is that a spouse can affect the likelihood of using home care in two ways: (1) they can reduce the likelihood of using home care by providing assistance to the partner; (2) they can increase the likelihood of use, other things equal, by advocating that a partner in need seek services and by facilitating the process. If the latter effect is constant throughout the life cycle and females in general are more able to provide assistance to a male spouse than vice versa, the combination of these two effects would generate the observed pattern.

Self-assessed health status (sahs2-sahs5), number of chronic conditions (chron4m) and number of activities of daily living for which an individual needs help (need1-need5) are all indicators of chronic health status and need for assistance. Not surprisingly, those who report a lower self-assessed health status are more likely to use home care, with those in poor health (sahs5)

[31] All standard errors and the related t-statistics and p-values were estimated through a bootstrap procedure that adjusts for the design effects of the NPHS [Efron and Tibshirani 1993; Statistics Canada 2002]

[32] For the remainder of the discussion of model results, we will in general stop repeating this caveat, but it is always implied when discussing parameter estimates from a multivariate model.

almost three-times more likely to use home care than those in excellent health. Home care use is not as sensitive as expected to the number of chronic conditions a person has, perhaps because we already capture chronic health status through self-assessed health status. We found that a dichotomous specification indicating whether a person had 0-3 or 4 or more chronic conditions was satisfactory. There is very little difference in probability of use at younger ages between those with differing numbers of chronic conditions, but beyond age 80 those with four or more conditions have a substantially higher likelihood of use (Figure 6.1(c)). The age interaction is also very important in the relationship between use of home care and the number of activities of daily living for which assistance is required (Figure 6.1(d)). In general, we observe the expected gradient – those who need greater assistance are at elevated risk, especially in the older age categories.

There is very little difference in the likelihood of using home care at younger ages between those living alone and those living with another person, but beyond age 70 an age interaction dominates, causing older individuals who live alone to be at higher risk of being a home care user than older individuals living with at least one other person (Figure 6.1(e)).

The social support index variable (soc0 - soc4), which indicates the strength of a person's social support network offers what appears as a counter-intuitive finding. The odds ratio indicates that, as a person ages, those with no social support are less likely to be a home care user than are those with moderate to high levels of social support (Figure 6.1(f)). Although on the one hand, we might expect those with no social support to have greater need, this may be counterbalanced by the fact that those who have strong social support networks are in general more engaged with the world and therefore may be more likely to seek services for a given need, and are more likely to have people checking in on them, prompting them to seek needed services and assisting them in obtaining such services. The difference in the likelihood of home care use between those with and without social support is greater for females than it is for males.

Education level was not strongly correlated with the probability of home care use. There was a statistically significant effect, however, between those whose highest educational level is "no high school" compared to those whose education level was "some high school or higher". Those whose highest education level was "less than high school" are less likely to be a home care user. This effect of education is greater at older ages and is greater for females than for males (Figure 6.1(g)). Given that those with less education have higher health care needs on average (which would lead to higher probability of home care use), this suggests that the education effect may reflect barriers to

receiving care among the less educated.

The main effect of income is generally not statistically significant, though the interaction terms between age and income are statistically significant, and indicate that beyond about age 60 those in the lower half of the income distribution (i.e., in the first or second income quartile) are more likely to use publicly funded home care than are those in the upper half of the income distribution (Figure 6.1(h)). This may reflect either unmeasured aspects of health status or the fact that we measure only use of public home care services and those in the upper half of the income distribution are more likely to use privately financed services.

The number of GP/FP visits is strongly positively correlated with home care use, though the magnitudes of the differences among those with different visit rates become important only above age 60 or so (Figure 6.1(i)).

The single most important variable affecting the probability of home care use is whether the person was hospitalized during the 32-month study period. The main effect odds ratio indicates that a person who had one hospital admission (inpatient or day procedure) was over 13 times more likely to be a home care user than a person with no admissions, and that a person with two or more admissions was approximately 85 times more likely than a person with no admissions. This is the only variable whose quantitative importance is substantial over the entire life cycle (Figure 6.1(j)). It captures the effect of post-hospitalization acute home care need, which is of growing importance in the home care sector, as well as perhaps more severe cases of those with chronic conditions that experience severe acute episodes. Furthermore, there is also an important age interaction (which reduces the overall odds ratio at older ages) in the effect of a hospitalization on home care use (Figure 6.1(j)).

In general the system level variables were not highly correlated with home care use. Two that were statistically important were the supply of long-term care beds in a person's CCAC region and the historical funding level (relative to the equity share) of the CCAC region in a person's area of residence. Both of these are positively correlated with home care use.

6.2 Part 2: Predicting Home Care Expenditures Among Home Care Users

The second part of the utilization model relates to the amount of expenditure among those who receive home care services. The goal is to develop an expenditure equation that relates a person's characteristics to home care expenditures, so as to allow us to predict the amount of a person's home care expenditure conditional on being a home care user. As discussed above, the skewed nature of the distribution of expenditure data requires that we use statistical techniques appropriate for such data. As discussed above, a commonly employed approach for such an analysis is to specify the dependent variable as the natural logarithm of expenditures. This will provide consistent and precise estimates of the model parameters. However, if the assumption of constant variance is violated, the method is biased when re-transforming the dependent variable back into the original dollar scale following estimation of the model. An alternative model in this case is a variant of the General Linear Model, which avoids the need to transform the data into natural logarithms, and therefore avoids the retransformation problem (but which can be less efficient than the former approach if the assumption of constant variance is satisfied).

Following the procedures outlined in Manning and Mullahy (2001), we tested which of the logged-OLS or the GLM approach was more appropriate. The analysis suggested that there is mild to moderate non-constant error variance under the logged-OLS, and the structure of the error was such that it would be difficult to adjust the re-transformation process to take it into account. The analysis further indicated that a GLM model with a gamma link function is most appropriate. Therefore, although a logged-OLS specification was used for aspects of model building, in all estimation that underlies share calculations a weighted Gamma-GLM model was used to estimate the part 2 model of expenditures conditional on an individual being a home care user.

Table 6.3 lists the results for the weighted gamma-GLM regression model. As with the part1 logistic regression, we begin with an assessment of model's overall explanatory power.

6.2.1 Part 2 Expenditure Model - Assessing Goodness of Fit

Because a GLM model differs from a standard regression model, one cannot calculate an R^2 statistic as a measure of fit. However, because the logged-OLS model parameters are unbiased (the deficiency of the logged-OLS model arises only in its application following estimation) and the model is based on standard regression methods, we measure goodness-of-fit for part 2 based on the results of the logged OLS model. The adjusted R^2 for the full model is 0.30 compared to 0.10 for the model based only on age and sex information. This difference in explanatory power suggests that

the inclusion of information beyond a person's age and sex substantially increases our ability to explain variation in home care expenditures among those who use home care services. A formal test of the statistical significance of all the additional variables in the full model beyond age and sex confirmed their important role in explaining home care expenditures among users (this holds true for both the logged-OLS model and the weighted GLM model). Finally, both the prediction bias and mean squared error in the prediction are substantially smaller for the full model than for the model based on age and sex alone.

6.2.2 Part 2 - GLM - Individual Variable Parameter Estimates

Our *a priori* hypotheses for the part 2 expenditure model regarding the nature of the relationship between the variables and home care expenditures are not as strong as was the case for analyzing the probability of home care use. *A priori*, for instance, one expects the likelihood of home care use to rise with age, just as one expects the likelihood to be higher for those who have been hospitalized. But conditional on a person being a home care user, it is less clear whether an older person's expenditures should be higher than a young adult's expenditure, or whether those whose home care use is post-hospital discharge will, on average, have higher or lower expenditures than a chronic user who has not been hospitalized.[33] Further, compared to the sample used to analyse use/non-use, the sample users on which the expenditure analysis is based is both smaller (1447 vs. 22855) and more homogenous (because they are all users).

The age-expenditure relationship is less strong than is the age-use relationship. Indeed, not a single main effect age category is statistically significant at the 5% level. The gradient is also quite flat across the age categories, with no clear trend. The age-interaction terms also have less explanatory power than they did in the use/non-use analysis. Sex is not quantitatively or statistically significant as a main effect, nor is there a strong age interaction with sex. Those who are single have a consistently higher predicted level of home care expenditures than do those who are married (Figure 6.2(a)).[34] As with the probability of use, level of expenditures is not highly sensitive to the specific number of chronic conditions. A simple dichotomous specification of 0-3 chronic conditions versus 4 or more chronic conditions captures the essential relationship. The parameter estimates indicate that at younger ages, users with 0-3 chronic conditions have higher expenditures

[33] A person using home care post-hospital uses the services for a shorter period, but may be more likely to use higher cost nursing services.

[34] The characteristics of the hypothetical individual for the base case are identical to those identified when discussing part 1 results.

than do individuals with four or more conditions, but that beyond approximately age 75, users with 4 or more chronic conditions have higher expenditures (Figure 6.2(b)). It is not clear why this pattern is observed, though we will see below that when parts 1 and 2 are combined, at all ages a person with 0-3 chronic conditions has lower expected home care expenditure than does a person with 4 or more. The set of variables with perhaps the most consistent relationship to home care expenditures among users is the number of activities of daily living for which the user requires assistance. There is a very clear gradient across levels of assistance, with the predicted expenditures for a person requiring help for 5 activities incurring expenditures 10 times higher than a person who requires no assistance (Figure 6.2(c)).

The relationships estimated for both social support and education are somewhat puzzling. The results suggest that expenditures are similar for both those with no social support and those with high levels of social support (and both are relatively flat over the life cycle) (Figure 6.2(d)). This is plausible if those with no social support have fewer advocates to assist them in gaining access to all needed services while those with strong social support networks draw on that network for help that partly substitutes for formal home care. It is unclear, however, why expenditures for those with some, but low, levels of support should increase over the life cycle and be so much lower than those with no or good social support. As with chronic conditions, this anomalous pattern disappears when parts 1 and 2 are combined.

In general, education shows no strong relationship to home care expenditures.

There is no main effect for physician visits in the model, only an interaction term with age, which indicates an increasing difference in expenditures among those with differing rates of physician visits (Figure 6.2(e)).

Users who had two or more hospital admissions during the study period are predicted to have substantially higher home care expenditures than are users who had fewer than 2 hospital admissions (again, the hospital admission could have been inpatient or day procedure) (Figure 6.2(f)).

Finally, physician supply is positively correlated with expenditure among home care users.

6.3 Combining Parts 1 and 2 to Estimate Expected Needs-based Home Care Expenditures

6.3.1 Combining Parts 1 and 2 to Estimate Expected Home Care Expenditures

The results of parts 1 and 2 are combined to estimate, for each person in the sample, the expected home care expenditures. The relationship between overall expected home care expenditures and each model variable is depicted in Figure 6.3(a)-(j). The model predicts that home care expenditures increase with age (Figure 6.3.(a)); are higher for females than males at older ages; are higher for single persons than married persons (Figure 6.3.(b)); are higher for those with 4 or more chronic conditions than those with 0-3 chronic conditions and that this difference increases over the life cycle (Figure 6.3(c)); are higher for those who require assistance with more activities of daily living than those who require less assistance and that this difference increases over the life cycle (Figure 6.3(d)); are higher for those living alone than those living with at least one other person and that this difference increases over the life cycle (Figure 6.3(e)); are higher for those with lower incomes than those with higher incomes (Figure 6.3(h)); are higher for those who have a higher rate of GP/FP visits than those with lower rates and that this difference increases over the life cycle (Figure 6.3(i)); and are higher for those who have been hospitalized once than those who have not been hospitalized and are highest for those who have been hospitalized two or more times (Figure 6.3(j)). The two adjusters for which a clear gradient across categories does not exist are social support and education. Those with no social support networks have the lowest expected expenditures; those with the most social support have the next highest; and those with a middle level have the highest, and the difference among the categories increases over the life cycle (figure 6.3(f)). One plausible explanation is that those with no social support access services the least (we saw that they had the lowest probability of using any services), those with the highest social support are more likely to use at least one service but do not require a large number because of the strong network around them, while those with some support are akin to those with strong support with respect to their likelihood of use but require more services because they lack a strong support network.

Over much of the life cycle the expected expenditures are very close for those with differing levels of education, but beyond approximately age 65 those with the lowest education level have the lowest expected expenditures, those with some high school have the highest and those with more education are in between (figure 6.3(g)). We can think of no explanation for the particular pattern observed.

6.3.2 Estimating Needs-Based Expected Home Care Expenditures

Having developed a model to predict expected expenditures, we now must estimate expected needs-based home care expenditures. Conceptually, in moving from expected expenditures to needs-based expected expenditures we remove the effect of factors that influence home care utilization but which should not influence a needs-based allocation of home care resources

The crucial step is to identify the "control" variables in each part of the model, where control variables are those factors that may influence utilization of home care but which should not influence a needs-based allocation. We previously identified a number of variables that were clearly control, and other variables that may be appropriate to treat as control depending upon the direction of the empirical relationship with respect to either probability of use or amount of use. Given the final specifications, in the part 1 model of use/non-use, the only unequivocally control variable is ae_ratio, the historical funding level of the CCAC region in which the individual resides. We previously argued that if the supply of long-term care beds was positively related to the probability of home care use it should be designated as a control variable whose variation across CCAC regions should not influence allocation (if it did, those CCAC regions with more beds would get more home care resources). The odds ratio on bed_ltc is greater than 1.0, so we treat it as a control variable in the part 1 model. Finally, because up to approximately age 80, those with higher education have a higher predicted probability of use and higher predicted expenditure conditional on being a user, and because we have no plausible explanation for the observed relationship between education level and overall expected home care expenditures, we treat education as a control variable. In the expenditure equation (part 2), the control variables include education and the supply of GP/FPs in a CCAC region.

Need-based home care expenditures are estimated by substituting the mean value of control variables for each individual's actual value. This ensures that variation in the actual distribution of these variables does not influence the needs-based calculation while retaining the overall mean expected expenditure in the sample.

Table 6.1: Measures of Explanatory Power and Goodness of Fit for Logistic Regression Model

Unweighted Logistic Regression - Full Model Listed in Tables 6.1			
Likelihood ratio test statistic that all coefficients are zero			Chi-sq stat: 4289.6 (p = 0.000)
C-statistic from ROC curve analysis:			0.92
Pseudo-R^2:			0.4
Unweighted Logistic Regression Including only Age-Sex Adjusters			
Likelihood ratio test statistic that all coefficients are zero			Chi-sq stat: 2124.8 (p = 0.000)
C-statistic from ROC curve analysis:			0.81
Pseudo-R^2:			0.2
Likelihood ratio test for age-sex model vs full model			Chi-sq: 2164.8 (p = 0.000)
Weighted Logistic Regression			
	Mean Bias in Predicted Probability	Mean Squared Error of Predicted Probability	Difference in Mean Predicted Probability Between Users and Non-users
Full model	-0.0019	0.04	0.337
Age-sex model	-0.0066	0.051	0.141

Table 6.2: Results of Weighted Logistic Regression of Use/Non-Use Relationship

Number of observations: 22,855
F(73, 22782): 31.17; p-value: 0.000

Dependent Variable: 0 = Individual did not use any publicly funded home care services in 32-month period surrounding interview date.
1 = Individual did use at least one publicly funded home care services in 32-month period surrounding interview date.

Variable	Odds Ratio	Standard Error	t-stat	p-value
age20_24	0.865	0.583	0.216	0.829
age25_29	0.818	0.394	0.418	0.676
age30_34	1.672	0.837	1.027	0.305
age35_39	2.264	1.205	1.536	0.125
age40_44	1.274	0.767	0.402	0.687
age45_49	1.105	0.647	0.170	0.865
age50_54	1.916	0.975	1.277	0.202
age55_59	1.777	0.961	1.062	0.288
age60_64	1.536	0.770	0.856	0.392
age65_69	3.376	1.728	2.376	0.018
age70_74	4.275	2.243	2.769	0.006
age75_79	4.363	2.300	2.794	0.005
age80_84	7.572	4.545	3.373	0.001
age85_89	10.400	6.757	3.604	0.000
agegte_90	27.414	20.870	4.349	0.000
sex	0.479	0.253	1.392	0.164
age20_24_sex	2.911	2.665	1.167	0.243
age25_29_sex	3.022	2.091	1.599	0.110
age30_34_sex	1.551	0.980	0.694	0.488
age35_39_sex	1.454	0.958	0.569	0.570
age40_44_sex	2.178	1.537	1.104	0.270
age45_49_sex	3.678	2.699	1.775	0.076
age50_54_sex	2.133	1.331	1.214	0.225
age55_59_sex	4.450	2.748	2.418	0.016
age60_64_sex	6.714	3.980	3.212	0.001
age65_69_sex	2.996	1.771	1.856	0.064
age70_74_sex	3.563	2.063	2.194	0.028
age75_79_sex	4.508	2.651	2.561	0.011
age80_84_sex	4.214	2.525	2.400	0.017
age85_89_sex	4.634	3.431	2.071	0.039
agegte_90_sex	5.214	5.570	1.546	0.122

Table 6.2: Results of Weighted Logistic Regression of Use/Non-Use Relationship (cont'd)

Variable	Odds Ratio	Standard Error	t-stat	p-value
marital	2.996	1.515	2.170	0.030
age_mar	0.983	0.008	2.112	0.035
sex_mar	0.756	0.161	1.313	0.190
sahs2	1.352	0.226	1.809	0.071
sahs3	1.273	0.203	1.514	0.130
sahs4	1.744	0.318	3.055	0.002
sahs5	2.923	0.651	4.817	0.000
chron4m	0.014	0.032	1.840	0.066
age_chr4m	1.057	0.034	1.745	0.081
needh1	0.382	0.312	1.180	0.238
needh2	2.134	1.784	0.906	0.365
needh3	0.351	0.414	0.889	0.374
needh4	1.617	1.913	0.406	0.685
needh5	4.138	5.594	1.051	0.294
age_nh1	1.023	0.012	1.927	0.054
age_nh2	1.008	0.012	0.612	0.541
age_nh3	1.036	0.017	2.121	0.034
age_nh4	1.027	0.019	1.434	0.152
age_nh5	1.018	0.022	0.822	0.411
dlivarr	0.430	0.218	1.663	0.097
age_liv	1.024	0.009	2.841	0.005
soc0	12.060	16.344	1.837	0.066
age_soc0	0.964	0.020	1.754	0.080
sex_soc0	0.260	0.193	1.816	0.070
educ1	2.606	1.162	2.149	0.032
age_edu1	0.989	0.006	1.616	0.106
sex_edu1	0.724	0.176	1.331	0.184
inc1	0.334	0.123	2.984	0.003
inc2	0.555	0.193	1.698	0.090
age_inc1	1.022	0.006	3.531	0.000
age_inc2	1.013	0.005	2.302	0.022
visit6_12	1.253	0.234	1.208	0.227
visit13_19	1.317	0.265	1.368	0.172
visitgte20	1.713	0.363	2.544	0.011
agevisits	1.000	0.000	4.006	0.000
hospadm1	13.311	4.898	7.035	0.000
hospadm2	84.996	32.368	11.666	0.000
agehosp1	0.985	0.006	2.622	0.009
agehosp2	0.975	0.006	4.473	0.000
sexhosp2	0.624	0.110	2.671	0.008
bed_ltc	1.004	0.003	1.582	0.114
ae_ratio	1.078	0.040	2.052	0.040
constant	0.001	0.000	12.211	0.000

Table 6.3: Results of Weighted Gamma-Generalized Linear Model Regression on Home Care Expenditure

Number of observations: 1447
Dependent Variable: = Dollar value of home care services received by a home care user in the 32-month period surrounding the interview date

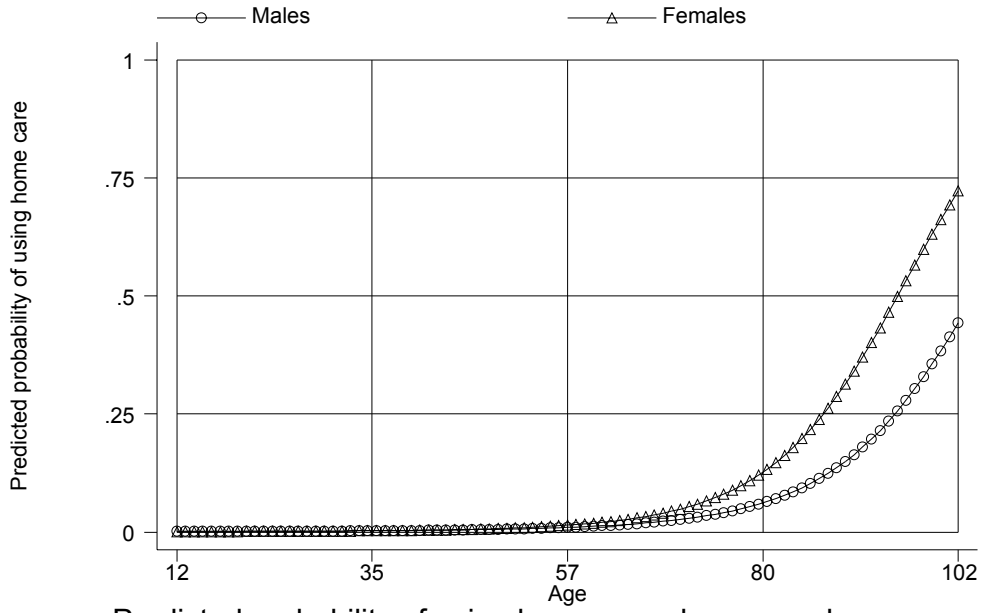
Variable	Coefficient	Standard error	t-stat	p-value
age20_24	-0.523	0.679	0.77	0.442
age25_29	0.505	0.529	0.954	0.34
age30_34	-0.957	0.491	1.951	0.051
age35_39	0.637	0.394	1.616	0.106
age40_44	0.022	0.482	0.045	0.964
age45_49	0.597	0.56	1.066	0.287
age50_54	-0.1	0.445	0.224	0.823
age55_59	0.305	0.507	0.602	0.547
age60_64	-0.017	0.378	0.046	0.964
age65_69	0.483	0.388	1.245	0.213
age70_74	-0.116	0.356	0.324	0.746
age75_79	-0.323	0.383	0.842	0.4
age80_84	0.219	0.38	0.577	0.564
age85_89	-0.223	0.367	0.607	0.544
agegte_90	0.441	0.585	0.753	0.451
sex	-0.863	0.619	1.396	0.163
age20_24_sex	1.69	1.393	1.213	0.225
age25_29_sex	-0.116	0.77	0.151	0.88
age30_34_sex	1.555	0.804	1.935	0.053
age35_39_sex	-0.208	0.672	0.31	0.757
age40_44_sex	0.487	0.777	0.628	0.53
age45_49_sex	0.056	0.842	0.067	0.947
age50_54_sex	0.951	0.724	1.313	0.189
age55_59_sex	0.414	0.802	0.516	0.606
age60_64_sex	0.978	0.654	1.496	0.135
age65_69_sex	1.072	0.678	1.581	0.114
age70_74_sex	1.196	0.651	1.838	0.066
age75_79_sex	1.51	0.656	2.303	0.021
age80_84_sex	0.818	0.649	1.261	0.208
age85_89_sex	1.162	0.651	1.785	0.075
agegte_90_sex	1.03	0.822	1.254	0.21

Table 6.3: Results of Weighted Gamma-Generalized Linear Model Regression on Home Care Expenditure (cont'd)

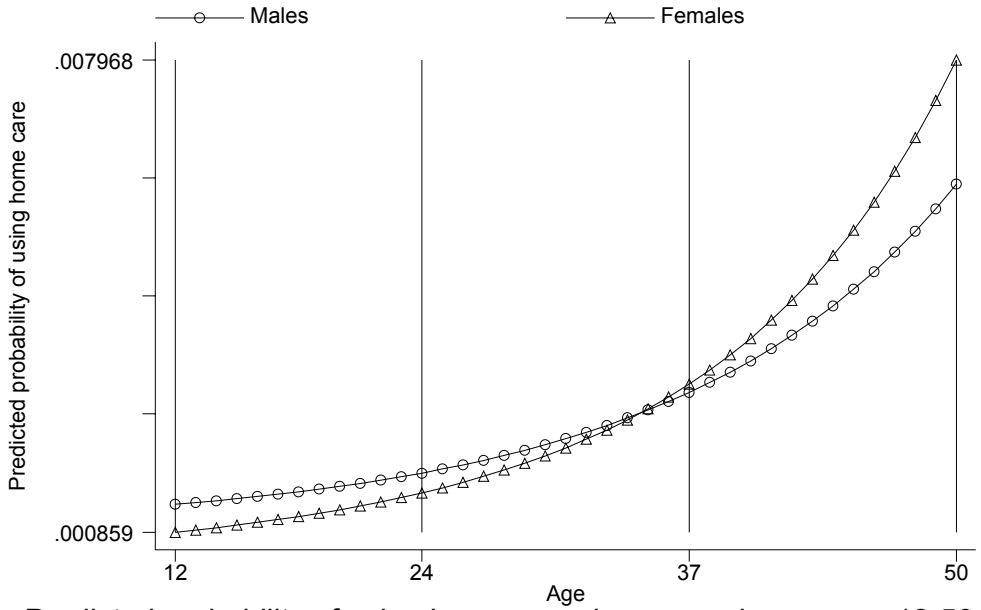
Variable	Coefficient	Standard error	t-stat	p-value
marital	0.504	0.088	5.721	0
chron4m	-2.377	1.357	1.752	0.08
age_chr4m	0.031	0.017	1.839	0.066
needh1	0.681	0.152	4.494	0
needh2	0.929	0.159	5.847	0
needh3	0.942	0.159	5.915	0
needh4	1.439	0.182	7.923	0
needh5	1.954	0.173	11.263	0
soc0	-0.679	1.128	0.602	0.547
soc1	-2.569	0.88	2.921	0.004
age_soc0	0.011	0.016	0.713	0.476
age_soc1	0.033	0.013	2.515	0.012
agevisits	0	0	2.412	0.016
hospadm2	0.284	0.1	2.833	0.005
phys_no	0.037	0.017	2.116	0.035

PART 1 GRAPHS

Figure 6.1(a)

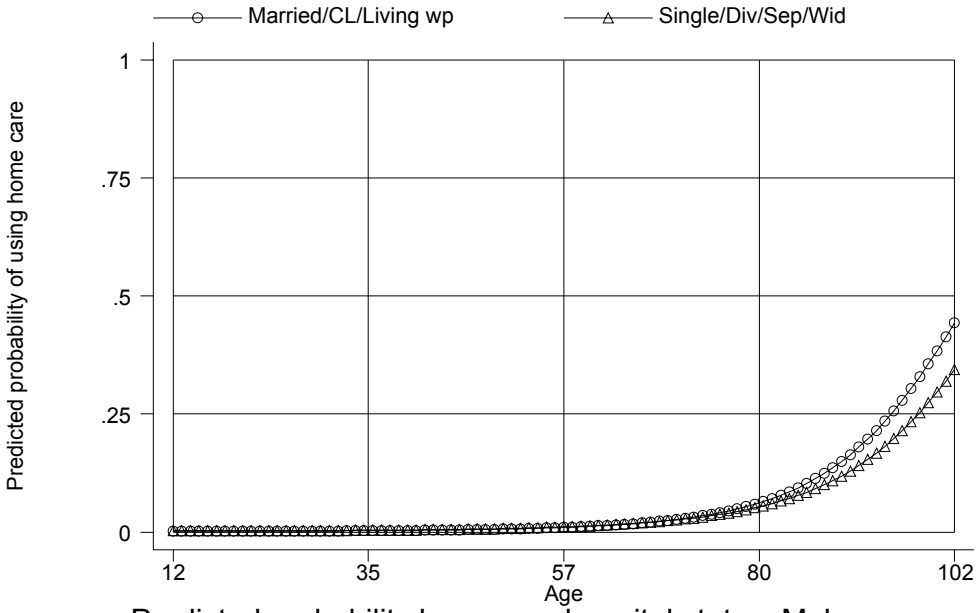


Predicted probability of using home care, by age and sex

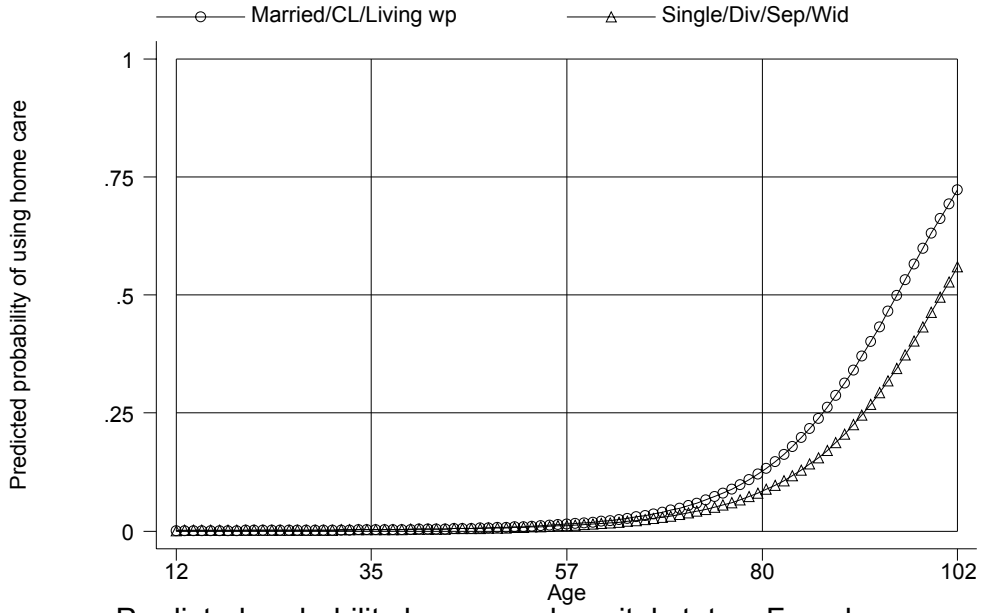


Predicted probability of using home care, by age and sex: ages 12-50

Figure 6.1(b)

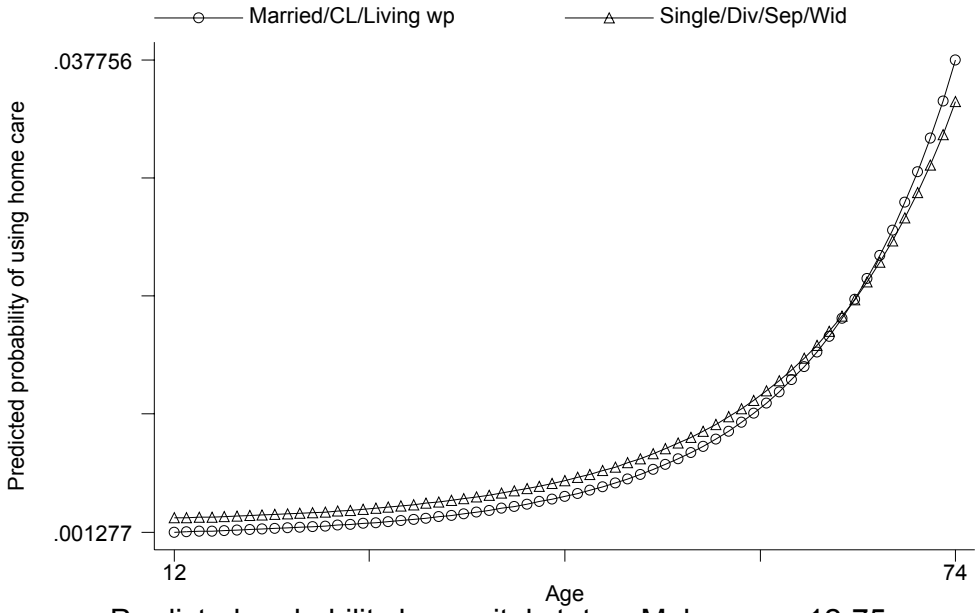


Predicted probability by age and marital status: Males

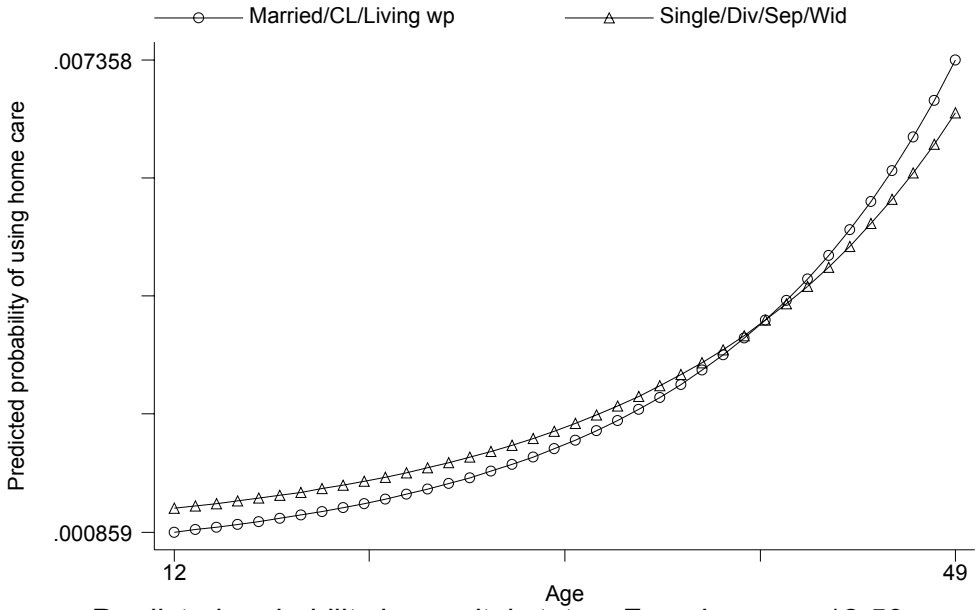


Predicted probability by age and marital status: Females

Figure 6.1(b-2)

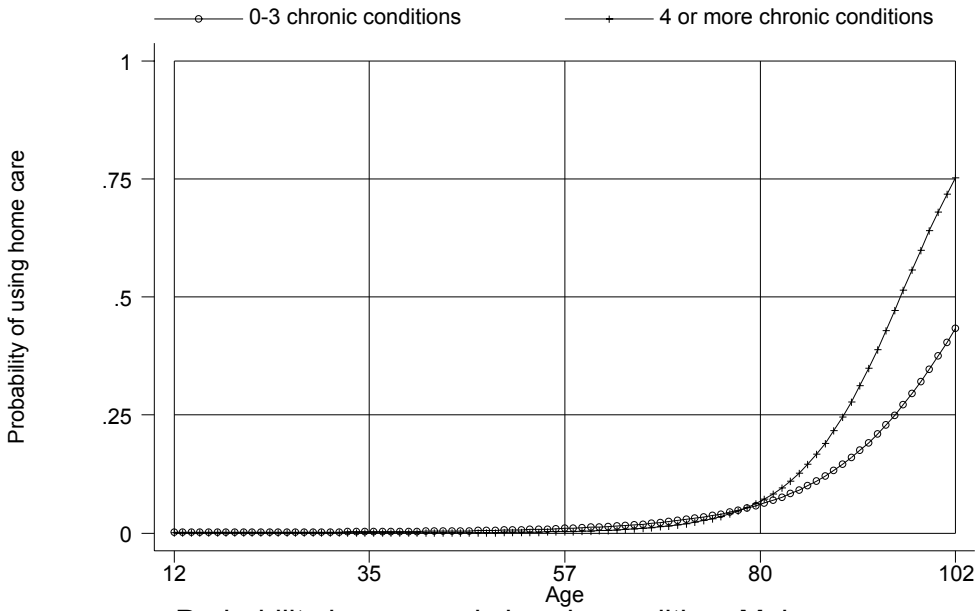


Predicted probability by marital status: Males ages 12-75

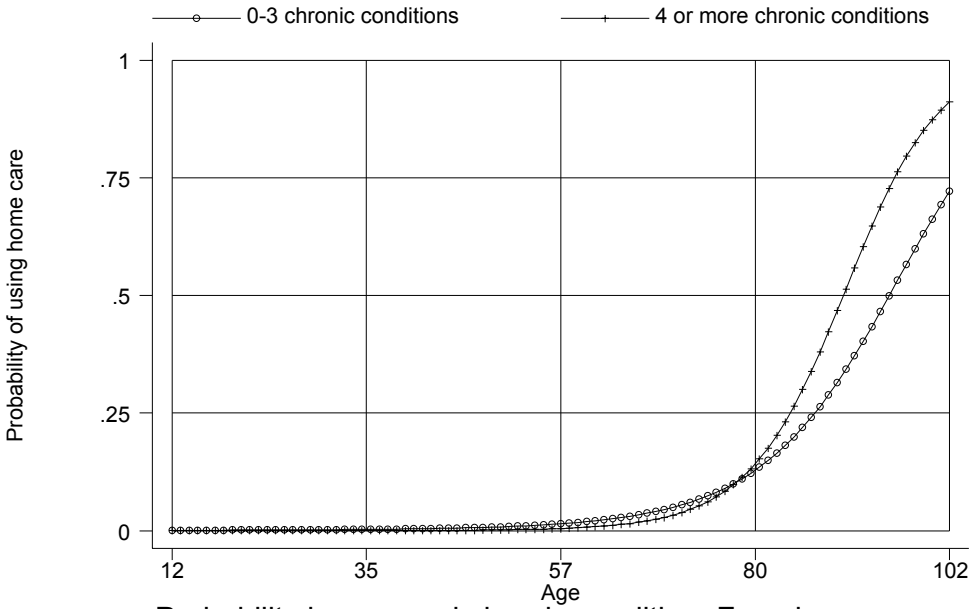


Predicted probability by marital status: Females ages 12-50

Figure 6.1(c)

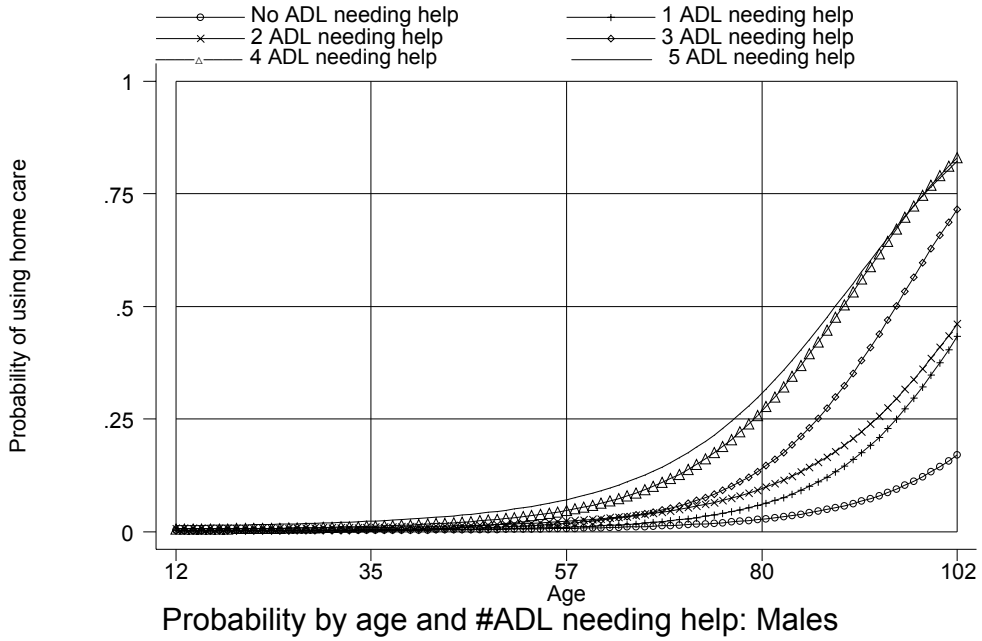


Probability by age and chronic condition: Males

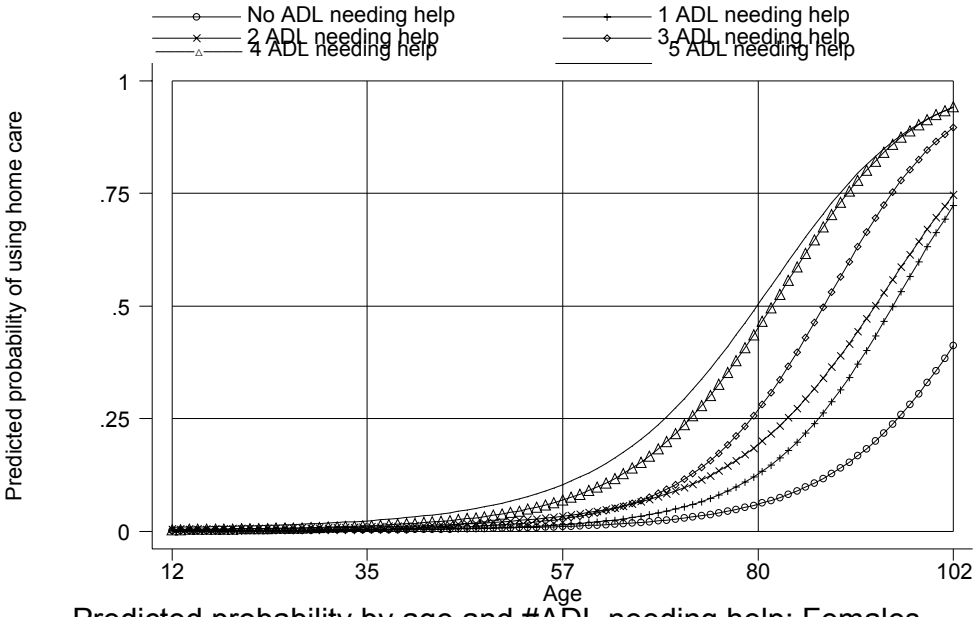


Probability by age and chronic condition: Females

Figure 6.1(d)

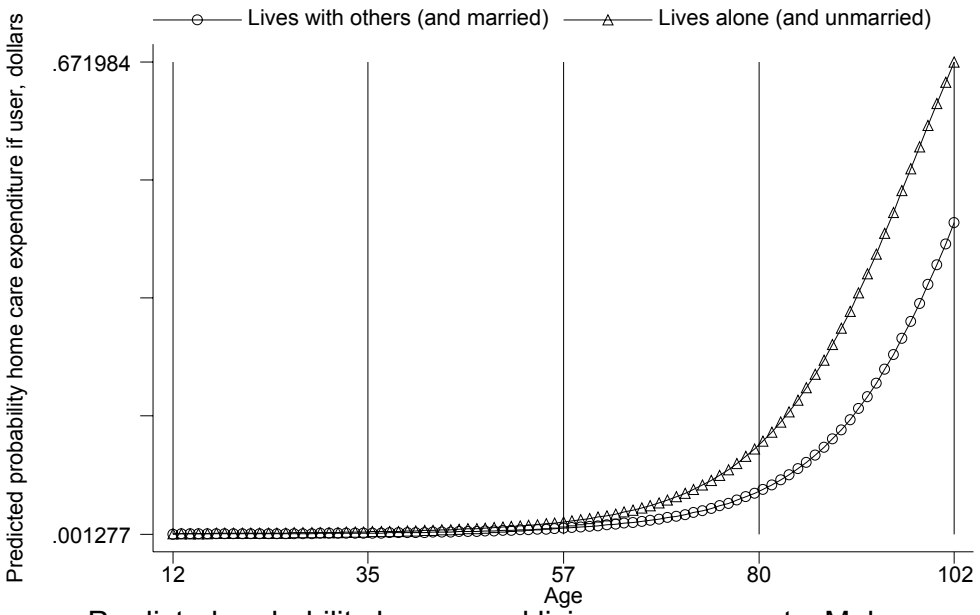


Probability by age and #ADL needing help: Males

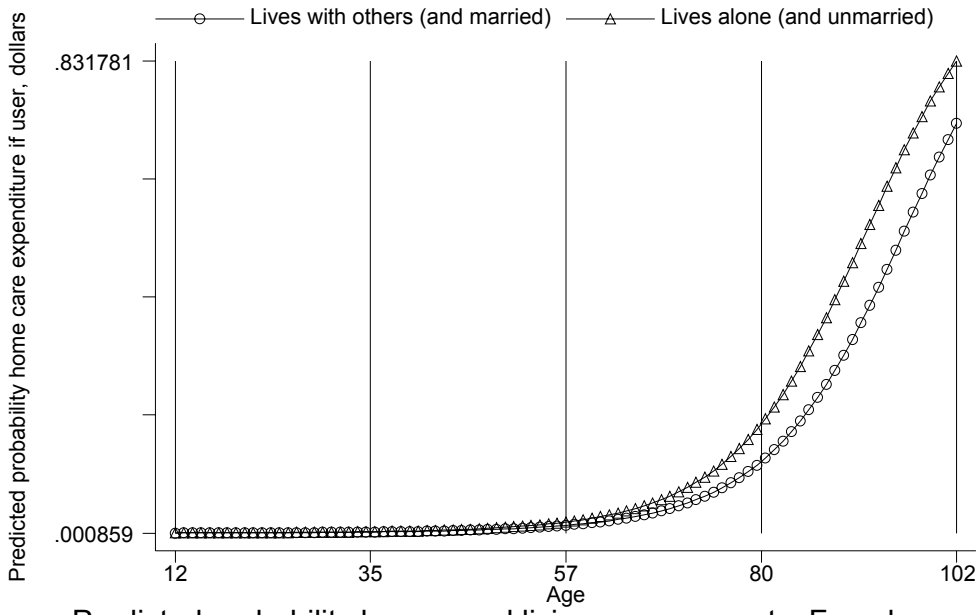


Predicted probability by age and #ADL needing help: Females

Figure 6.1(e)

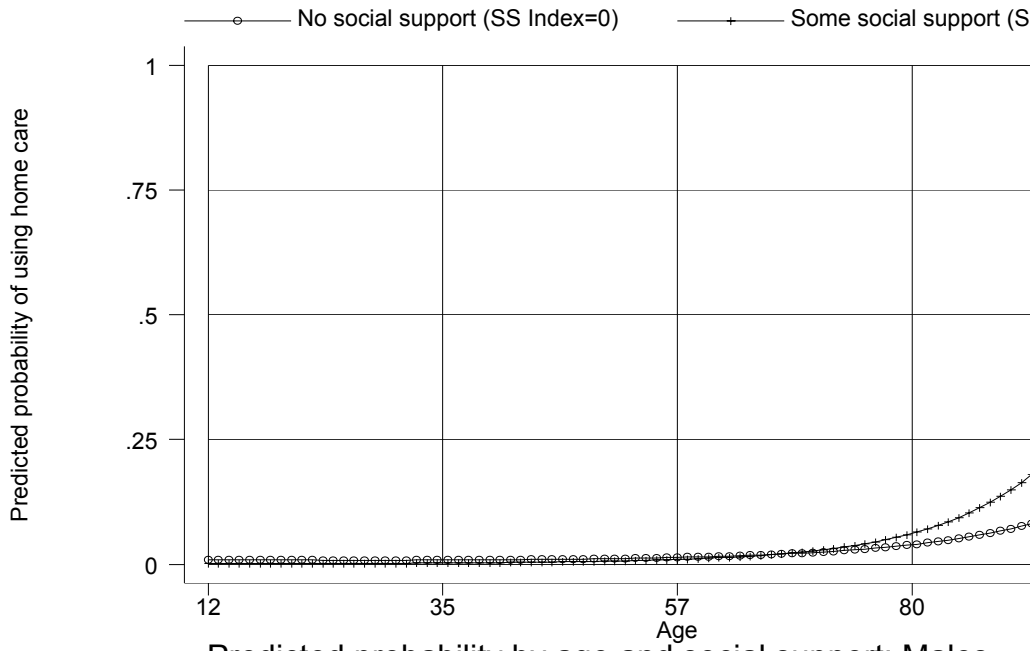


Predicted probability by age and living arrangements: Males

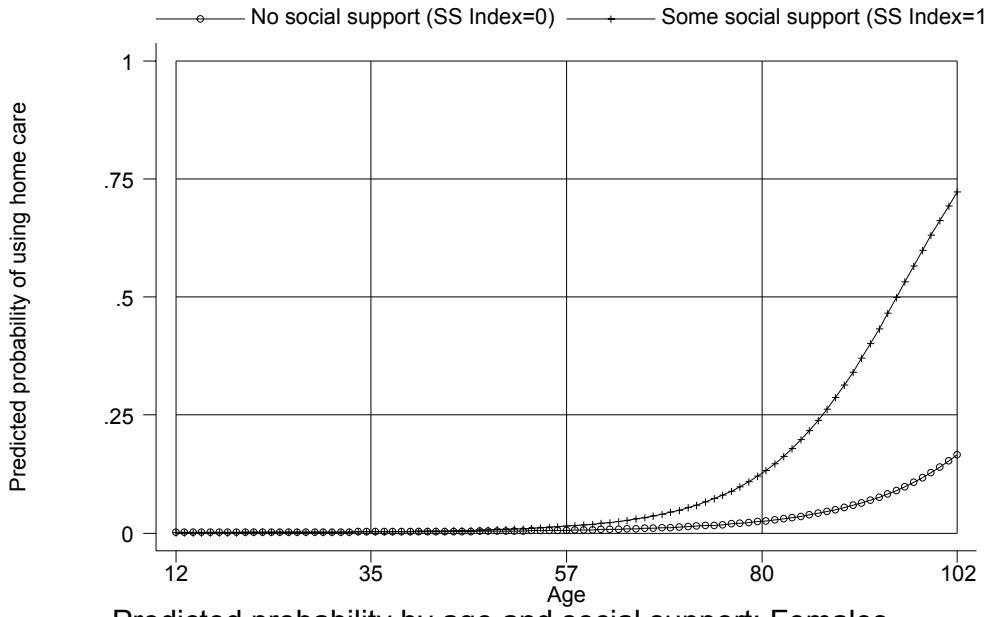


Predicted probability by age and living arrangements: Females

Figure 6.1(f)

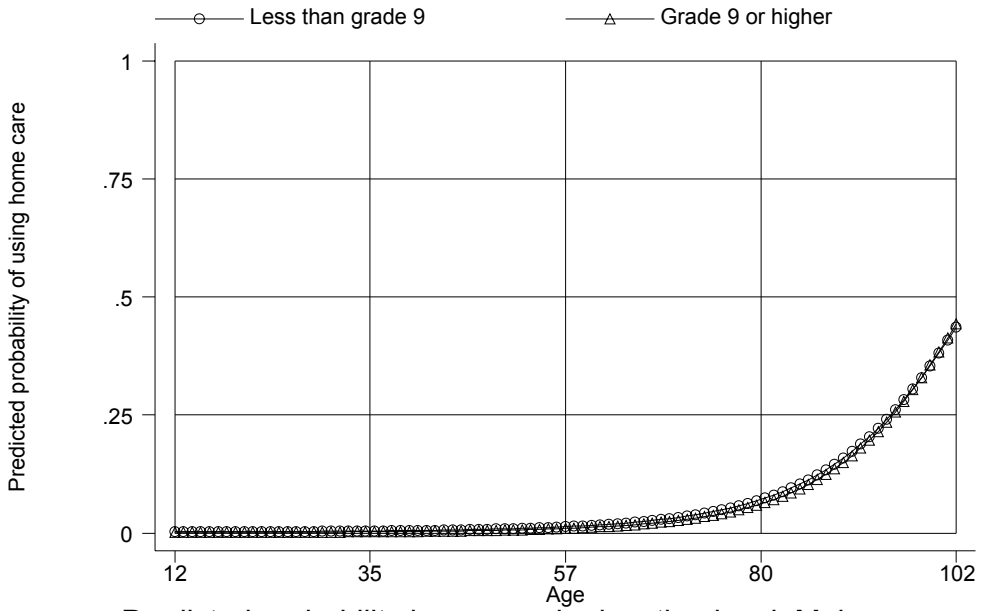


Predicted probability by age and social support: Males

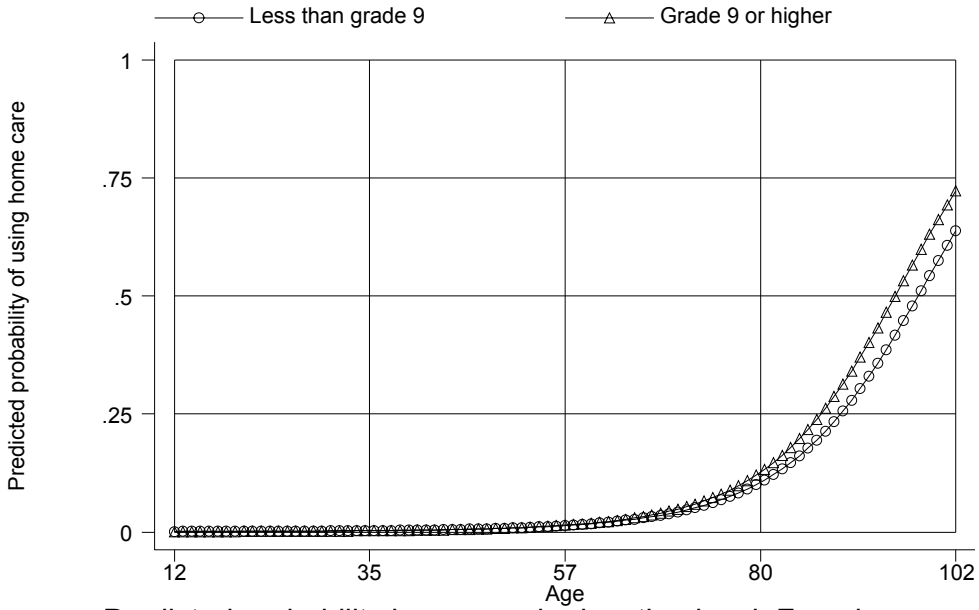


Predicted probability by age and social support: Females

Figure 6.1(g)

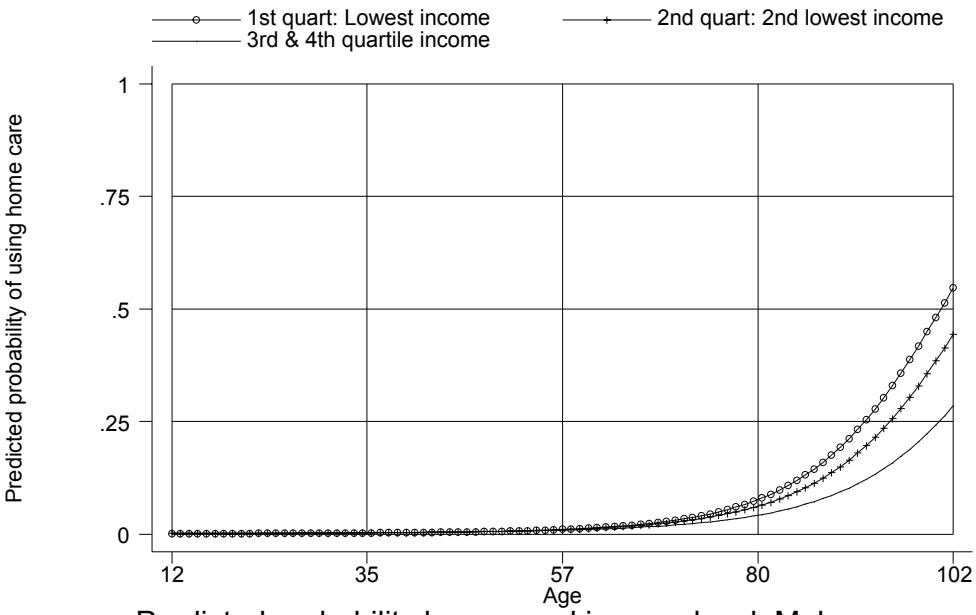


Predicted probability by age and education level: Males

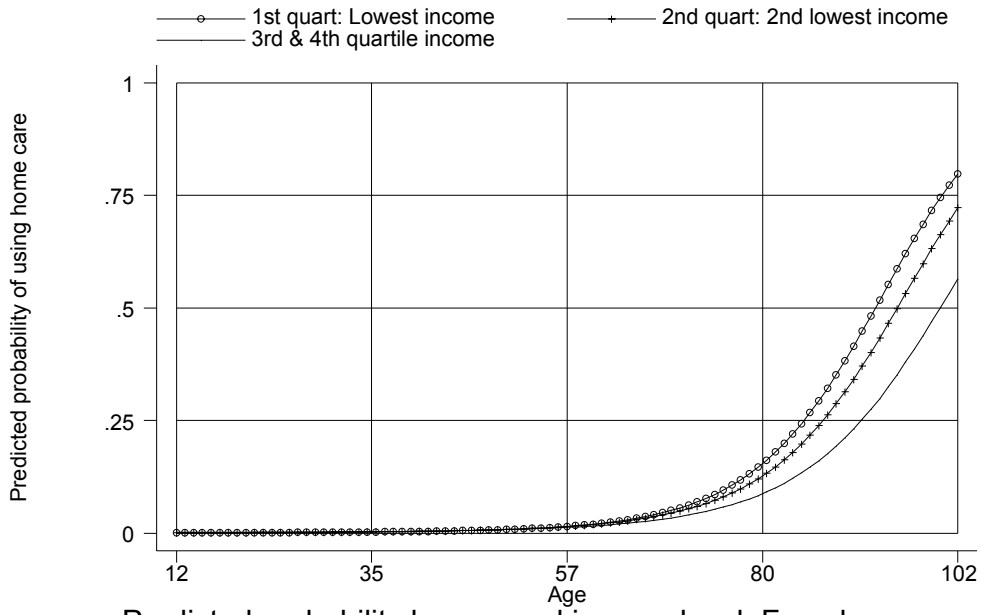


Predicted probability by age and education level: Females

Figure 6.1(h)

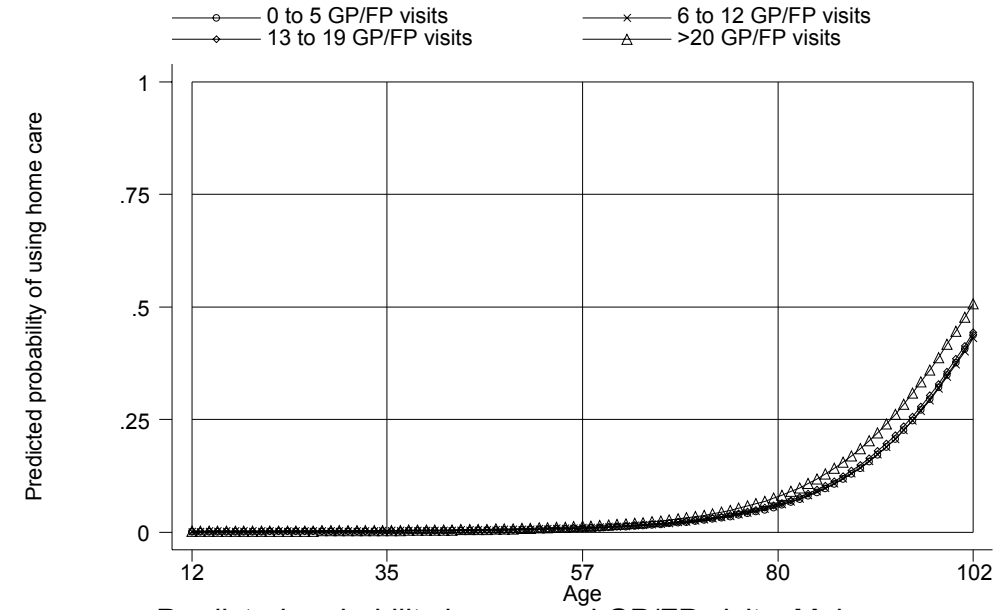


Predicted probability by age and income level: Males

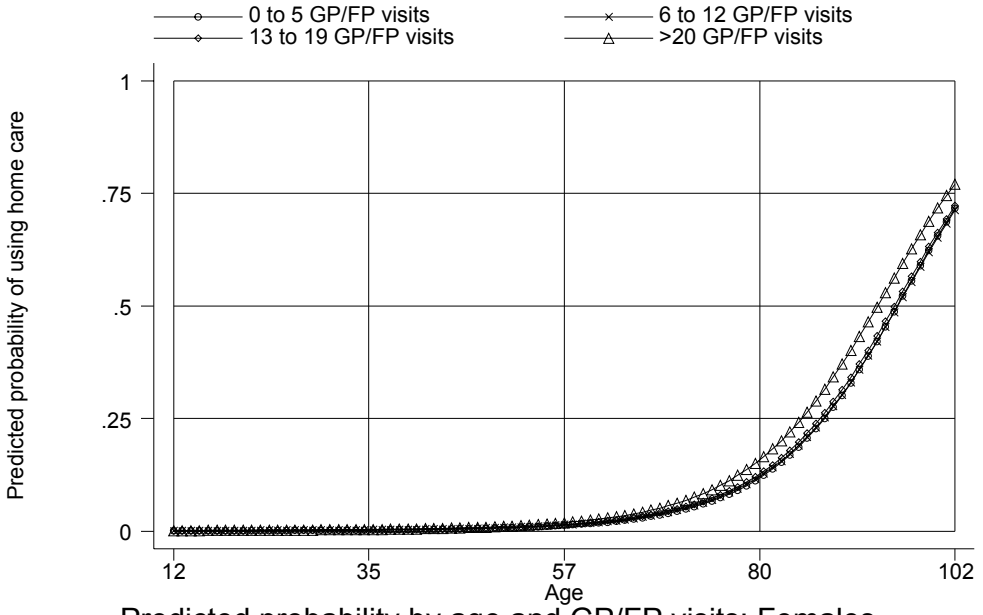


Predicted probability by age and income level: Females

Figure 6.1(i)

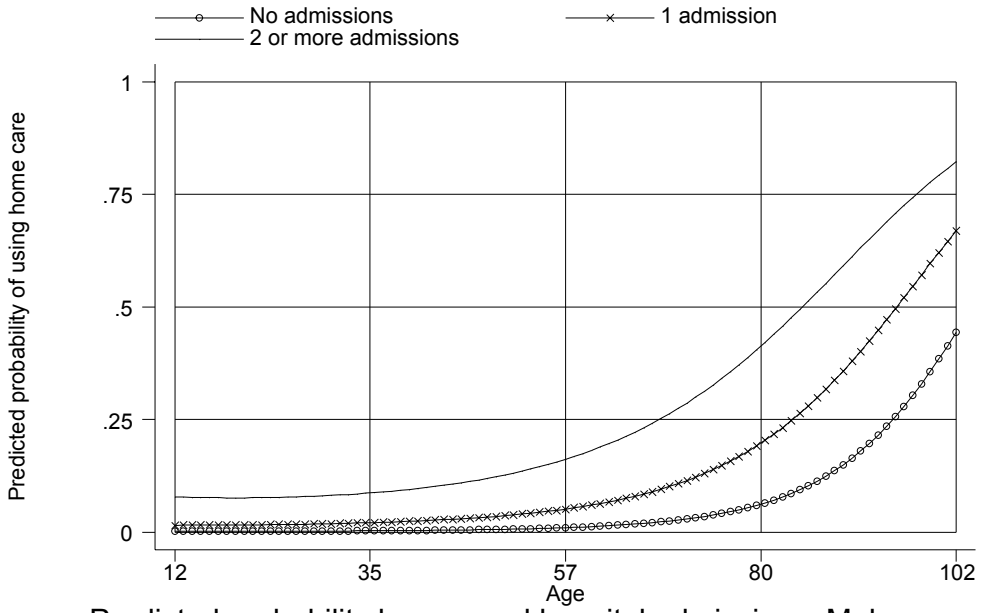


Predicted probability by age and GP/FP visits: Males

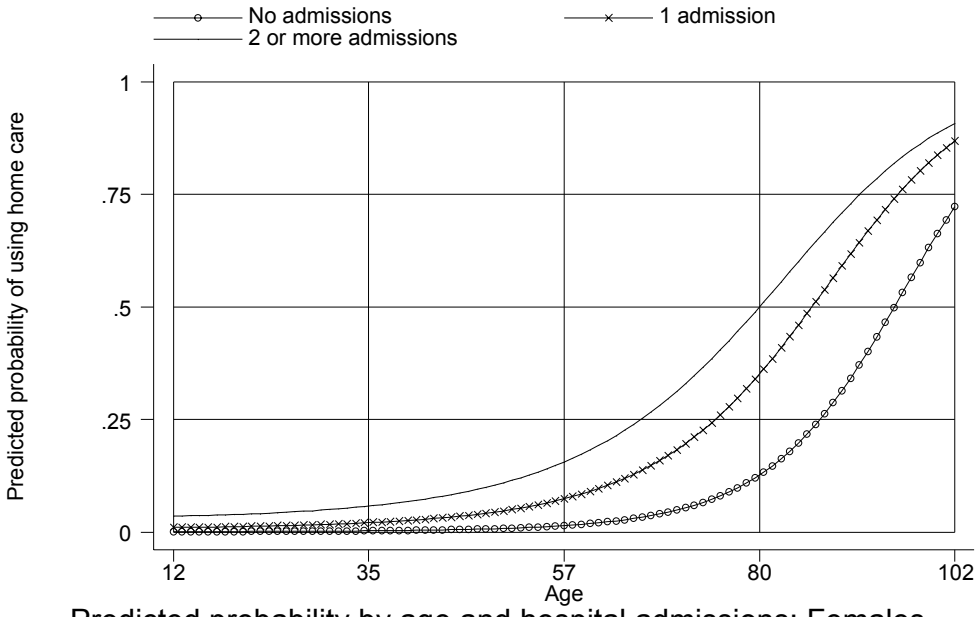


Predicted probability by age and GP/FP visits: Females

Figure 6.1(j)



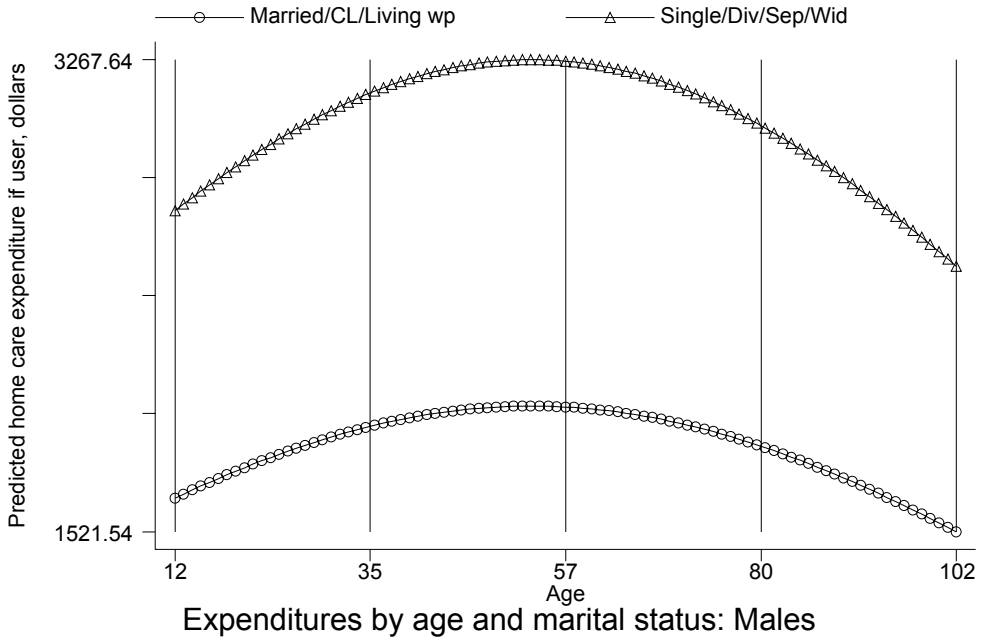
Predicted probability by age and hospital admissions: Males



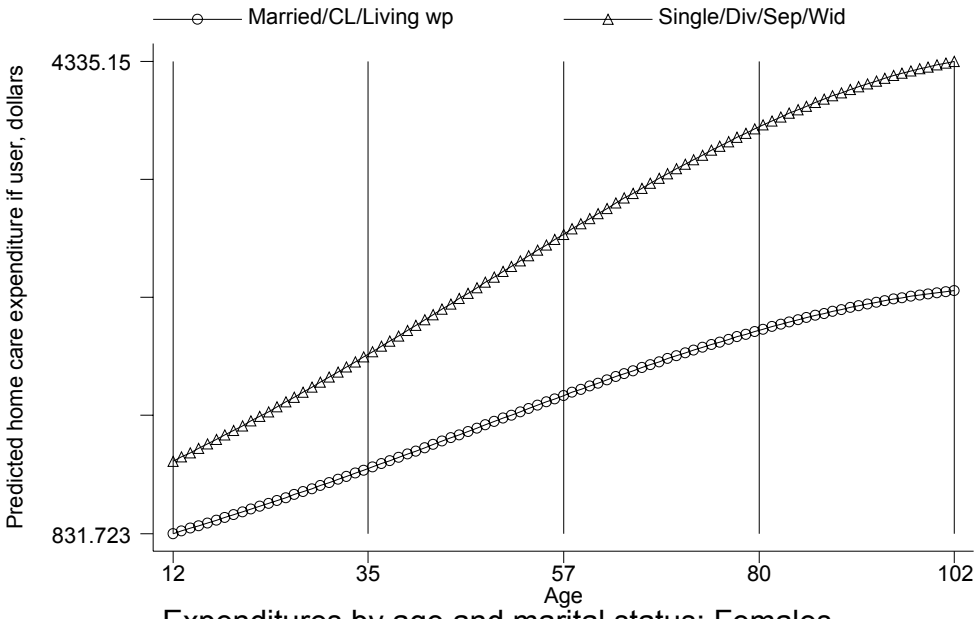
Predicted probability by age and hospital admissions: Females

PART 2 GRAPHS

Figure 6.2(a)

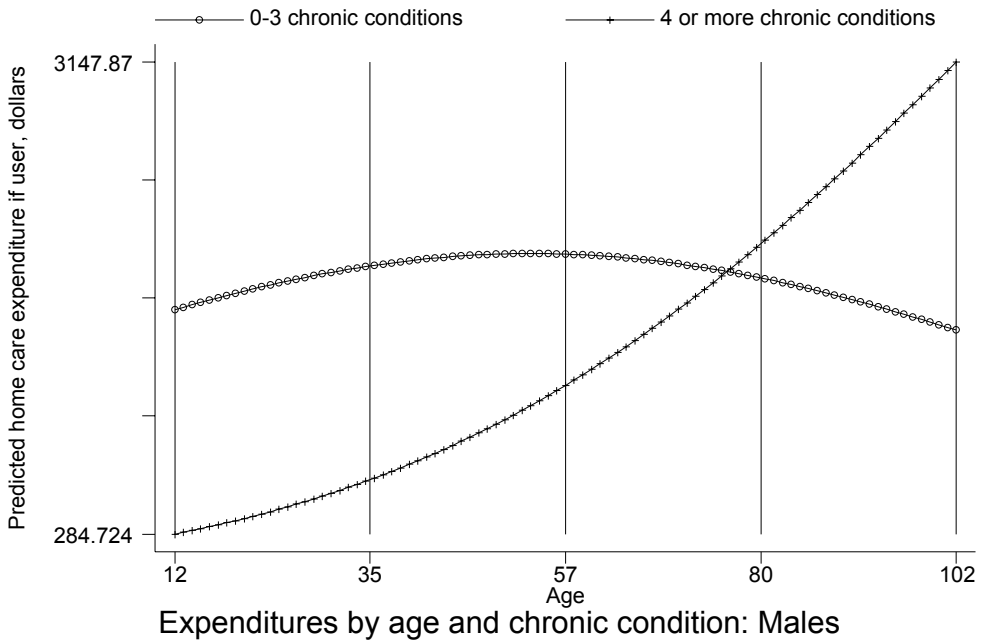


Expenditures by age and marital status: Males

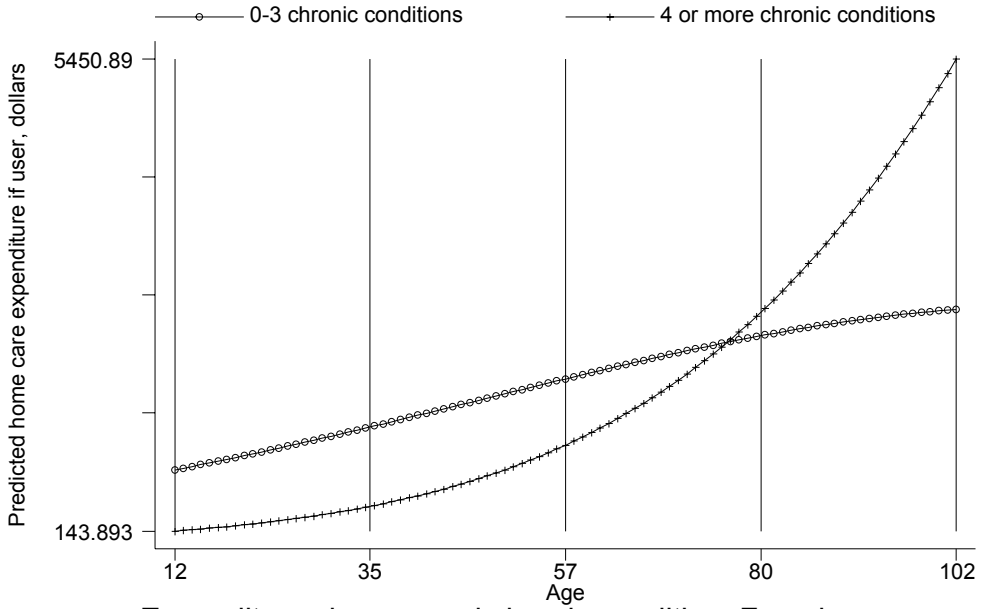


Expenditures by age and marital status: Females

Figure 6.2(b)

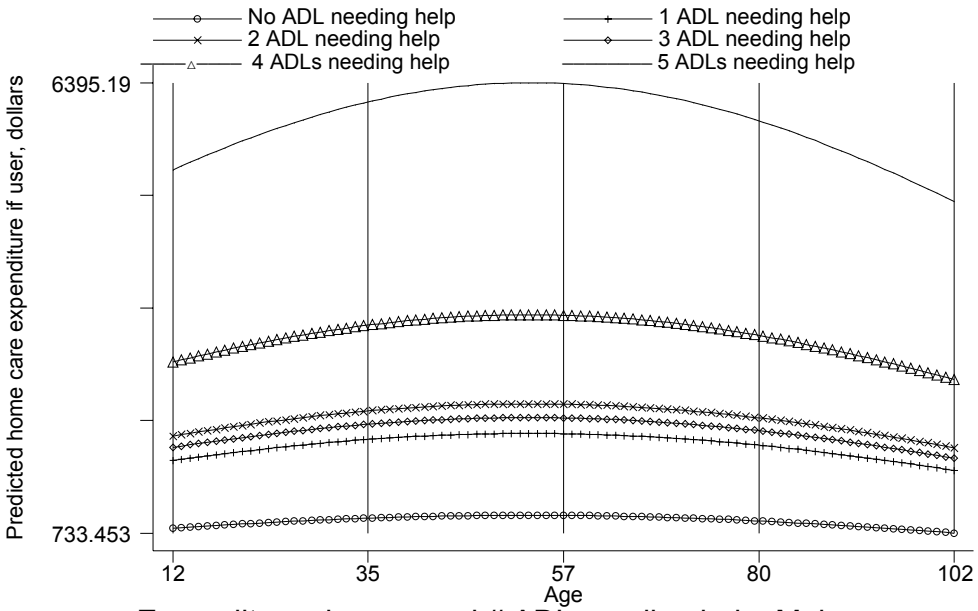


Expenditures by age and chronic condition: Males

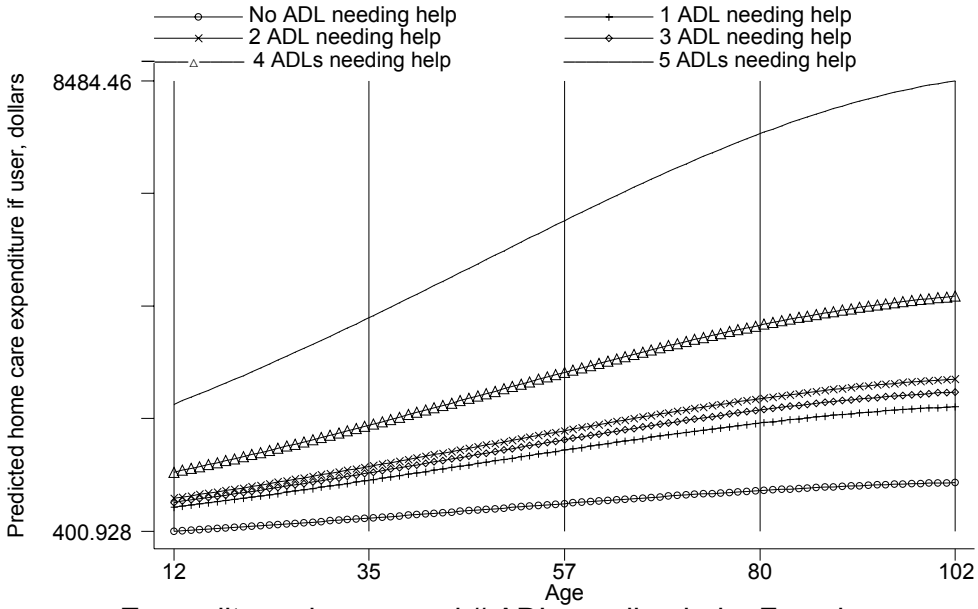


Expenditures by age and chronic condition: Females

Figure 6.2(c)

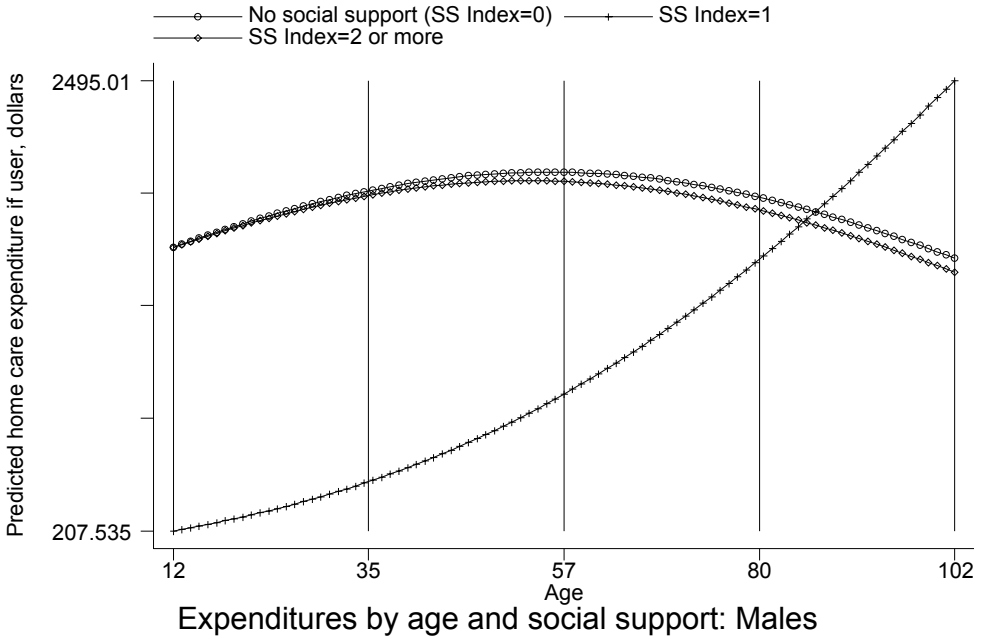


Expenditures by age and # ADL needing help: Males

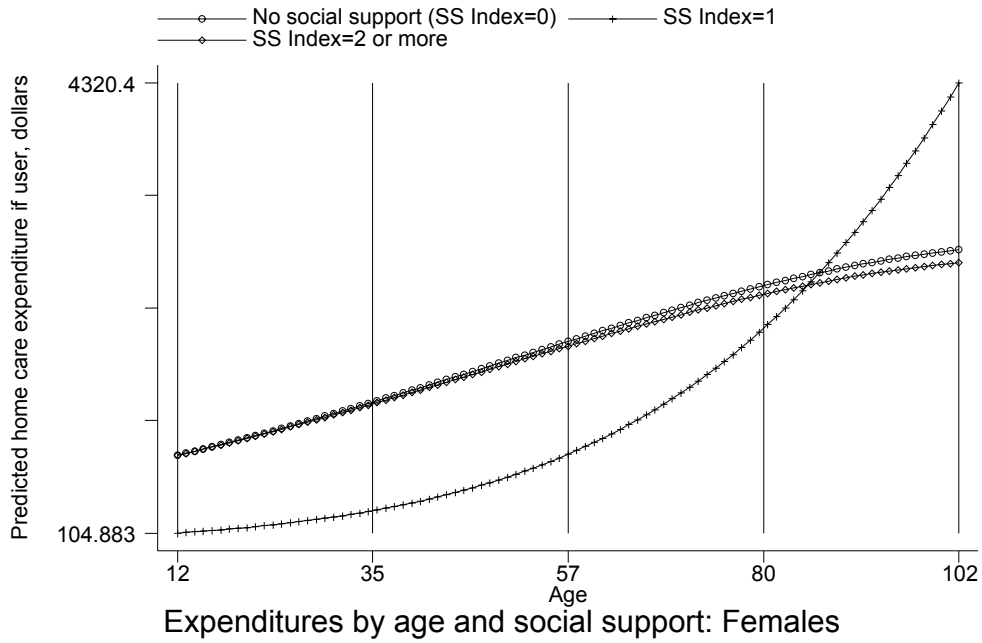


Expenditures by age and # ADL needing help: Females

Figure 6.2(d)

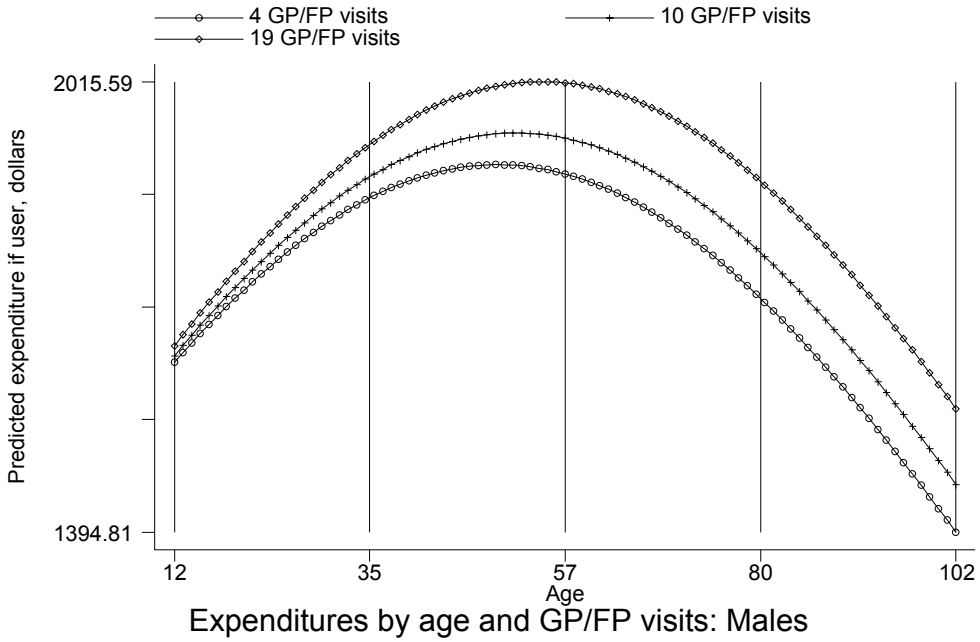


Expenditures by age and social support: Males

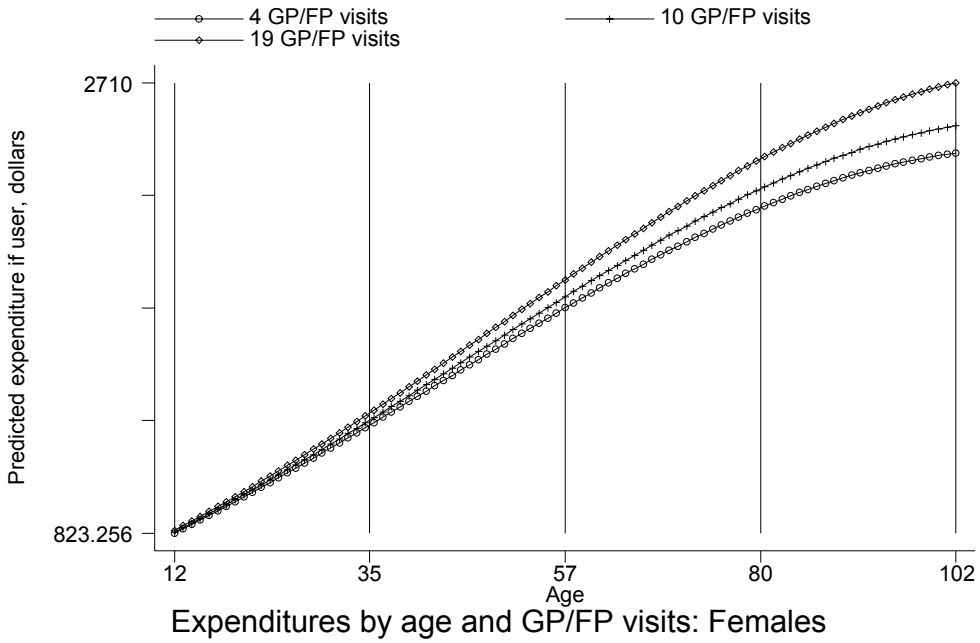


Expenditures by age and social support: Females

Figure 6.2(e)

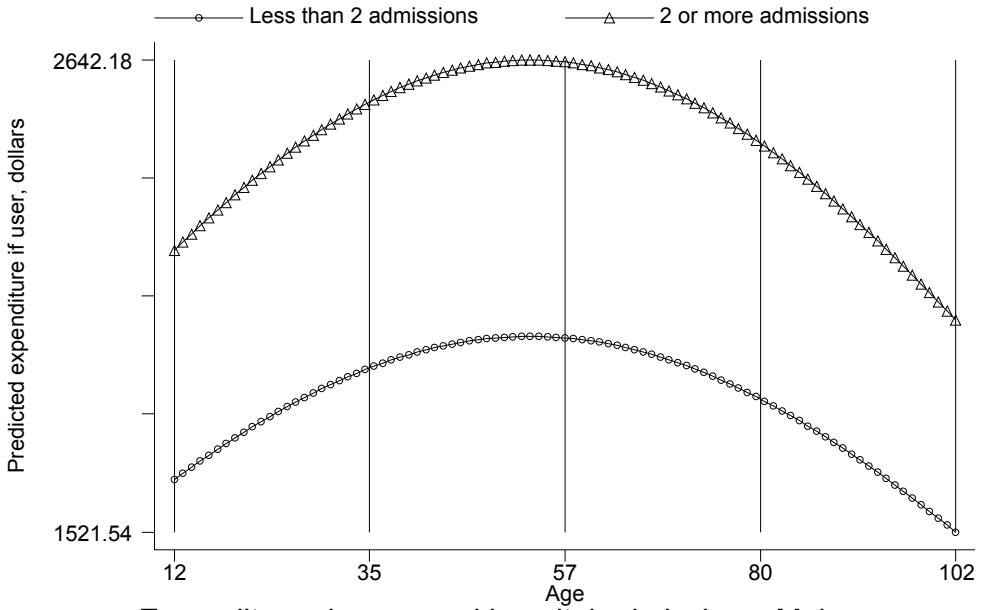


Expenditures by age and GP/FP visits: Males

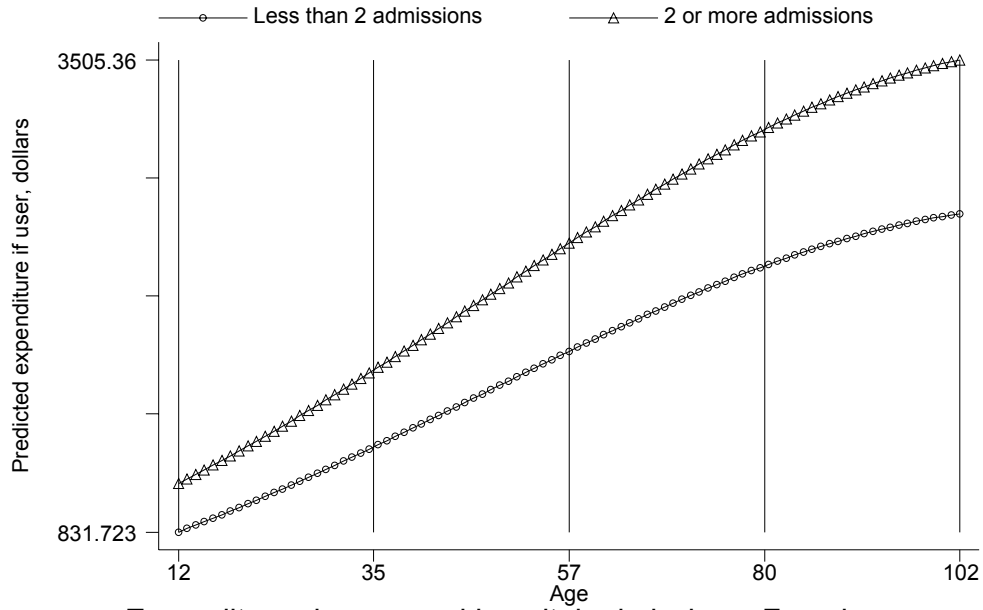


Expenditures by age and GP/FP visits: Females

Figure 6.2 (f)



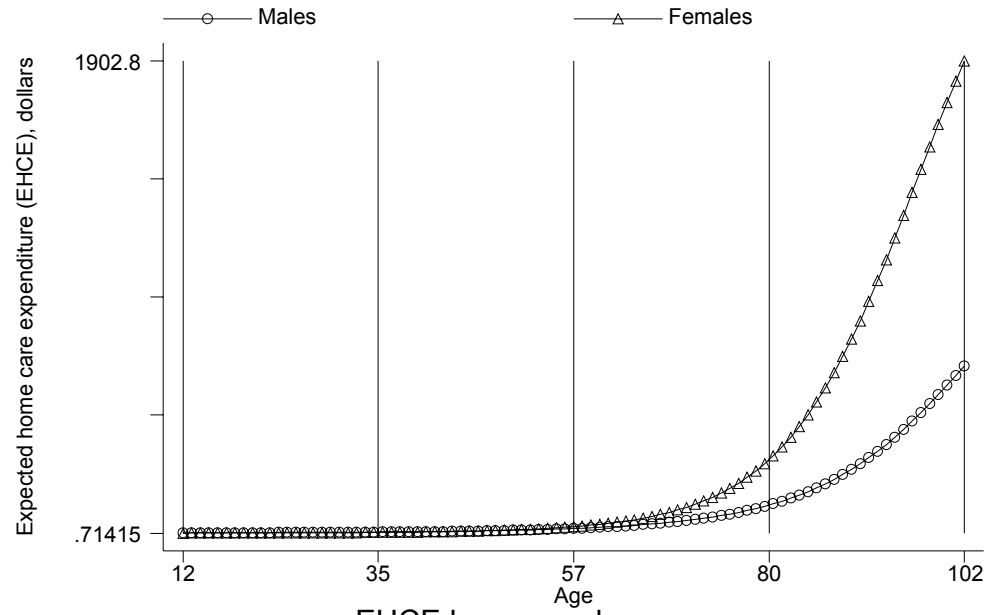
Expenditures by age and hospital admissions: Males



Expenditures by age and hospital admissions: Females

PART 3 GRAPHS

Figure 6.3(a)



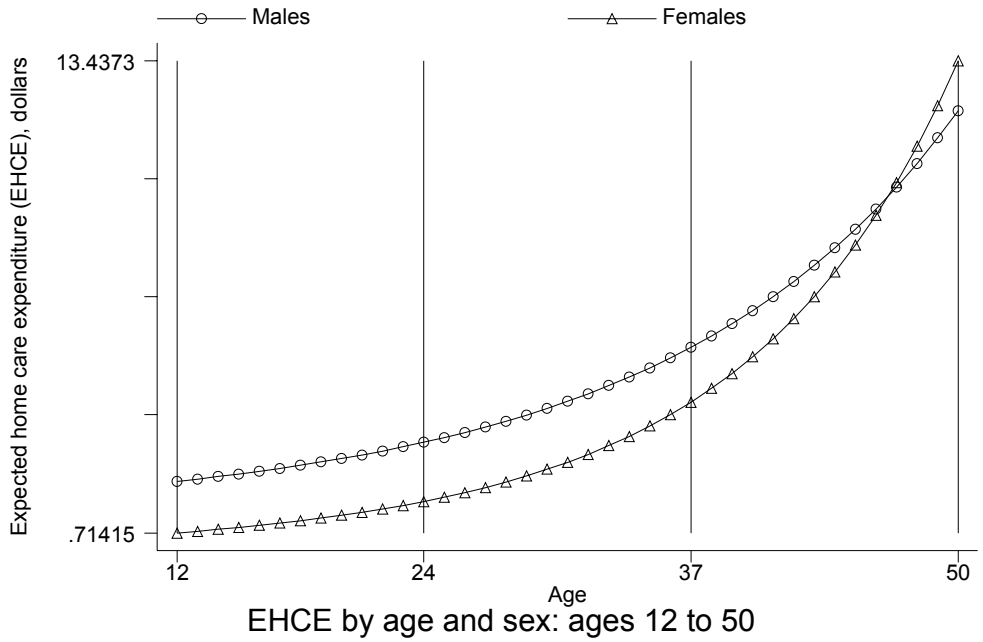
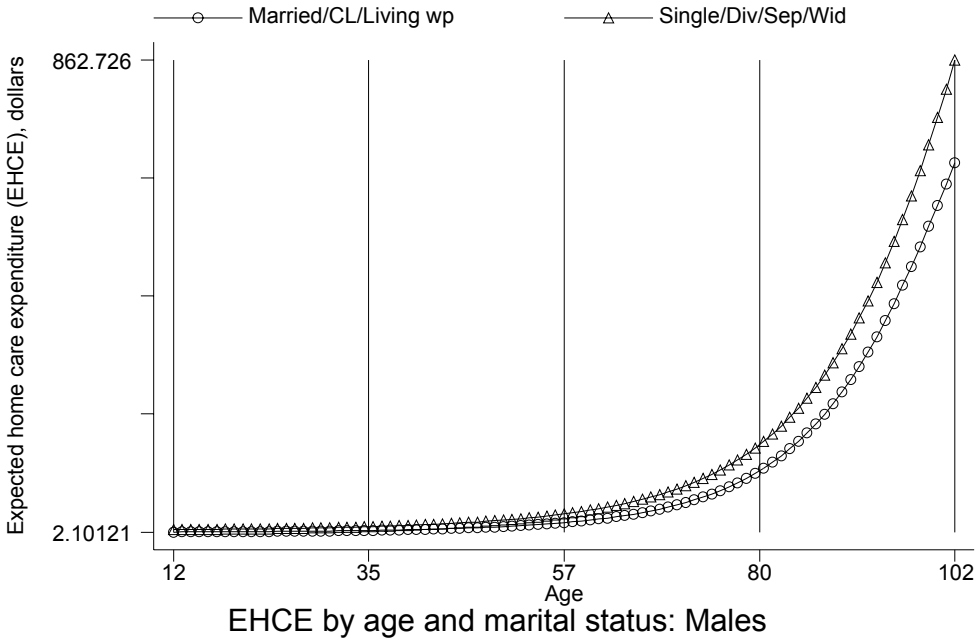
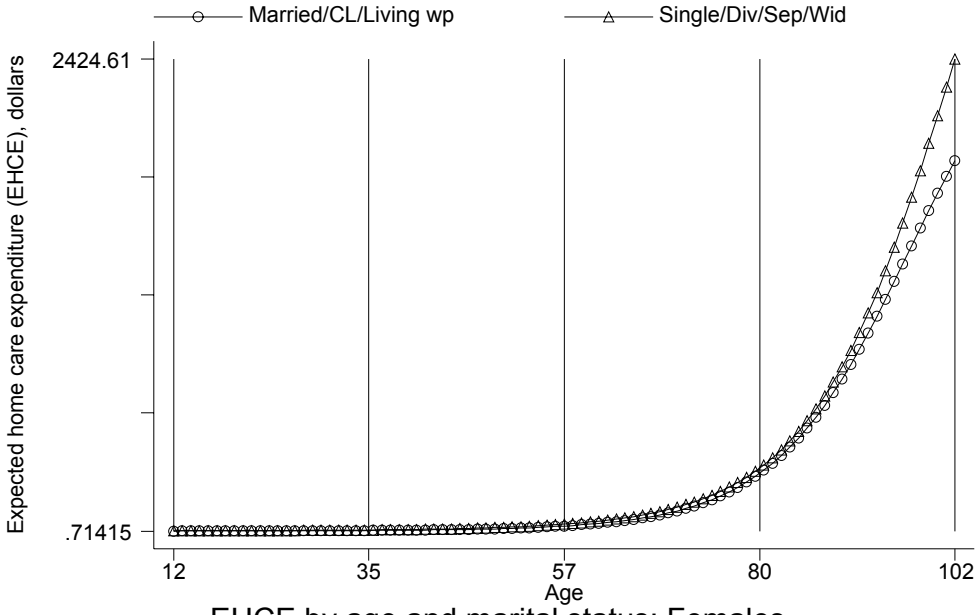


Figure 6.3(b)

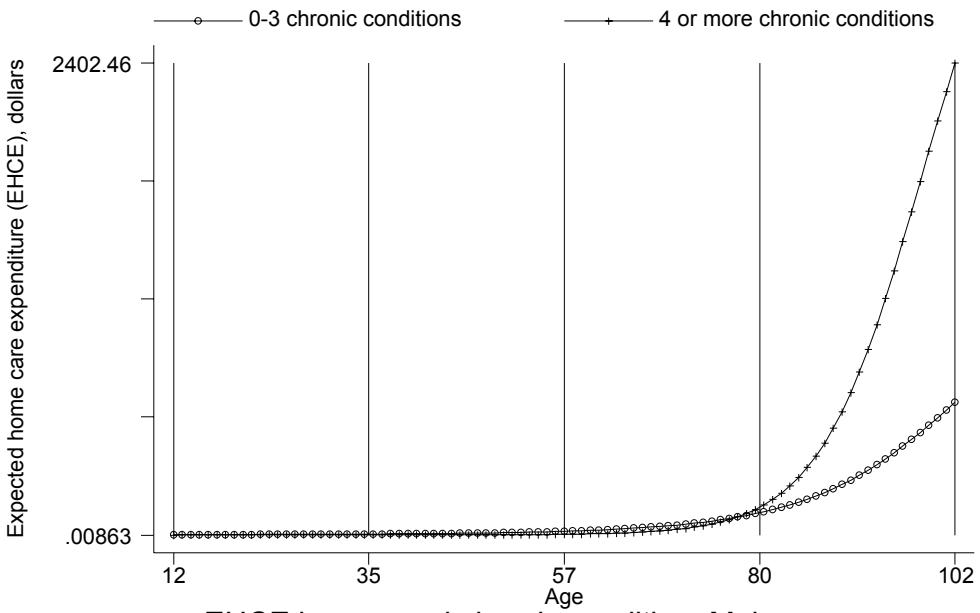


EHCE by age and marital status: Males

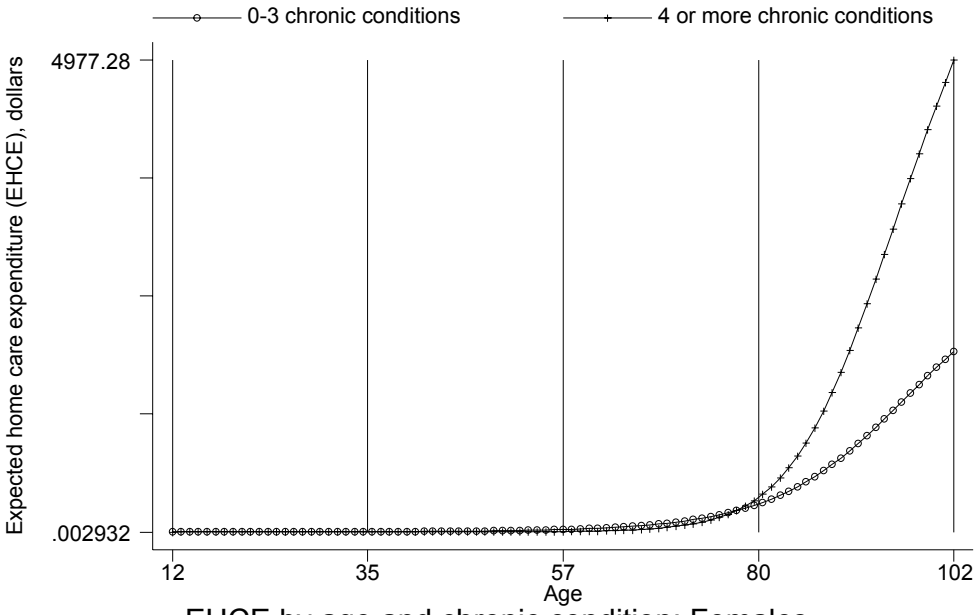


EHCE by age and marital status: Females

Figure 6.3(c)

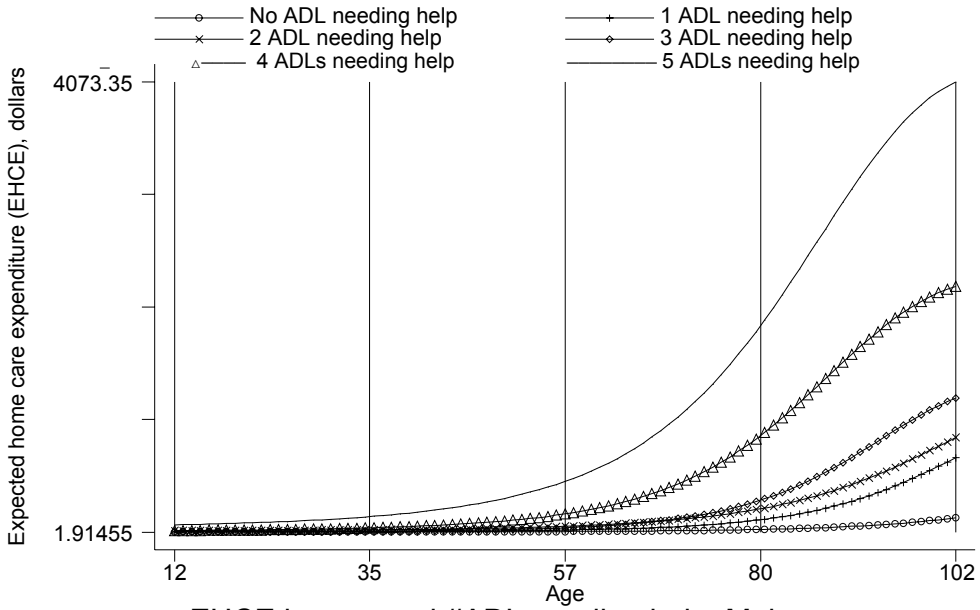


EHCE by age and chronic condition: Males

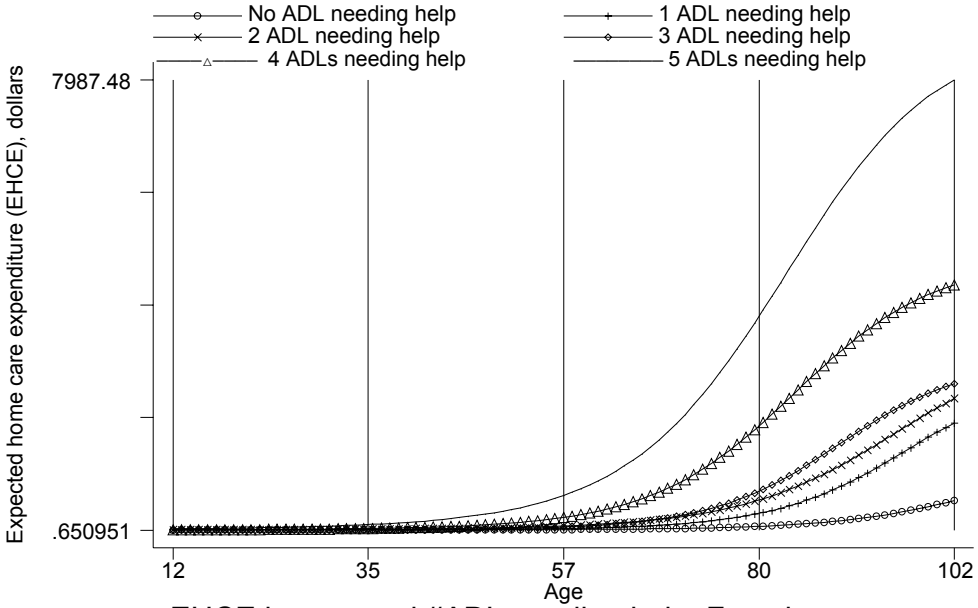


EHCE by age and chronic condition: Females

Figure 6.3(d)

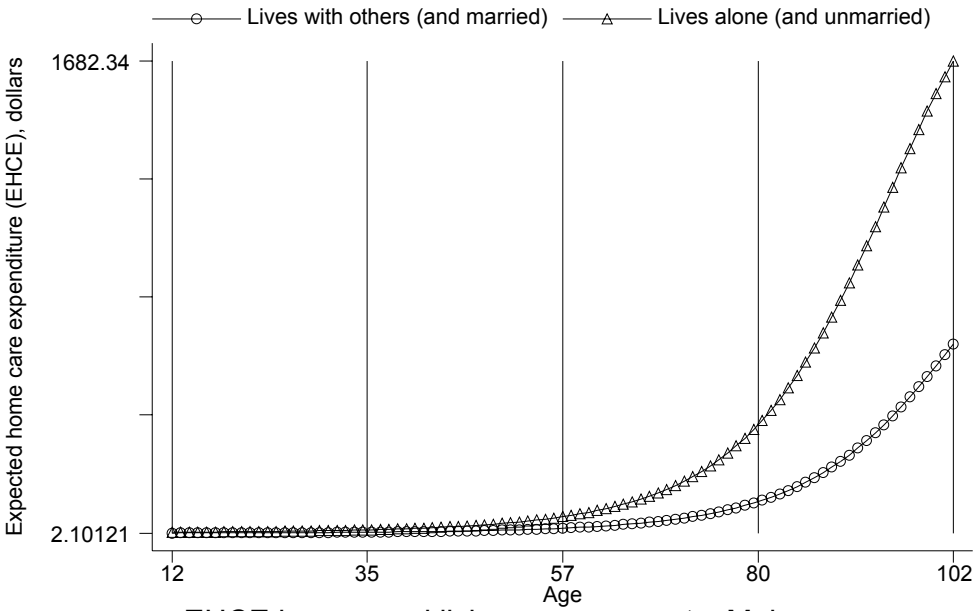


EHCE by age and #ADL needing help: Males

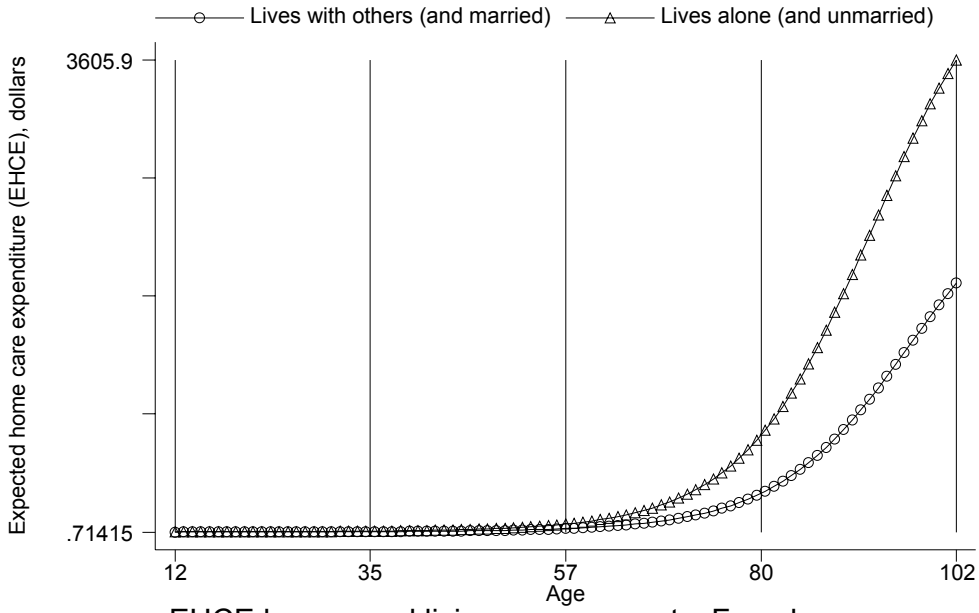


EHCE by age and #ADL needing help: Females

Figure 6.3(e)

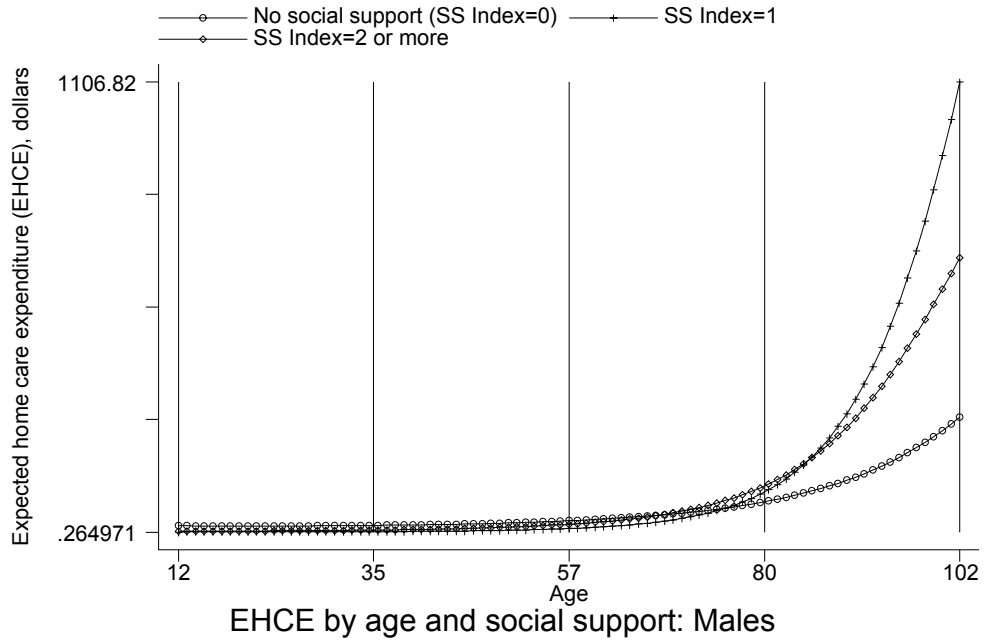


EHCE by age and living arrangements: Males

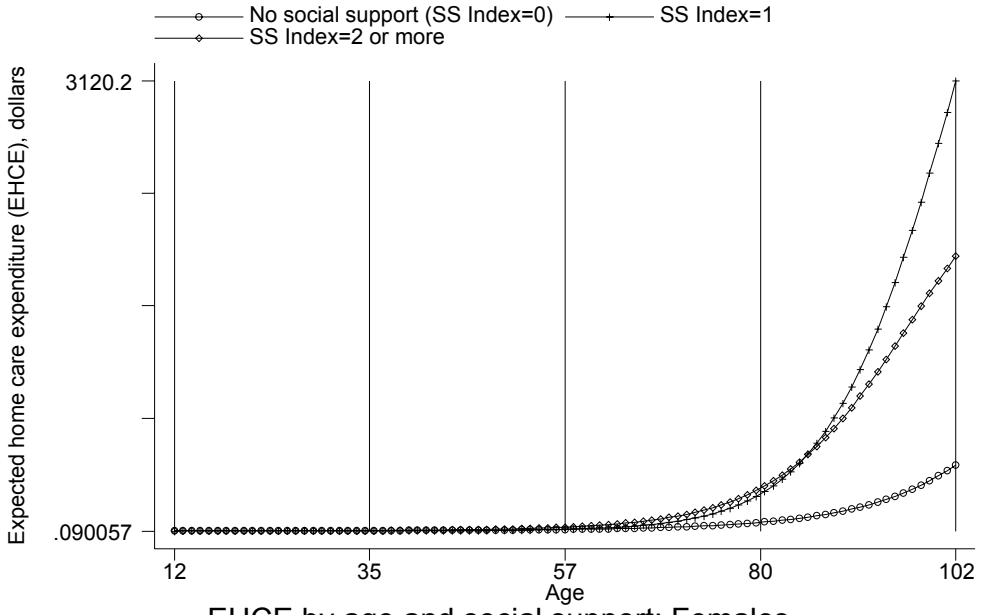


EHCE by age and living arrangements: Females

Figure 6.3(f)

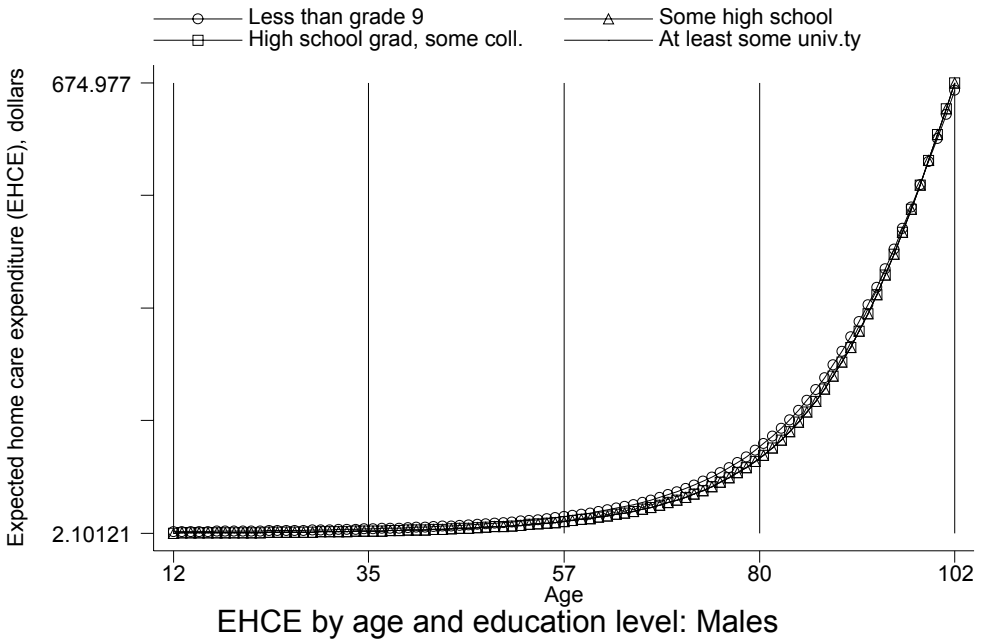


EHCE by age and social support: Males



EHCE by age and social support: Females

Figure 6.3(g)


Less than grade 9
Some high school
High school grad, some coll.
At least some univ.ty
Expected home care expenditure (EHCE), dollars
674.977
2.10121
12
35
57
80
102
Age
EHCE by age and education level: Males

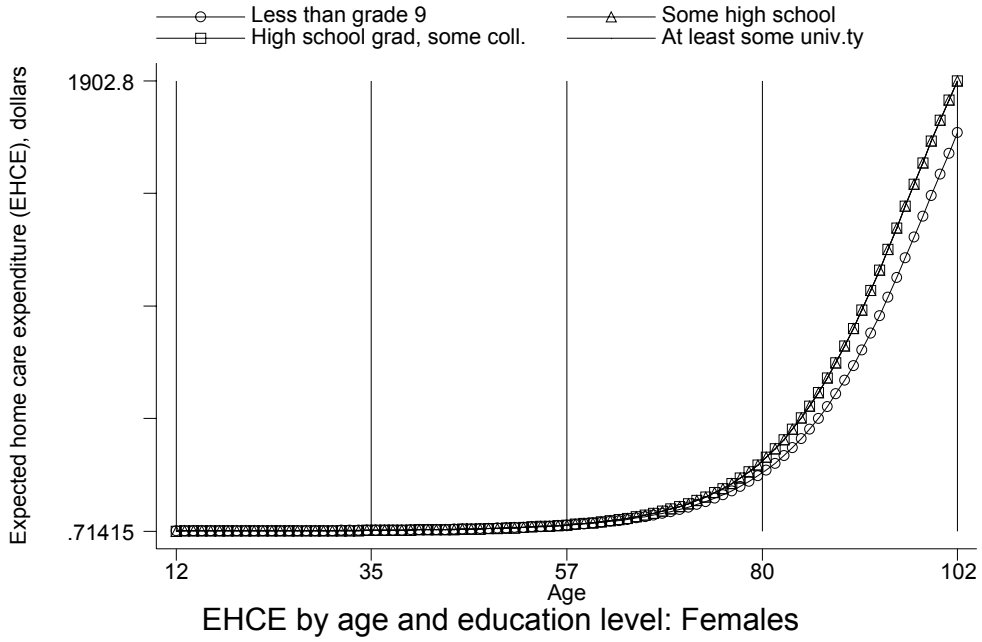
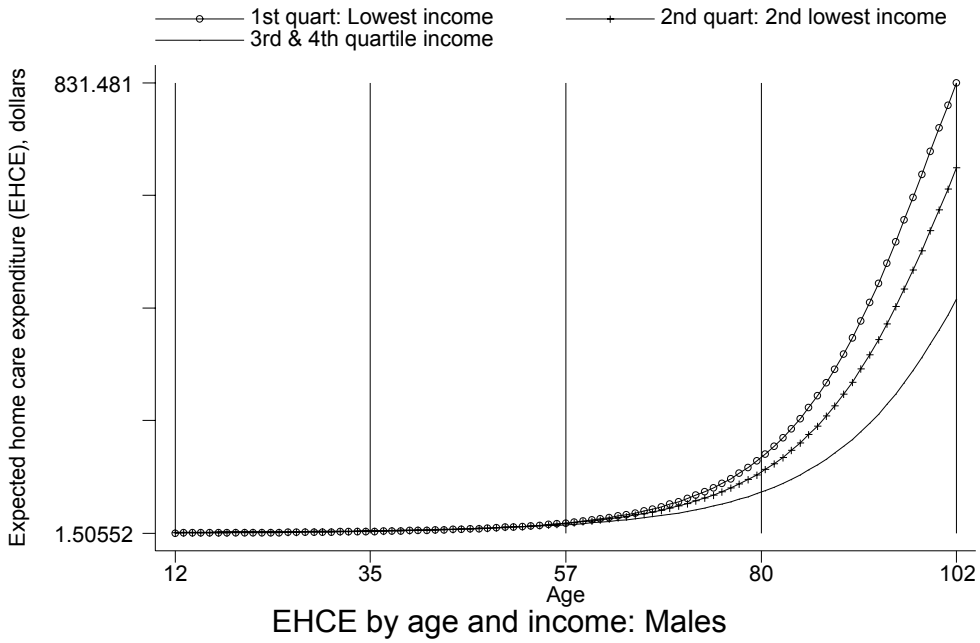
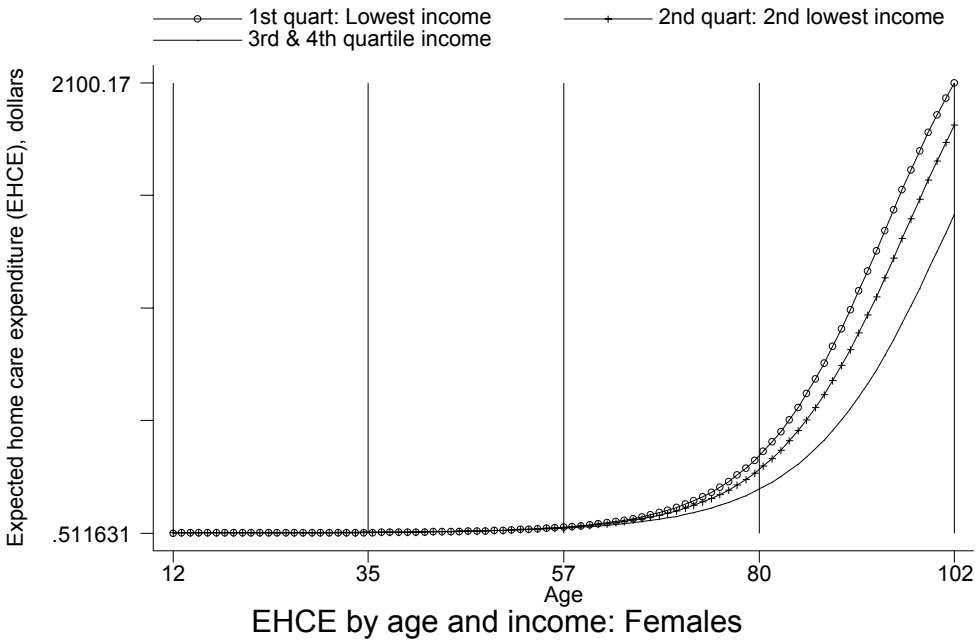

Less than grade 9
Some high school
High school grad, some coll.
At least some univ.ty
Expected home care expenditure (EHCE), dollars
1902.8
.71415
12
35
57
80
102
Age
EHCE by age and education level: Females

Figure 6.3(h)

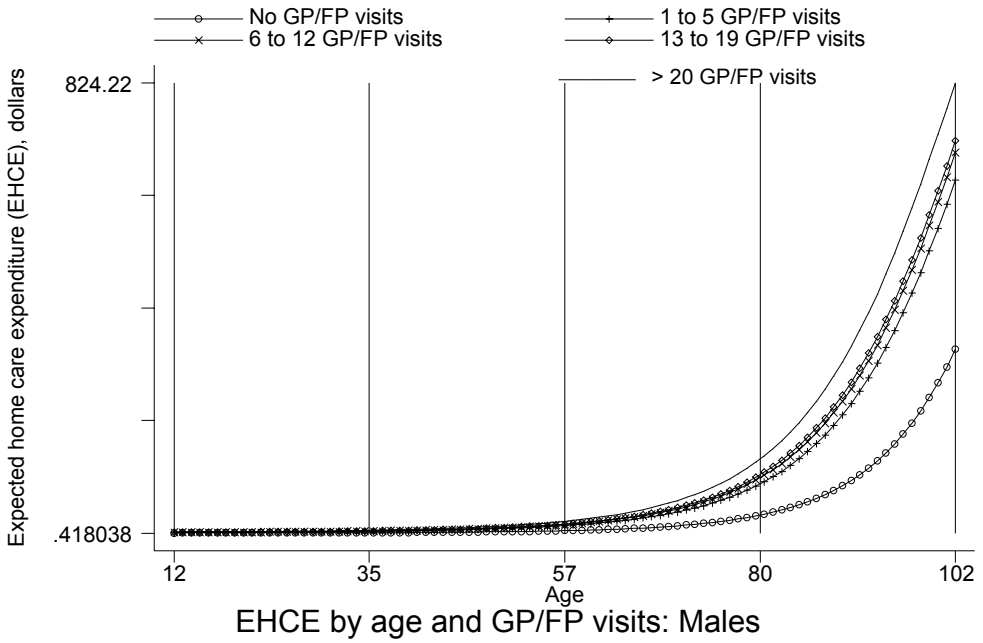


EHCE by age and income: Males

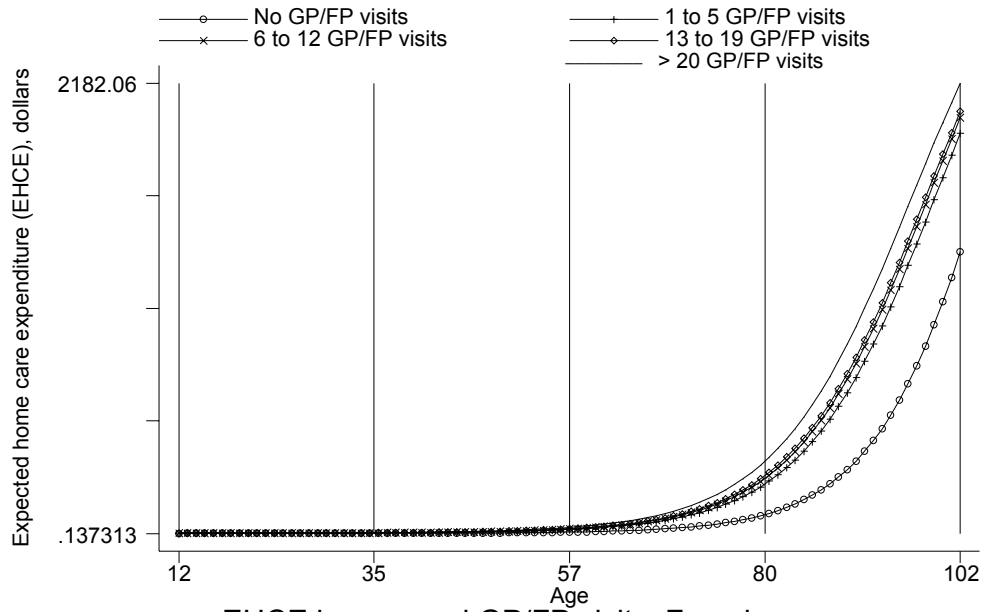


EHCE by age and income: Females

Figure 6.3(i)

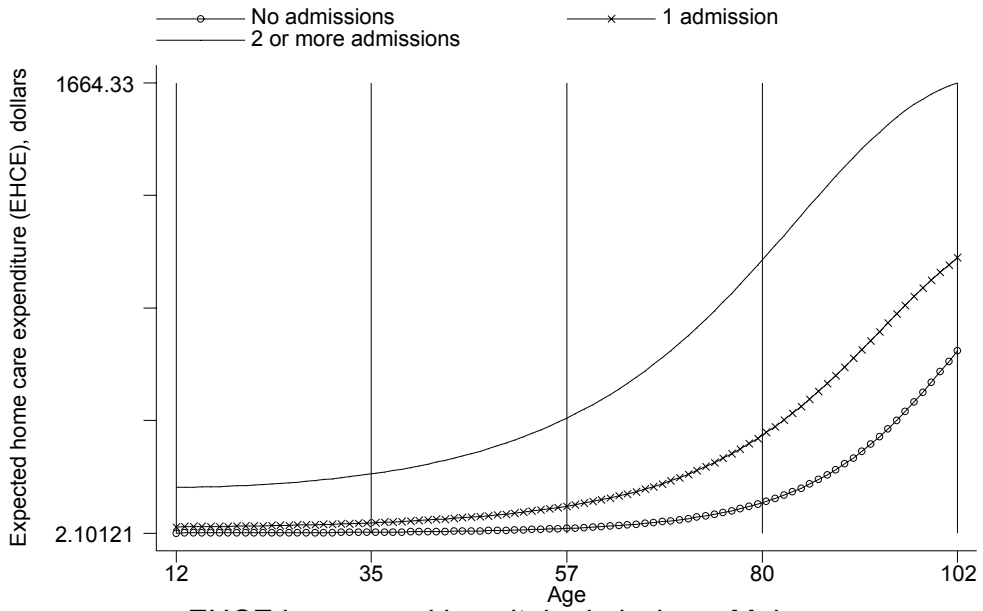


EHCE by age and GP/FP visits: Males

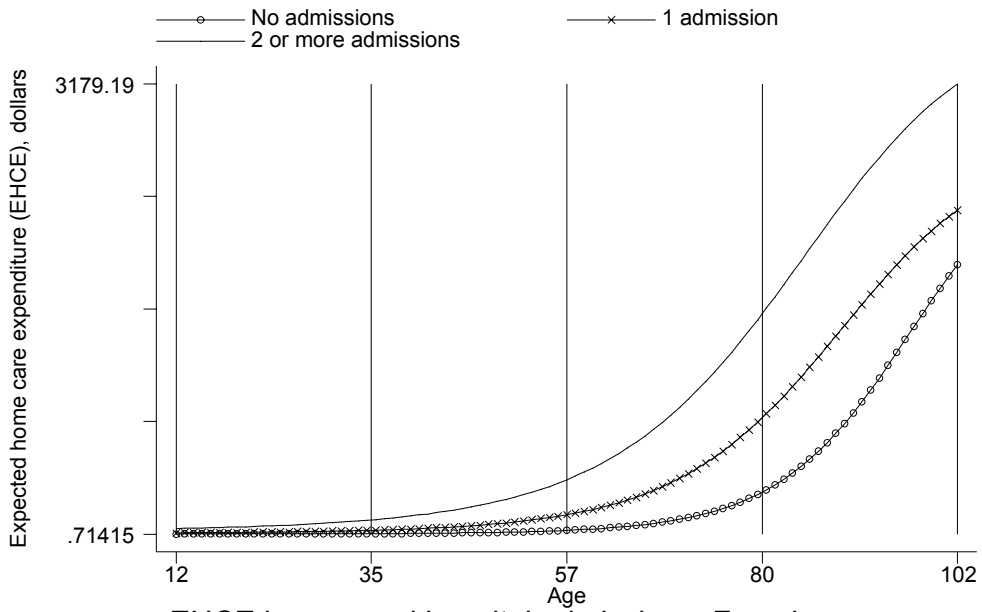


EHCE by age and GP/FP visits: Females

Figure 6.3(j)



EHCE by age and hospital admissions: Males



EHCE by age and hospital admissions: Females

7.0 CALCULATING CCAC BUDGET SHARES FOR INDIVIDUALS AGED 12 OR OVER

The utilization model described above provides an estimate of each survey respondent's expected needs-based home care expenditures during the 32 months surrounding the interview (based on the respondent's need-related characteristics and the characteristics of the CCAC region in which she resides). See Table 7.1 for a summary of the adjusters included model used to predict needs-based home care expenditures. The Ontario Health Survey gives us a "snapshot" of each CCAC region's population with respect to all of the individual-level variables in the model (and we know the regional-level variables). Using the sample weights associated with each observation, it is therefore possible to estimate the total expected needs-based home care expenditures for residents of each CCAC region. And from this, we can then calculate each CCAC region's needs-based share of the total budget.

The steps are as follows:

1. Multiply the expected needs-based home care expenditures for each individual by the sample observation's "inflation" factor for the individual.[35] Call the resulting number the "inflated needs-based expected home care expenditure," or IEHCE, for the individual. That is,

$$IEHCE_i = EPHCE_i * I_i$$

where: $EPHCE_i$ is person i's needs-based expected home care expenditure; and I_i is the inflation factor for person i.

2. For each of the 43 CCAC regions, sum the IEHCE across all sample respondents who reside in the CCAC region. Call th7e resulting number the CCAC region's needs-based expected home care expenditures, or CEHCE. That is,

$$CEHCE_c = \sum_{i \in c} IEHCE_i$$

where c designates a CCAC region.

[35] The inflation factor is the inverse of the sample observation's probability weight. In the case of a simple 10% random sample of the population, for example, the sample weight for each observation is 0.10. The inflation factor is therefore 1/0.10, or 10. This reflects the fact that, when calculating population estimates from the sample, each sample observation represents 10 individuals in the population.

3. Sum the CEHCE across the 43 CCAC regions to obtain a provincial needs-based expected home care expenditure, or PEHCE. That is,

$$PEHCE = \sum_c CEHCE_c$$

4. A CCAC region's needs-adjusted share of the home care budget, or CNASHC is therefore:

$$CNASHC_c = CEHCE_c / PEHCE.$$

One important caveat to this method must be noted. The Ontario component of the 1996 NPHS was designed to provide valid population estimates only at the level of 23 Ontario health regions. In 12 cases the CCAC region boundaries and health region boundaries coincide (Table 7.2). But in all other cases, the CCAC region is smaller than the health region of which it is part. In 6 cases a health region includes 2 CCAC regions; in 3 cases a health region includes 3 CCAC regions; in 1 case a health region includes 4 CCAC regions; and finally, in one case the health region includes 6 CCAC regions. In these cases, the CCAC region share estimates will be less precise, and there is a greater chance that the sample respondents are not fully representative of the CCAC region's population.

Table 7.1: Adjusters Included in the Needs-based Funding Model with Indication of Need vs. Control Status of all Factors

Adjustment Factor	Specification
Age	• Specified in terms of 5-year age groups (e.g., age 20-24, age 25-29) • Interacted with other factors, including sex, marital status, chronic conditions, needing help with ADLs, living arrangements, social support, education, household income, GP visits and hospital admissions
Sex	0 = male; 1 = female
Marital status	0 = married, common-law 1 = single, widowed, separated, divorced
Self-assessed Health Status	Five levels of self-assessed health status: sahs1 (excellent) - sahs5 (poor)
Number of Chronic Conditions	Dichotomous variable, chron4m: 0 = three or fewer chronic conditions 1 = four or more chronic conditions
Need Assistance with Activities of Daily Living (ADLs)	Five levels: needh1 (1 ADL) - needh5 (5 ADLs)
Living arrangements	dlivarr: 0 = lives with someone; 1 = lives alone
Social support	Five levels of support: soc0 (lowest) - soc5 (highest)
Education level*	Four levels: educ1 (no high school) - educ4 (at least some college or university)
Household income per capita	Four level corresponding to income quartiles: inc1 (< $11,199) - inc4 (> $24,000)
Number of GP/FP visits	Five levels: visit0 (no visits) - visitgte20 (20 or more visits)
Number of hospital admissions	Three levels: hospadm0 (no admissions) - hospadm2 (2 or more admissions)
Long-term care bed supply by CCAC region*	bed_ltc: beds per 10,000 population
Historic relative level of CCAC funding*	ae_ratio: ratio of past actual to equity funding
GP/FP supply in the CCAC region*	phys_no: GP/FPs per 10,000 population

Notes:
- See Table 5.2 for more detailed information on the variables
- * indicates a control variable, i.e., the variable was considered a non-need driver of utilization and did not influence needs-based allocation (see p. 34).

Table 7.2: Mapping Borders Between 23 Health Regions and 43 CCAC Regions

One-to-One Mapping	
Health Region	**CCAC Region**
Ottawa-Carleton	Ottawa-Carleton
Durham	Durham
York	York
Simcoe	Simcoe
Halton	Halton
Niagara Hamilton-Wentworth	Niagara Hamilton-Wentworth
Peel	Peel
Wellington-Dufferin	Wellington-Dufferin
Waterloo	Waterloo
Essex	Essex
Sudbury/Manitoulin	Sudbury/Manitoulin

1 Health Region Contains 2 CCAC Regions	
Health Region	**CCAC Region**
Prescott-Russell-Stormont-Dundas-Glengarry-Renfrew	• Prescott-Russell-Stormont-Glengarry-Dundas • Renfrew
Northumberland-Victoria-Haliburton-Peterborough	• Haliburton-Northumberland-Victoria • Peterborough
Brant-Halidmand-Norfolk	• Haldimand-Norfolk • Brant
Lambton-Kent	• Kent • Lambton
Algoma-Cochrane	• Algoma • Cochrane
Thunder Bay-Kenora-Rainy River	• Thunder Bay • Kenora-Rainy River

Table 7.2: Mapping Borders Between 23 Health Regions and 43 CCAC Regions (cont'd)

1 Health Region Contains 3 CCAC Regions	
Health Region	**CCAC Region**
Lanark-Leeds-Greenville-Hastings-Prince Edward-Frontenac-Lennox-Addington	• Lanark-Leeds-Greenville • Frontenac-Lennox-Addington • Hastings-Prince Edward
Elgin-Middlesex-Oxford	• Elgin • Oxford • Middlesex
Bruce-Grey-Perth-Huron	• Perth • Bruce-Grey • Huron

1 Health Region Contains 4 CCAC Regions	
Health Region	**CCAC Region**
Timiskaming-Muskoka-Parry Sound-Nipissing	• Timiskaming • Muskoka • Parry Sound • Nipissing

1 Health Region Contains 6 CCAC Regions	
Health Region	**CCAC Region**
Metro Toronto	• Toronto East York • Toronto Etobicoke • Toronto North York • Toronto Scarborough • Toronto City • Toronto York

8.0 CALCULATING CCAC-REGION BUDGET SHARES FOR THE POPULATION UNDER 12

The Ontario buy-in for the 1996-97 NPHS was limited to residents 12 years of age and over. The Ontario sample of respondents less than 12 years of age consists of the NPHS core survey only, too small a sample to conduct analyses of the age 0-11 group at any level lower than the entire province. Consequently, the above-described method can only be applied to the population aged 12 or over. We therefore use the existing equity funding formula to allocate funds to the population aged 0-11.[36]

8.1 The Current Equity Funding Formula

The current formula adjusts CCAC region budget shares on the basis of a provincial average per capita age-sex home care cost, which is annually updated and is obtained by dividing, for each age-sex category, the provincial cost of home care services by the provincial population. This provincial average per capita age-sex cost is multiplied by the total number of people in each CCAC region in each age-sex cell, and these values are summed across all age-sex categories to obtain a CCAC region's overall budget. Finally, each CCAC region's expenditure is divided by the total provincial budget to obtain the CCAC region's percentage share.

8.2 Applying the Existing Equity Funding Formula to Allocate Funds to the Population Aged 0-11

For this analysis, we obtained the following data:

- The provincial average per capita age-sex home care cost that was calculated by the MOHLTC to apply the current equity funding formula (EFF) to the 2001-'02 fiscal year[37];
- Statistics Canada postcensal estimates of the population for July 31,2001 by CCAC region[38] and by single year of age.

We defined the following three age categories: 0-4, 5-9 and 10-11. We aggregated the age-

[36] One of the concerns of the equity formula with respect to children has been its inability to adjust for or reflect the situation of three CCAC regions that do not have a Children's Treatment Centre. Unfortunately, therefore, this concern will continue to be unaddressed in allocations based on this work.

[37] The MOHLTC used OHCAS 1998-99 fiscal year data and the 2000-01 purchased unit of service cost to calculate the provincial average per capita home care cost.

[38] The original data were classified by Census Divisions and Census Sub-Divisions and were re-mapped by CCAC regions.

specific Statistics Canada population data to the above mentioned age categories, by sex and by the 43 CCAC regions. The provincial average per capita home care cost is available for the following age categories: 0-4, 5-9, 10-14.

We multiplied the provincial average per capita age-sex-specific home care cost by the total number of people in each age-sex category for each CCAC region to obtain the total cost for each CCAC region and for each age-sex group. This calculation is straightforward for the 0-4 and 5-9 age categories; for the 10-11 categories, however, we had to assume that the average provincial weighted home care cost for the population aged 10 and 11 is the same as that for the population aged 10 to 14. This assumption seems reasonable as an individual's use of home care resources is likely to stay relatively stable as he/she moves through this age group.

Once the cost for each CCAC region's 0-11 population was obtained, we used the same method as detailed in section 8.1 above to calculate each CCAC region's percentage share of the 0-11 budget. Algebraically, these calculations can be expressed as follows:

$$share_{i<12} = \frac{\sum_a \sum_s c_{as} \cdot pop_{asi}}{\sum_a \sum_s \sum_i c_{as} \cdot pop_{asi}}$$

where $share_{i<12}$ = CCAC region i's share of provincial budget for individuals 0-11;

c_{as} = Provincial average home care cost for age group a and sex s;

pop_{asi} = Total number of people of age a, sex s in CCAC region i;

a = 0-4, 5-9, 10-11;

$\sum_a \sum_s c_{as} \cdot pop_{asi}$ = Budget for the population of age 0 to 11 for CCAC region i;

$\sum_a \sum_s \sum_i c_{as} \cdot pop_{asi}$ = Provincial budget for the population of age 0 to 11.

The resulting shares are provided in Table 8.1.

8.3 Calculation of the Proportion of the Total Budget for the Population of Ages 0 to 11 and for the Population of Ages 12 or Over

In order to quantify the proportion of the total budget for each of the population sub-sets, we applied the same method as detailed above to the population of age 12 or over. Firstly, we determined the provincial budget for the population aged 12 or over by multiplying the number of people in each age-sex category for each CCAC region by the average provincial per capita age-sex home care cost and then summing across age-sex categories and across CCAC regions to obtain:

$$TOT_{\geq 12} = \sum_a \sum_s \sum_i c_{as} \cdot pop_{asi}$$

where $TOT_{\geq 12}$ = Total budget for those aged 12 or over;

c_{as} = Provincial average home care cost for age group a and sex s;

pop_{asi} = Total number of people of age a, sex s in CCAC region i;

a = 12-14, 15-19, 20-24, 25-29, 30-34, ... 85+.

Having calculated the total budget for the population of ages 0 to 11 as detailed in the previous section, we can now add the two budgets together:

$$TOT = TOT_{<12} + TOT_{\geq 12}$$

where $TOT_{<12} = \sum_a \sum_s \sum_i c_{as} \cdot pop_{asi}$ with a = 0-4, 5-9, 10-11

and determine the proportions of the budget for those 12 or over and for those under age 12 with simple algebra:

$$budprop_{\geq 12} = \frac{TOT_{\geq 12}}{TOT} \quad \text{and}$$

$$budprop_{<12} = \frac{TOT_{<12}}{TOT}.$$

Based on these calculations, the proportion of the budget for the population of age 12 or over ($budprop_{\geq 12}$) is equal to 93.2134% and the proportion of the budget for the population of age 0 to 11 ($budprop_{<12}$) is equal to 6. 7866%.

Table 8.1: CCAC Region Shares of the Budget for the Population Under 12 Years of Age

CCAC Region	Percentage share
Eastern Counties	1.650%
Ottawa-Carleton Region	6.403%
Lanark, Leeds and Greenville	1.323%
Kingston, Frontenac, Lennox and Addington	1.344%
Hastings and Prince Edward Counties	1.199%
Haliburton, Northumberland and Victoria	1.325%
Peterborough County	0.957%
Durham Region	5.102%
York Region	6.860%
Toronto East York	0.950%
Toronto Etobicoke	3.089%
Toronto North York	5.280%
Toronto Scarborough	5.141%
Toronto (City of)	4.358%
Toronto (former City of) York	1.377%
Peel Region	10.073%
Wellington-Dufferin Counties	2.266%
Halton Region	3.348%
Hamilton-Wentworth Region	4.187%
Niagara Region Haldimand-Norfolk Region	3.354% 0.915%
Brant County	1.105%
Waterloo Region	4.083%
Perth County	0.679%
Oxford County	0.914%
Elgin County	0.771%
Chatham and Kent County	0.964%
Windsor and Essex County	3.391%
Sarnia and Lambton County	1.045%
London and Middlesex County	3.558%
Huron County	0.492%
Grey-Bruce Counties	1.201%
Simcoe County	3.445%
Muskoka and (East) Parry Sound	0.396%
Renfrew County	0.850%
Nipissing County	0.644%
(West) Parry Sound County	0.298%
Manitoulin and Sudbury Timiskaming District	1.524% 0.282%
Cochrane District	0.758%
Algoma District	0.924%
Thunder Bay District	1.233%
Kenora and Rainy River Districts	0.945%
TOTAL	**100.000%**

9.0 COMBINING THE BUDGET SHARES FOR THOSE AGED 12 OR OVER WITH THOSE UNDER AGE 12 TO DETERMINE CCAC REGION NEEDS-BASED BUDGET SHARES

We now have information on each CCAC region's share of the budget for those aged 12 or over (based on calculations described in section 7.0), each CCAC region's share of the budget for those under age 12 (previous section), and the proportions of the budget for those 12 or over and those under age 12. It is straightforward to calculate a CCAC region's overall need-based budget share as follows:

$$NBBS_{ccac} = share_{\geq 12} \cdot budprop_{\geq 12} + share_{<12} \cdot budprop_{<12}$$

We carried out these calculations to determine each CCAC region's needs-based share of the total budget for home care and community support services. We then converted these share estimates into estimates of a CCAC region's dollars-per-capita allocation based on the total 1999-00 budget. These estimates are presented in Table 9.1, along with the actual per capita funding received by the CCAC region for 1999-00 and the CCAC region's equity funding per capita allocation based on the 2000-01 equity funding shares.[39] The CCAC regions have been ordered by the size of the implied change from the 1999-00 actual allocation. There are a number of things to note about the results.

- The needs-based shares imply some large shifts from both current funding and the equity funding approach. The needs-based estimates imply reductions from actual funding of over 40% for 2 CCAC regions, and funding cuts of between 25 and 40% for an additional 4 CCAC regions. At the other extreme, the needs-based estimates imply a budget increase of over 100% for 3 CCAC regions, between 50 and 100% for 2 CCAC regions, and between 25 and 50% for an additional 6 CCAC regions. These implied changes are large by any measure, and we will return to this issue below.

[39] We have chosen to present the share (per capita dollar allocation) information using a CCAC region number rather than name. The validity of this overall approach must rest on its conceptual and empirical basis, and not on perceptions (true or false) regarding specific CCAC regions or other considerations. The CCAC region numbers have been assigned to CCAC regions randomly. The dollars-per-capita are calculated as follows: ($NBBS_{CCAC}$ · 1999-00 Total Budget)/CCAC population. We present these figures because they are easier to interpret than the shares themselves. The "actual" figures (col(b)) represent the CCAC region's actual per capita allocation. The equity funding figures (col(d)) refer to the per capita allocation under the current age-sex equity formula and indicates a CCAC region should receive if all funds were allocated on the basis of the equity formula. Because the equity formula does not explicitly allocate to the 6 CCAC regions in Metropolitan Toronto, we approximated the equity share for each of the 6 CCAC regions on the basis of their proportion of Metro Toronto's total 1999-2000 actual budget. For example, if a Metro Toronto CCAC region received 20% of Metro Toronto's actual budget, then its equity share would be equal to 20% of Metro Toronto's equity budget.

- Of the 19 CCAC regions for which the needs-based approach indicates that the region's funding should be increased compared to actual levels, the equity formula also indicates an increase for 16 of these regions. But, among the 24 CCAC regions in which the needs-based approach indicates that funding should be decreased compared to actual levels, the equity formula agrees in only 6 cases. This reflects in part the fact that the current equity approach spreads big decreases among a small number of CCAC regions and small increases among the remaining. There are a few notable differences between the needs-based and equity approaches. For CCAC region 3 the equity formula would decrease funding 13% from actual while the needs-based formula would increase funding by 13%. And, more importantly, for CCAC region 28, the equity formula would decrease funding 22% from actual while the needs-based approach would increase it by 64%. This implies that not only is it the case that the current age-sex equity formula does not redistribute enough, it actually redistributes in the wrong direction in some cases.

Are the needs-based estimates to be believed? There are at least two issues at play. One is the extent to which the populations in these CCAC regions with large changes differ from the provincial average, particularly after adjusting for the CCAC region's age-sex distribution (as the current equity formula does). The second issue is the statistical precision of the estimates.

9.1 CCAC Region Characteristics

Table 9.2 presents information on the characteristics of selected CCAC regions for which the needs-based estimates imply large reallocation from current and/or equity funding. Within these CCAC regions, the table focuses on the population age 70+ because this is where home care use is concentrated (13% of the sample is 70+, but 55% of all users are 70+), because equity funding already adjusts for the age-sex distribution and we therefore want to look at characteristics within a given age category, and because this cut-point provided reasonable sample size in the CCAC regions. Sample sizes, particularly at the older end are too small to do age-sex specific tables. Age however, is clearly the more important driver of home care expenditures and the table allows one to assess differences in the sex distribution at the older ages. We focus on the characteristics of the model that have the largest impact on the probability of use and/or expenditure conditional on being a user. Finally, for purposes of comparison, we include descriptive statistics for the full provincial sample. The patterns are clear. Those CCAC regions for which the needs-based estimates imply large funding reductions have populations over age 70 that: are younger (within the elderly sub-

population), have a lower proportion of women and married individuals, are in better health status, suffer from fewer chronic conditions, require less assistance with activities of daily living, have weaker social networks, have lower rates of GP/FP visits, and have fewer hospital admissions. Compared to the provincial population over age 70, for instance, CCAC region 14 (which currently receives a per capita allocation approximately equal to the mean across CCAC regions) has a higher proportion age 70-74 (0.594 vs. 0.464), a correspondingly lower proportion age 75-89, about equal proportion of females and married individuals. Although about 12% less of its elderly in excellent health (0.109 vs. 0.124), this CCAC region has about 50% less with 4 or more chronic conditions (0.026 vs. 0.054), 74% less who need assistance with 2 ADLs (0.010 vs. 0.038), 23% less who need assistance with 3 to 5 ADLs, a GP/FP visit rate of about 13% less than the provincial average (22.04 vs. 25.3), 6% more people with no hospital admissions and over 14% fewer people with 2 or more hospital admissions (0.279 vs. 0.325). The opposite is true for those populations for which the needs-based estimates imply large increases in funding. Compared to the provincial population over age 70, CCAC region 24 (which also currently receives a per capita allocation approximately equal to the mean across CCAC regions) has: more than 2.5 times the proportion of its elderly population aged 85+ (0.20 vs. 0.067), a 21% higher proportion of females (0.716 vs. 0.590), over 35% more who are married (0.605 vs. 0.447), a 67% higher proportion of people in fair or poor health (0.396 vs. 0.238), nearly 2.5 the proportion with 4 or more chronic conditions, (0.137 vs. 0.054), over 2.5 times the proportion who need assistance with 3 to 5 activities of daily living, over 38% higher rate of GP/FP visits (34.98 vs. 25.3), and over 40% higher proportion with 2 or more hospital admissions. The age distribution is particularly important because age interacts with so many variables (e.g., sex, marital status, chronic conditions, need for assistance, visits, hospitalizations) in determining the probability of use.

9.2 Precision of Estimates

As noted above, the Ontario component of the 1996 NPHS upon which this work is based was designed to provide valid estimates of common health-related population parameters with acceptable levels of precision only at the level of 23 health regions. Our estimates are, in a number of cases, for CCAC regions substantially smaller than the health regions. Table 9.3 provides the

needs-based share estimates together with their standard errors and 95% confidence intervals.[40] The CCAC regional allocations are estimated with considerable imprecision for a number of the CCAC regions. A number of the CCAC regions with the largest implied changes from current or equity funding are those whose shares are estimated with the least precision. Given that we have estimated 43 shares, and given the level of imprecision with which many of them are estimated, it is not surprising that some of the point estimates imply large changes; purely by chance we would expect to obtain a small number of extreme values. The CCAC regions for which the current funding and the confidence limits overlap include some where the point estimate and the current funding are close, e.g., CCAC regions 26 and 22, and those for which they differ substantially but the imprecision is sufficient to widen the confidence interval out to include the equity and actual allocations (e.g., CCAC region 43). Even in these latter cases, the needs-based estimate is the best estimate possible with these data, and represents a direction for reallocation even if the point estimate itself may be an outlier.

We return to some of these issues and their implication for funding CCAC regions below.

[40] The standard errors were estimated using the bootstrap technique, using 500 replications based on the bootstrapping weights provided with the NPHS data by Statistics Canada. The sample weights were adjusted to reflect the 23,062 sub-sample of the NPHS that was able to be linked to Ontario MOHLTC administrative data.

Table 9.1: CCAC Region Needs-based, Actual and Equity* Dollars Per Capita Allocations

CCAC Region	Needs-based	Actual funding	% diff (a) vs. (b)	Equity Funding	% diff (a) vs. (d)	% diff (d) vs. (b)
	(a)	*(b)*	*(c)*	*(d)*	*(e)*	*(f)*
9	$55.74	$111.43	-50.0%	$106.66	-47.7%	-4.3%
13	$69.47	$124.36	-44.1%	$126.08	-44.9%	1.4%
34	$91.04	$148.43	-38.7%	$123.30	-26.2%	-16.9%
37	$111.54	$166.90	-33.2%	$143.39	-22.2%	-14.1%
42	$71.59	$98.77	-27.5%	$100.25	-28.6%	1.5%
4	$56.20	$74.98	-25.0%	$76.39	-26.4%	1.9%
14	$96.48	$125.86	-23.3%	$127.52	-24.3%	1.3%
15	$87.84	$114.29	-23.1%	$115.84	-24.2%	1.4%
16	$119.09	$143.47	-17.0%	$145.53	-18.2%	1.4%
12	$85.56	$102.10	-16.2%	$103.80	-17.6%	1.7%
36	$93.45	$111.56	-16.2%	$113.17	-17.4%	1.4%
18	$105.34	$125.22	-15.9%	$126.76	-16.9%	1.2%
5	$77.41	$91.40	-15.3%	$92.72	-16.5%	1.4%
31	$116.88	$136.68	-14.5%	$138.79	-15.8%	1.5%
33	$109.86	$127.77	-14.0%	$123.31	-10.9%	-3.5%
38	$85.25	$98.41	-13.4%	$99.76	-14.5%	1.4%
1	$106.64	$122.19	-12.7%	$120.58	-11.6%	-1.3%
8	$142.19	$157.14	-9.5%	$130.57	8.9%	-16.9%
21	$112.17	$123.43	-9.1%	$124.58	-10.0%	0.9%
17	$84.59	$92.97	-9.0%	$94.67	-10.6%	1.8%
2	$140.07	$147.60	-5.1%	$149.33	-6.2%	1.2%
27	$123.72	$129.07	-4.1%	$130.77	-5.4%	1.3%
22	$68.07	$69.16	-1.6%	$70.41	-3.3%	1.8%
41	$100.19	$101.83	-1.6%	$103.37	-3.1%	1.5%
29	$114.26	$111.40	2.6%	$113.00	1.1%	1.4%
10	$138.20	$133.59	3.5%	$135.21	2.2%	1.2%
40	$162.35	$152.39	6.5%	$154.70	4.9%	1.5%
26	$111.45	$103.63	7.5%	$105.09	6.1%	1.4%
6	$162.33	$145.64	11.5%	$147.68	9.9%	1.4%
19	$144.76	$128.50	12.7%	$130.35	11.1%	1.4%
3	$161.86	$143.00	13.2%	$124.00	30.5%	-13.3%
39	$149.47	$123.99	20.6%	$123.13	21.4%	-0.7%
30	$146.14	$111.82	30.7%	$112.96	29.4%	1.0%
7	$190.64	$141.69	34.5%	$143.24	33.1%	1.1%
32	$198.77	$140.82	41.2%	$142.76	39.2%	1.4%
20	$166.06	$117.11	41.8%	$118.80	39.8%	1.4%
23	$189.48	$131.92	43.6%	$133.81	41.6%	1.4%
25	$197.32	$133.58	47.7%	$135.41	45.7%	1.4%
28	$273.83	$166.83	64.1%	$130.11	110.5%	-22.0%
11	$243.59	$138.48	75.9%	$140.32	73.6%	1.3%
35	$303.13	$149.68	102.5%	$151.53	100.1%	1.2%
24	$274.61	$123.20	122.9%	$124.88	119.9%	1.4%
43	$317.27	$100.10	217.0%	$101.35	213.1%	1.2%
		Mean	10.7%		12.1%	-1.1%
		S.d.	48.9%		49.4%	5.9%

* The "actual" figures represent the CCAC region's actual per capita allocation for the 1999-00 budget. The equity funding figures refer to the per capita allocation under the current age-sex equity formula if all funds were allocated on the basis of the equity formula. Because the equity formula does not explicitly allocate to the six CCAC regions in Metropolitan Toronto, we approximated the equity share for each of the 6 CCAC regions on the basis of their proportion of Metro Toronto's total 1999-2000 actual budget. For example, if one of the Metro Toronto CCAC regions received 20% of Metro Toronto's actual budget, then its equity share would be equal to 20% of Metro Toronto's equity budget.

Table 9.2: Comparison of Population Characteristics in CCAC Regions with Large Increases and CCAC Regions with Large Decreases in Funding under the Needs-Based Model Compared to Actual and Equity Funding

LARGE DECREASES IN FUNDING									LARGE INCREASES IN FUNDING								
Age 70(+)	CCAC 9		CCAC 37		CCAC 14		Provincial		**Age 70(+)**	CCAC 28		CCAC 24		CCAC 43		Provincial	
Variable	Obs	Mean	Obs	Mea	Obs	Mean	Obs	Mean	Variable	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
Ages 70 - 74	35	0.501	28	0.420	123	0.594	2,974	0.464	Ages 70 - 74	31	0.46	23	0.386	36	0.334	2,974	0.464
Ages 75 - 79	35	0.241	28	0.314	123	0.235	2,974	0.281	Ages 75 - 79	31	0.275	23	0.355	36	0.273	2,974	0.281
Ages 80 - 84	35	0.241	28	0.156	123	0.115	2,974	0.166	Ages 80 - 84	31	0.192	23	0.03	36	0.289	2974	0.166
Ages 85 - 89	35	0.133	28	0.111	123	0.031	2,974	0.067	Ages 85 - 89	31	0.07	23	0.2	36	0	2974	0.067
Ages 90 (+)	35	0.000	28	0.000	123	0.024	2,974	0.023	Ages 90 (+)	31	0	23	0.03	36	0.104	2974	0.023
Sex (% females)	35	0.400	28	0.660	123	0.595	2,974	0.590	Sex (% females)	31	0.518	23	0.716	36	0.725	2,974	0.590
Marital status (% not married)	35	0.378	28	0.499	123	0.482	2,974	0.447	Marital status (% not married)	31	0.503	23	0.605	36	0.733	2,974	0.447
Excellent SAHS	35	0.139	28	0.039	123	0.109	2,974	0.124	Excellent SAHS	31	0.103	23	0.027	36	0.073	2,974	0.124
Very good/good SAHS	35	0.661	28	0.779	123	0.634	2,974	0.639	Very good/good SAHS	31	0.577	23	0.578	36	0.497	2,974	0.639
Fair/poor SAHS	35	0.200	28	0.182	123	0.257	2,974	0.238	Fair/poor SAHS	31	0.320	23	0.396	36	0.430	2,974	0.238
4 or more chronic conditions	35	0.031	28	0.000	123	0.026	2,974	0.054	4 or more chronic conditions	31	0.118	23	0.137	36	0.075	2,974	0.054
Needs help with 2 ADLs	35	0.000	28	0.111	123	0.010	2,974	0.038	Needs help with 2 ADLs	31	0.064	23	0.030	36	0.071	2,974	0.038
Needs help with 3-5 ADLs	35	0.032	28	0.107	123	0.070	2,974	0.091	Needs help with 3-5 ADLs	31	0.073	23	0.239	36	0.115	2,974	0.091
No social support	35	0.000	28	0.000	123	0.072	2,974	0.019	No social support	31	0.000	23	0.100	36	0.014	2,974	0.019
No. of GP/FP visits	35	18.88	28	24.54	123	22.04	2,974	25.30	No. of GP/FP visits	31	22.59	23	34.98	36	29.43	2,974	25.30
No hospital admissions	35	0.509	28	0.444	123	0.503	2,974	0.475	No hospital admissions	31	0.442	23	0.358	36	0.346	2,974	0.475
1 hospital admission	35	0.268	28	0.268	123	0.218	2,974	0.199	1 hospital admission	31	0.256	23	0.184	36	0.388	2,974	0.199
2 hospital admissions	35	0.224	28	0.288	123	0.279	2,974	0.325	2 hospital admissions	31	0.303	23	0.458	36	0.265	2,974	0.325

Table 9.3: NPHS Need-based Dollars Per Capita vs. Actual and Equity Dollars per Capita

CCAC Region	NPHS Needs-based	Standard error	95% Confidence interval		% diff. between upper CI and estimate	Actual funding	Equity funding
9	$55.74	$8.52	$36.93	$69.02	23.8%	$111.43	$106.66
4	$56.20	$8.72	$36.71	$69.97	24.5%	$74.98	$76.39
17	$84.59	$13.69	$57.14	$110.14	30.2%	$92.97	$94.67
38	$85.25	$14.02	$58.90	$111.65	31.0%	$98.41	$99.76
31	$116.88	$17.75	$89.07	$154.76	32.4%	$136.68	$138.79
1	$106.64	$15.96	$82.36	$143.21	34.3%	$122.19	$120.58
42	$71.59	$12.34	$50.73	$96.82	35.2%	$98.77	$100.25
14	$96.48	$17.00	$65.07	$132.37	37.2%	$125.86	$127.52
26	$111.45	$17.60	$83.53	$154.17	38.3%	$103.63	$105.09
5	$77.40	$16.88	$44.19	$107.32	38.7%	$91.40	$92.72
33	$109.86	$20.25	$75.16	$154.31	40.5%	$127.77	$123.31
22	$68.07	$14.73	$38.64	$95.72	40.6%	$69.16	$70.41
13	$69.47	$15.07	$42.90	$99.51	43.2%	$124.36	$126.08
34	$91.04	$18.48	$63.23	$131.09	44.0%	$148.43	$123.30
18	$105.34	$19.81	$72.02	$151.90	44.2%	$125.22	$126.76
12	$85.55	$17.79	$57.04	$125.76	47.0%	$102.10	$103.80
41	$100.19	$21.20	$65.81	$147.93	47.6%	$101.83	$103.37
21	$112.17	$22.37	$78.15	$167.00	48.9%	$123.43	$124.58
15	$87.85	$20.06	$51.77	$131.51	49.7%	$114.29	$115.84
30	$146.14	$30.79	$98.48	$219.53	50.2%	$111.82	$112.96
29	$114.26	$24.52	$74.13	$171.85	50.4%	$111.40	$113.00
16	$119.09	$30.76	$61.32	$179.86	51.0%	$143.47	$145.53
6	$162.34	$39.14	$99.26	$249.36	53.6%	$145.64	$147.68
19	$144.76	$30.94	$99.84	$222.66	53.8%	$128.50	$130.35
39	$149.47	$37.26	$93.91	$230.34	54.1%	$123.99	$123.13
32	$198.77	$46.48	$130.71	$314.65	58.3%	$140.82	$142.76
7	$190.64	$48.42	$118.24	$301.91	58.4%	$141.69	$143.24
25	$197.32	$51.53	$113.93	$313.58	58.9%	$133.58	$135.41
8	$142.19	$36.89	$83.49	$225.99	58.9%	$157.14	$130.57
40	$162.35	$46.66	$91.81	$260.81	60.6%	$152.39	$154.70
10	$138.20	$37.85	$78.90	$223.53	61.7%	$133.59	$135.21
27	$123.72	$36.49	$64.57	$203.82	64.7%	$129.07	$130.77
37	$111.54	$32.70	$59.45	$186.83	67.5%	$166.90	$143.39
2	$140.07	$48.12	$68.71	$245.15	75.0%	$147.60	$149.33
36	$93.45	$31.91	$42.68	$165.12	76.7%	$111.56	$113.17
11	$243.59	$79.89	$124.42	$433.93	78.1%	$138.48	$140.32
24	$274.61	$101.86	$105.76	$500.80	82.4%	$123.20	$124.88
20	$166.07	$76.25	$45.64	$326.45	96.6%	$117.11	$118.80
3	$161.86	$57.17	$98.70	$323.90	100.1%	$143.00	$124.00
23	$189.47	$92.89	$45.06	$383.72	102.5%	$131.92	$133.81
35	$303.13	$137.04	$97.39	$617.14	103.6%	$149.68	$151.53
28	$273.83	$121.23	$97.71	$575.49	110.2%	$166.83	$130.11
43	$317.27	$219.64	$59.95	$803.60	153.3%	$100.10	$101.35
				Mean	58.4%		
				S.d.	26.5%		

10.0 ASSESSING THE RELATIONSHIP BETWEEN THE AVERAGE COST OF PROVIDING A HOME CARE SERVICE AND CCAC REGION CHARACTERISTICS

The overall objective of the project is to develop a needs-based funding formula for home care and community care services. It is important that the formula take account of factors beyond the control of a CCAC which affect its need for resources. One such possible factor is differences in the cost among CCAC regions of providing home care services due, for instance, to a CCAC region's population density (because it may cost more per visit where the provider has to travel a greater distance between clients) or a CCAC region's total population (because there may be (dis)economies of scale in the provision of home care services).

The purpose of this analysis is to explore the relationship between the cost of providing home care services and a variety of characteristics of a region that are beyond the control of a CCAC, and in particular a region's population density, total population, and relative level of funding. We focussed on these CCAC region characteristics for the following reasons.

10.0.1 Population Density in the CCAC Region

CCAC regions in rural and remote areas of the province may experience higher costs per unit of home care service provided because of the greater travel required to reach clients. This can increase per unit costs in two ways: (1) the travel itself is costly in terms of vehicles, fuel, etc.; (2) the time cost of each visit is larger, which increases the staff cost per unit of service provided. In contrast, wages and facility costs are generally higher for urban CCAC regions.

10.0.2 Total Population in the CCAC Region

In economic language, diseconomies of scale arise when the average cost of providing a service increases as the output level increases; economies of scale are present when such costs decrease as output increases. It may be the case that the provision of home care services is subject initially to economies of scale as certain fixed costs of providing any service are spread over a larger number of units of service provided, but, as the client population grows very large, diseconomies of scale develop due to problems coordinating the large number of staff and clients. This pattern would generate a "U-shaped" average cost curve (i.e., average costs higher at both low and high service/client levels), with this shape being most pronounced for the overhead component of CCAC region costs.

10.0.3 Relative Funding Level

The equity funding formula based on age and sex alone in use since 1994 has identified the extent to which the actual budget of a CCAC region deviates from its needs-based budget (where need is assessed only by age-sex distribution of the CCAC region population). Other things equal, one might expect the average cost per unit of service in "over-funded" CCAC regions to be higher to the extent that reduced budget pressures allow: (1) higher input costs (e.g., wages); (2) greater inefficiencies; or (3) higher cost patterns of care. In contrast, if the more generously funded CCAC regions extended service provision to less severe cases, then average cost could be lower in such CCAC regions. In any event, in identifying the relationship between the average cost of providing a unit of home care and a CCAC region's population density and total population, it is important to control for the relative level of funding among CCAC regions.

10.1 Data for Cost Analysis

10.1.1 Cost and Service Data

Ideally, we want a measure of a CCAC region's cost to generate a specific increment of health through its home care programs. This cost then reflects the efficiency of the CCAC in both producing the services themselves (i.e., a unit of nursing care) and the efficiency with which the CCAC mixes services to meet client needs (i.e., are they choosing the most effective and efficient mix of services to produce health and well-being among residents). Of course, no such data are available. The Ministry of Health's Community Support Service data file, however, does include annual data on a CCAC's total costs for each of nine home care programs, total units of service delivered in each program, and the total number of clients who receive a service in each program. This information allows us to calculate a variety of average cost measures.

These data files, however, suffer from some important limitations. First, they do not allow one to separate costs into direct service provision costs and overhead costs. Therefore, using these data it is not possible to assess the presence of economies of scale in the provision of home care services, which pertains to the relationship between the overhead costs per unit of service provided and the total number of clients served.

Second, the various types of home care services are measured in different units (e.g., for nursing services a unit corresponds to a visit while for personal support/homemaking a unit represents an hour of service). It is therefore not possible to sum in a meaningful way the total units

of services provided by a CCAC. We can, however, conduct separate analyses for each of the service types.

Third, the data do not allow us to adjust explicitly for the severity of the caseloads in the different CCAC regions. Even if two CCACs have the same measured average cost of providing a unit of a home care service (e.g. a visit), one CCAC may have a more complex (or severe) caseload. This limitation is partially mitigated by the fact that units for some services are measured by the time spent. There may be therefore some unmeasured aspects of case-mix in our analysis.

Finally, the data suffer from important data quality problems, particularly in earlier years. We addressed this problem in two ways. First, we based the analysis on the most recent data available - FY 1997-98, 1998-99 and 1999-2000. Second, we conducted detailed data checks to identify and correct potentially incorrect data values. Details regarding this process can be found in Appendix G. A number of the values which were flagged as questionable had unreasonably large year-to-year changes in the number of units provided, clients or costs. Some of these changes may have been linked to divestment activities during the period and different methods of recording internally provided and externally provided services. Where a data value on units of services provided was flagged as being questionable, we did the following: we first compared the value from the CSS database against the OHCAS database. Where the two databases agreed (i.e., were within 5% of each other), we left the value as is. Where there was a discrepancy between the two, we investigated which figure was more consistent with changes in expenditures, which was more consistent with the trend in units across years, and whether it corresponded to an important event in the CCAC's history of divestment. The end result was data on costs and units of each service delivered that are as high in quality as we can obtain at this time.

10.1.2 Population and Density Data

Statistics Canada population estimates by age-sex category and by year were provided by the Ontario Ministry of Health and Long-Term Care. The data are originally classified by Ontario's 49 Census Divisions so had to be mapped and aggregated into 38 CCAC regions, the same geographical areas by which the CSS data are classified.

Data on population density were obtained by dividing the total population in each home care program (mentioned above) by the land area measured in square kilometres reported in the Statistics Canada 1996 Census of the Population. Again, the Census data were originally classified by Ontario's 49 Census Divisions so had to be mapped into 38 CCAC regions.

10.1.3 Relative Funding Data

The data regarding the relative level of CCAC region funding was provided by the MOHLTC. The relative level of funding was measured as the ratio of the CCAC region's actual budget in a each fiscal year to the level of funding the age-sex adjusted equity formula indicated the CCAC region needed.

10.2 Variable Specification for the Cost Analysis

10.2.1 The Dependent Variable: Average Cost per Unit of Service

We did separate analyses for each of four service programs (nursing, homemaking/personal support services, physiotherapy and occupational therapy).[41] For each year in each CCAC region we calculated an average cost of providing a unit of service in each program. We defined a CCAC region's average cost per unit as the total costs for the program (which includes both funds received from the Ministry and private sources of revenues such as user charges or private grants) divided by the total units of service provided through the program. If CCAC regions measure units similarly and allocate their costs similarly across programs, variation in the cost per unit should represent true differences in the cost of producing the service.

$CU_{c,j,t}$ = cost per unit of service j in year t in CCAC region c

$$= \frac{\text{(total expenditure on service j in CCAC region c in year t)}}{\text{(units of service j produced in CCAC region c in year t)}}$$

10.2.2 Independent Variables

There are three independent variables.

a) CCAC region population density, defined as the population per square kilometre
b) CCAC region total population
c) Relative funding level, defined as the ratio of actual budget to age-sex adjusted equity budget.

Table 10.1 presents the variables included in the cost analysis along with their descriptive statistics.

[41] These are the largest programs. They account for, an average, 96% of CCAC spending on direct home care services. We limited our analysis to these services on the recommendation of the CFRC.

10.3 Cost Analysis

10.3.1 Descriptive Bivariate Analysis

The first step was to examine the bivariate relationship between average cost and each CCAC region characteristic. We first visually examined a scatter plot of the relationship between average cost across CCAC regions and CCAC region characteristics for each home care service.

10.3.2. Multivariate Analysis

We estimate what has been labelled a "behavioural cost function" in the health economics literature.[Evans R 1984] This approach attempts to identify statistically the relationship between organization-specific costs of providing a service and characteristics of the organization. The approach identifies correlates of costs, not a measure of absolute efficiency. It may be that all the CCAC regions are inefficient in some sense; the most we can do is identify factors associated with relative degrees of inefficiency.

We estimated a model of the general form:

$$avgcost_{ct} = f(popden_{ct}, totpop_{ct}, fundgen_{ct})$$

where:

- $avgcost_{ct}$ = a measure of the cost of providing home care services in CCAC region c in year t;
- popdenit = population density in CCAC region c in year t
- $totpop_{ct}$ = total population in CCAC region c in year t
- $fundgen_{ct}$ = the ratio of CCAC region c's actual funding to its age-sex equity funding budget in year t.

A corresponding linear regression model can be written as follows:

$$avgcost_{ct} = \alpha_{ct} + \beta_1 popden_{c,t} + \beta_2 totpop_{c,t} + \beta_3 fundgen_{c,t} + \varepsilon_{c,t}$$

where: avgcost, popden, totpop, and fundgen are as above (c = CCAC region, t = year)

α_{ct} is an intercept

$\varepsilon_{c,t}$ is random error term

β_1, β_2, and β_3 are slope parameters to be estimated.

Four models are commonly used in contexts such as this where one has both time-series and cross sectional variation in the data. The four models -- ordinary least squares, the "between" estimator, a fixed effects model and a random effects model – each exploit differing sources of variation to differing extents. The ordinary least squares model gives equal weight to cross-sectional and time-series variation in the data; the between estimator uses only cross-sectional variation; the fixed

effects uses only time-series variation; and the random effects model uses a weighted average of the two sources of variation. Although we have both cross-sectional and times series variation in our data (data on each of 38 CCAC regions for each of 3 years), the cross-sectional variation dominates the time series variation.[42] Hence, the fixed effects estimator is least appropriate in this context. Provided we take into account the interdependence of observations from the same CCAC region in the OLS model, we expect the estimates to be very similar for the OLS model, the between estimator and the random effects model.

10.4 Results of Cost Analysis

10.4.1 Descriptive Bivariate Analysis

Table 10.1 lists descriptive statistics on average cost across CCAC regions and the independent variables for the period of this analysis. Figures 10.1 to 10.3 depict scatter plots of the relationship between the CCAC region average cost of providing a home care service and the CCAC region's total population, population density, and historical funding level, for each of nursing services, homemaking/personal support services, physiotherapy and occupational therapy. On each graph there are 113 points, corresponding to an annual value for each of 3 years for each of the 38 CCAC regions (114 minus 1 point for a missing observation for one year for one CCAC region). Figure 10.1(a), for example, depicts the relationship between average cost (the vertical axis) and total population (the horizontal axis) for nursing services. It is clear from the graph that there is no systematic relationship between average cost per unit of nursing care and a CCAC region's total population: CCAC regions with the same population size have widely varying average costs while the average cost for the largest CCAC region falls right in the middle of the range of average costs. The same appears true for the other three home care services. Figure 10.2 presents the scatterplots for the relationship between average cost and CCAC regional population density for each of the services. These scatterplots tell the same story - no systematic relationship between a CCAC region's average cost and the population density in the CCAC region. Finally, Figure 10.3 depicts the relationship between a CCAC region's average cost and the historical funding level to the CCAC region. Once again, the plots reveal that there is no systematic relationship.

[42] Population and population density, for instance, change very slowly year-to-year, and the variation we do observe is likely just imputed from the 1996 and 2001 censuses.

The overwhelming lack of evidence of a systematic relationship between CCAC region average cost and each of these three CCAC region characteristics suggests that multi-variate analysis is unlikely to reveal something masked by bi-variate analysis.

10.4.2 Multivariate Analysis

Table 10.2 presents the results from an OLS regression of average costs on the three CCAC region characteristics for each of the home care services, with robust standard errors that adjust for the lack of independence among observations from the same CCAC region.[43] The regression results provide further confirmation that there is no systematic relationship between a CCAC region's average costs and these CCAC regional characteristics. There is not a single statistically significant variable coefficient, and in 2 of the 4 cases F-test fails to reject the hypothesis that all variable coefficients (except the constant) are jointly equal to zero.

10.5 Conclusions Regarding the Cost Analysis

The above analysis leads to a clear conclusion: there is no evidence at this time that CCAC region funding shares require adjustment to reflect differences in average costs across CCAC regions that differ with respect to population size or density, or across CCAC regions whose historical funding levels have differed.

[43] As expected, the results for the OLS model, the model based on the between estimator, and the model based on the random effects estimator were nearly identical.

Table 10.1: Descriptive Statistics on Variables in Cost Analysis

Dependent Variable: Average Cost Per Unit of Service

Home Care Program	Year	Obs.	Mean	S.d.	Min	Max
Homemaking/ Personal support	1997/98	38	19.24	1.64	16.99	23.55
	1998/99	38	19.63	1.85	17.12	24.93
	1999/00	37	19.62	2.28	16.85	25.901
Nursing	1997/98	38	41.53	6.26	30.96	66.55
	1998/99	38	42.80	8.19	33.43	83.65
	1999/00	37	43.80	9.94	32.42	80.34
Physiotherapy	1997/98	38	74.13	18.33	46.14	123.17
	1998/99	38	78.35	18.06	54.32	125.48
	1999/00	37	77.55	17.73	53.38	128.51
Occupational Therapy	1997/98	38	97.78	28.36	49.48	194.03
	1998/99	38	98.16	28.85	54.37	199.89
	1999/00	37	96.67	21.63	61.50	150.52
Independent Variables						
Total Population	1997/98	38	296,039	415,014	38,347	2,490,914
	1998/99	38	299,635	420,015	37,828	2,508,948
	1999/00	37	303,150	424,502	37,273	2,523,556
Population Density	1997/98	38	202.2	617.6	0.21	3829.51
	1998/99	38	204.79	622.64	0.21	3857.23
	1999/00	37	207.18	626.82	0.21	3879.70
Actual to Equity Funding Ratio	1997/98	38	1.051	0.142	0.913	1.441
	1998/99	38	1.031	0.103	0.958	1.357
	1999/00	37	1.019	0.075	0.982	1.282

Table 10.2 Results of Regression Analysis of Relationship Between Average Cost per Unit of Service and CCAC Region Population, Population Density and the Historical Funding Level

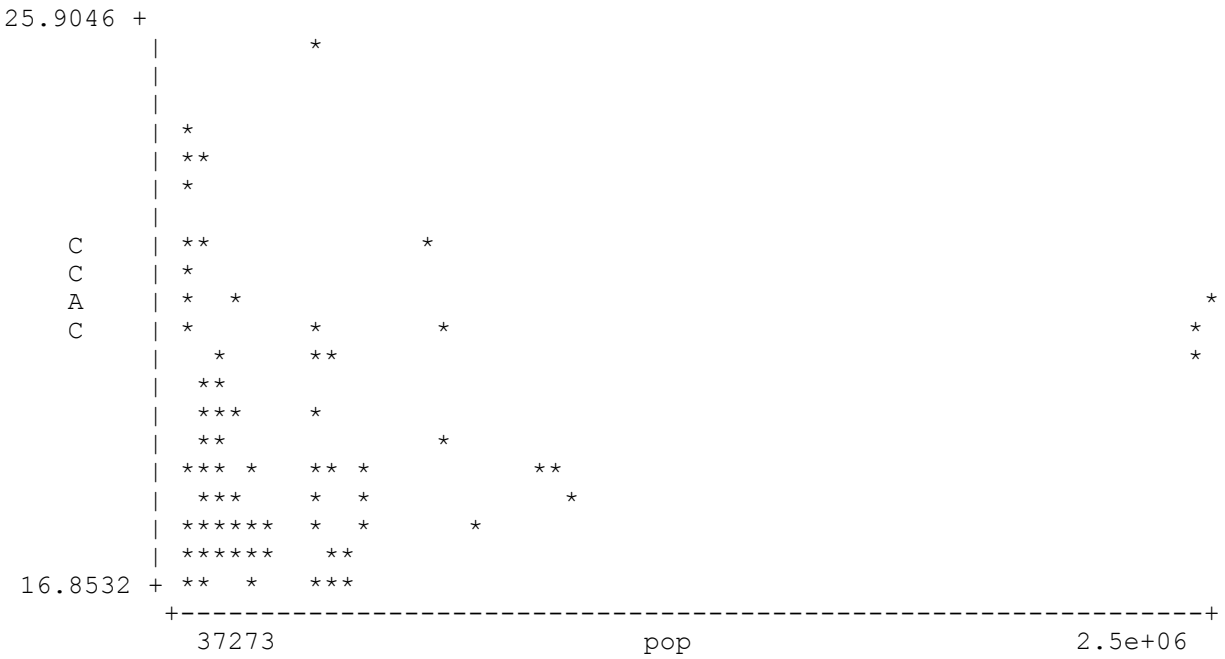
OLS with Robust Standard Errors			
	Coefficient	**SE**	**P-value**
Homemaking/Personal Support			
Overall Measurement of Fit			
N = 113 R^2 = 0.10 F-statistic = 24.0			0.00
Variable			
Population	-0.471	0.661	0.48
Population-squared	0.069	0.059	0.252
Density	-0.002	0.004	0.442
Density-squared	0	0.000002	0.527
Constant	19.42	3.302	5.88
Nursing			
Overall Measurement of Fit			
N = 113 R^2 = 0.06 F-statistic = 0.84			0.53
Variable			
Population	-3.58	2.831	0.214
Population-squared	0.302	0.273	0.276
Density	0.011	0.013	0.444
Density-squared	0.00001	0.000009	0.247
Constant	55.754	14.907	3.74

Table 10.2: Results of Regression Analysis of Relationship Between Average Cost per Unit of Service and CCAC Population, Population Density and the Historical Funding Level (cont'd)

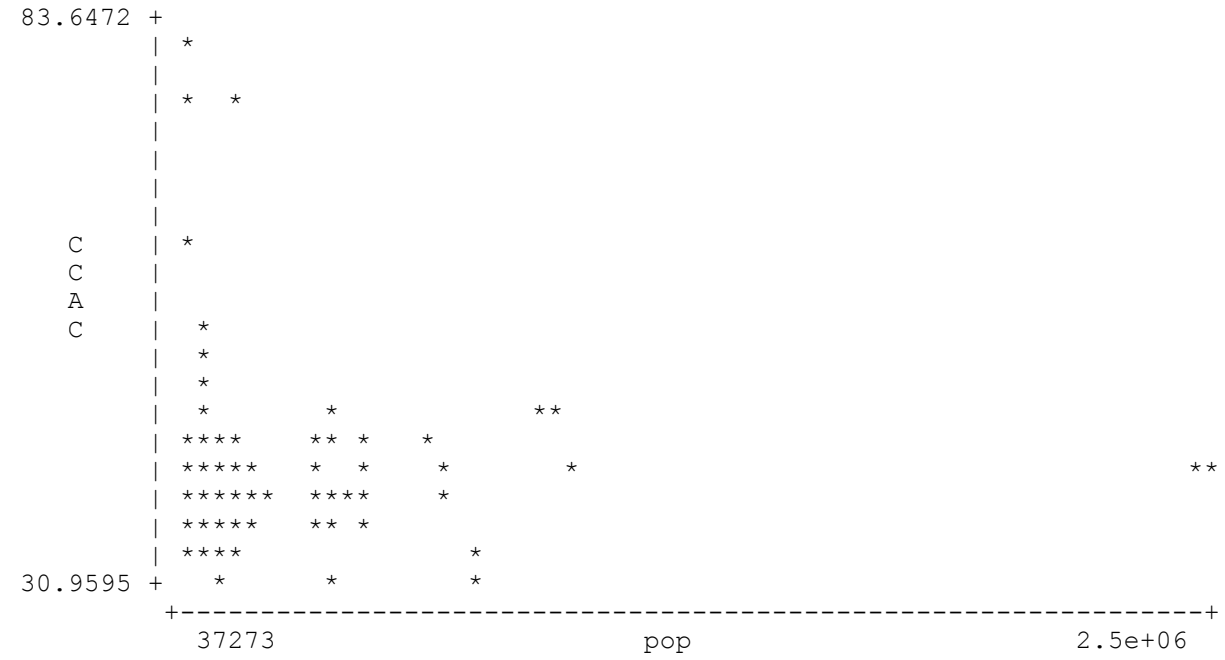
	Coefficient	SE	P-value
Physiotherapy			
Overall Measurement of Fit			
N = 113 R^2 = 0.10 F-statistic = 53.51			0
Variable			
Population	3.847	5.178	0.462
Population-squared	-0.164	0.441	0.712
Density	-0.042	0.031	0.193
Density-squared	0.0000136	0.0000161	0.405
Constant	60.298	31.786	0.066
Occupational Therapy			
Overall Measurement of Fit			
N = 113 R^2 = 0.04 F-statistic = 0.65			0.663
Variable			
Population	8.426	9.82	0.396
Population-squared	-0.725	0.932	0.441
Density	-0.061	0.06	0.309
Density-squared	0.0000324	0.0000325	0.326
Constant	99.193	38.417	2.58

FIGURE 10.1: SCATTERPLOT OF RELATIONSHIP BETWEEN AVERAGE COSTS OF PROVIDING A UNIT OF HOME CARE SERVICE AND CCAC REGION TOTAL POPULATION: NURSING SERVICE, HOMEMAKING/PERSONAL SUPPORT, PHYSIOTHERAPY, OCCUPATIONAL THERAPY

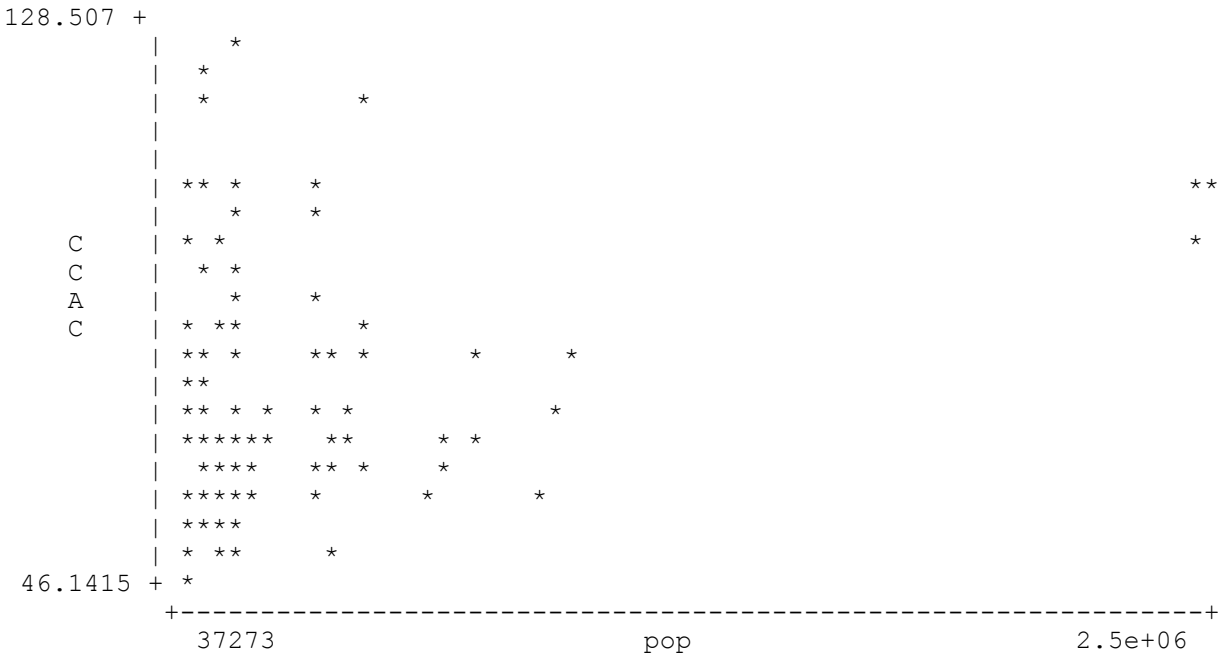
(a) Plot: Average Cost of Homemaking/Personal Support vs. CCAC Region Population



(b) Plot: Average Cost of Nursing Services vs. CCAC Region Population



(c) Plot: Average Cost of Physiotherapy Services vs. CCAC Region Population



(d) Plot: Average Cost of Occupational Therapy vs. CCAC Region Population

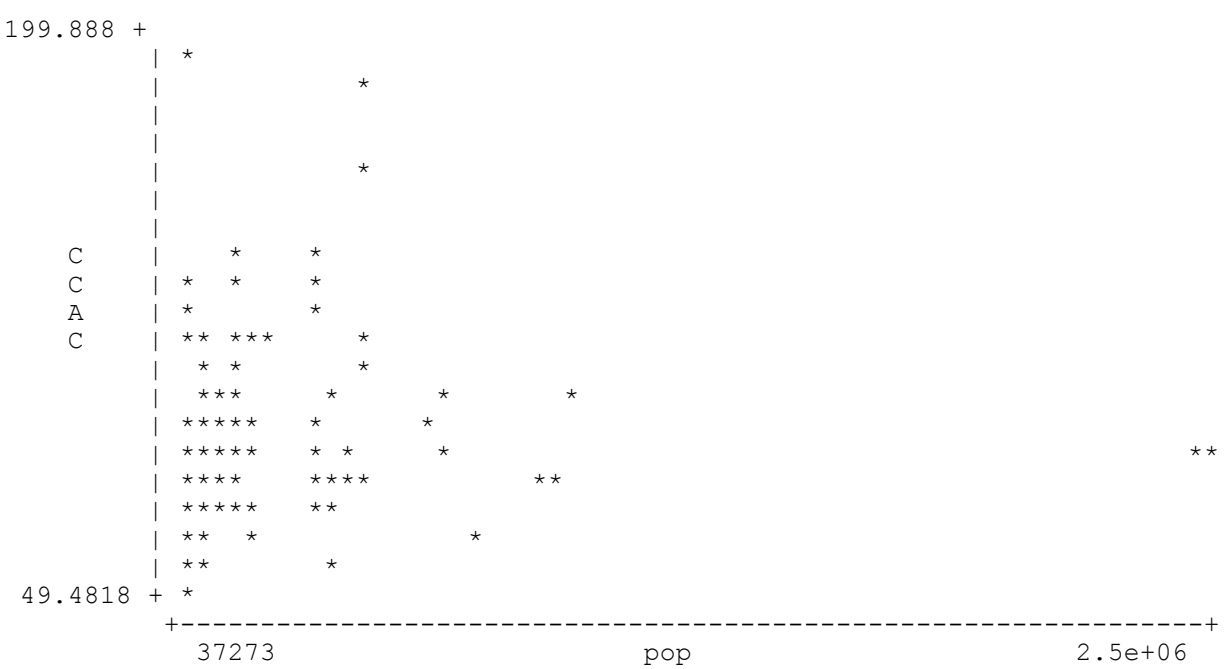
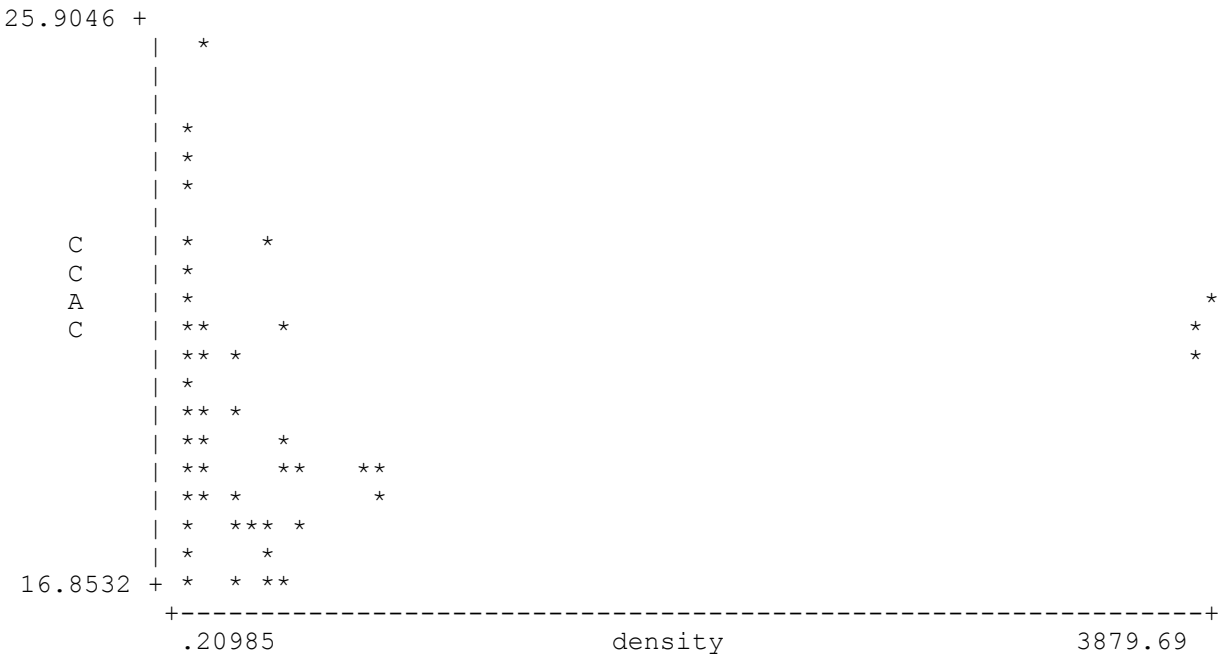
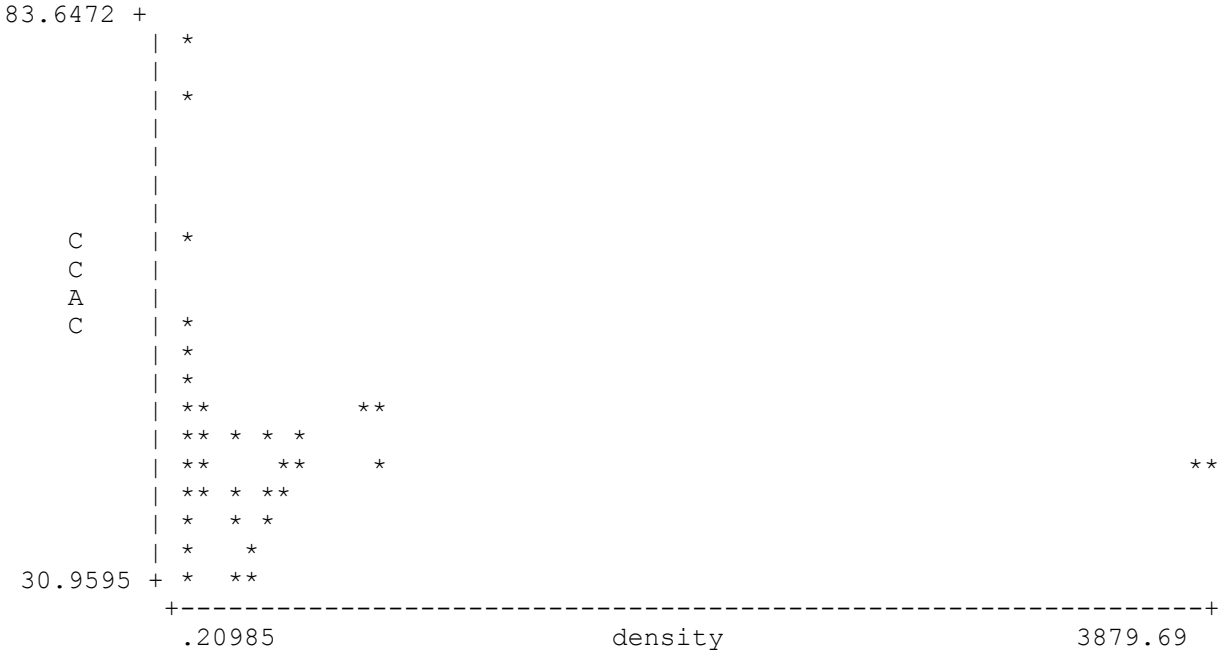


FIGURE 10.2: SCATTERPLOT OF RELATIONSHIP BETWEEN AVERAGE COSTS OF PROVIDING A UNIT OF HOME CARE SERVICE AND CCAC REGION POPULATION DENSITY: NURSING SERVICE, HOMEMAKING/PERSONAL SUPPORT, PHYSIOTHERAPY, OCCUPATIONAL THERAPY

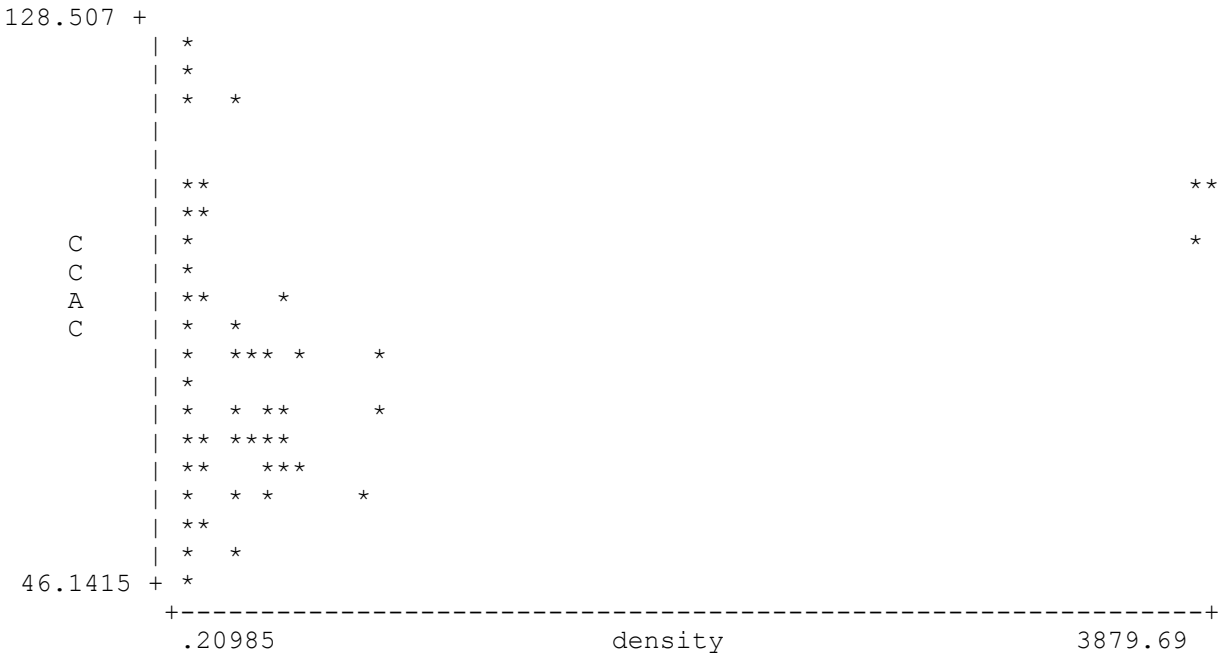
(a) Plot: Average Cost of Homemaking/Personal Support vs CCAC Region Population Density



(b) Plot: Average Cost of Nursing Services vs CCAC Region Population Density



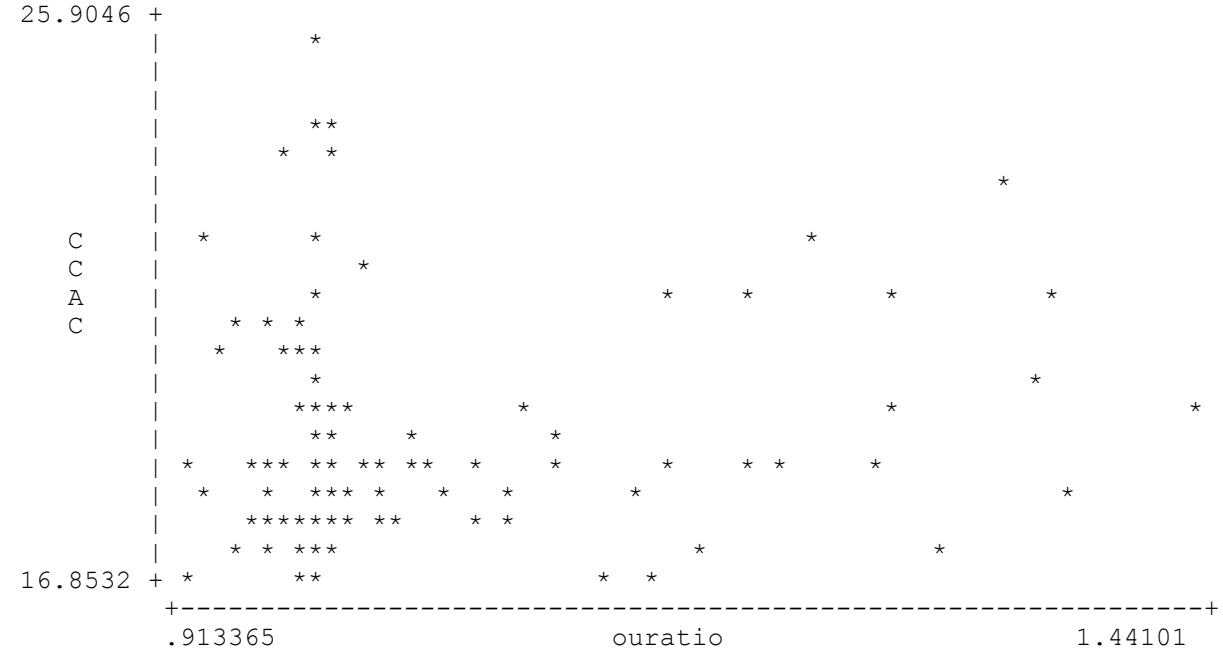
(c) Plot: Average Cost of Physiotherapy vs. CCAC Region Population Density



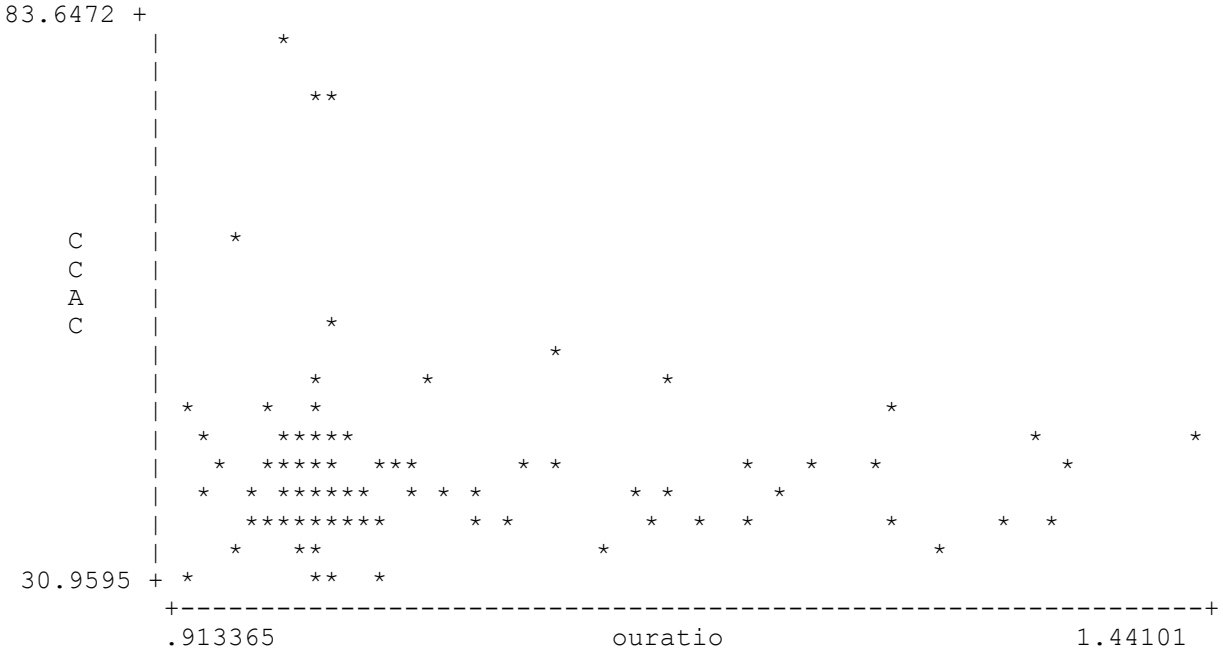
(d) Plot: Average Cost of Occupational Therapy Services vs. CCAC Region Population Density

FIGURE 10.3: SCATTERPLOT OF RELATIONSHIP BETWEEN AVERAGE COSTS OF PROVIDING A UNIT OF HOME CARE SERVICE AND CCAC REGION HISTORICAL FUNDING: NURSING SERVICE, HOMEMAKING/ PERSONAL SUPPORT, PHYSIOTHERAPY, OCCUPATIONAL THERAPY

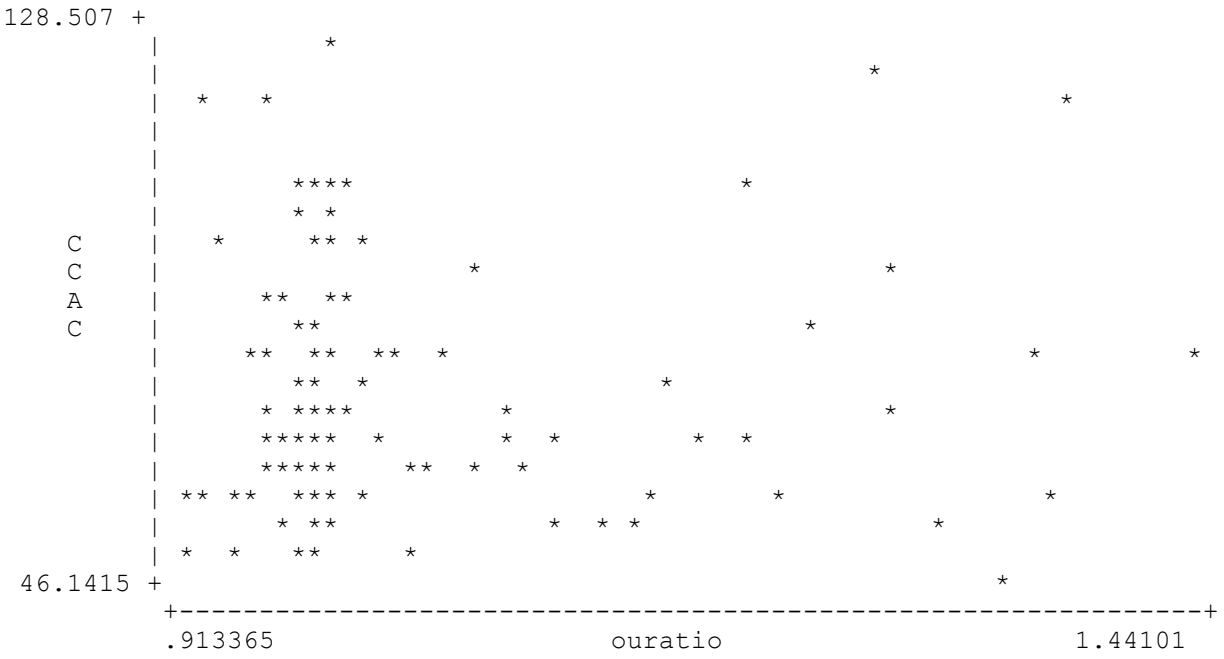
(a) Plot: Average Cost of Homemaking/Personal Support vs. Ratio of CCAC Region Actual to Equity Funding



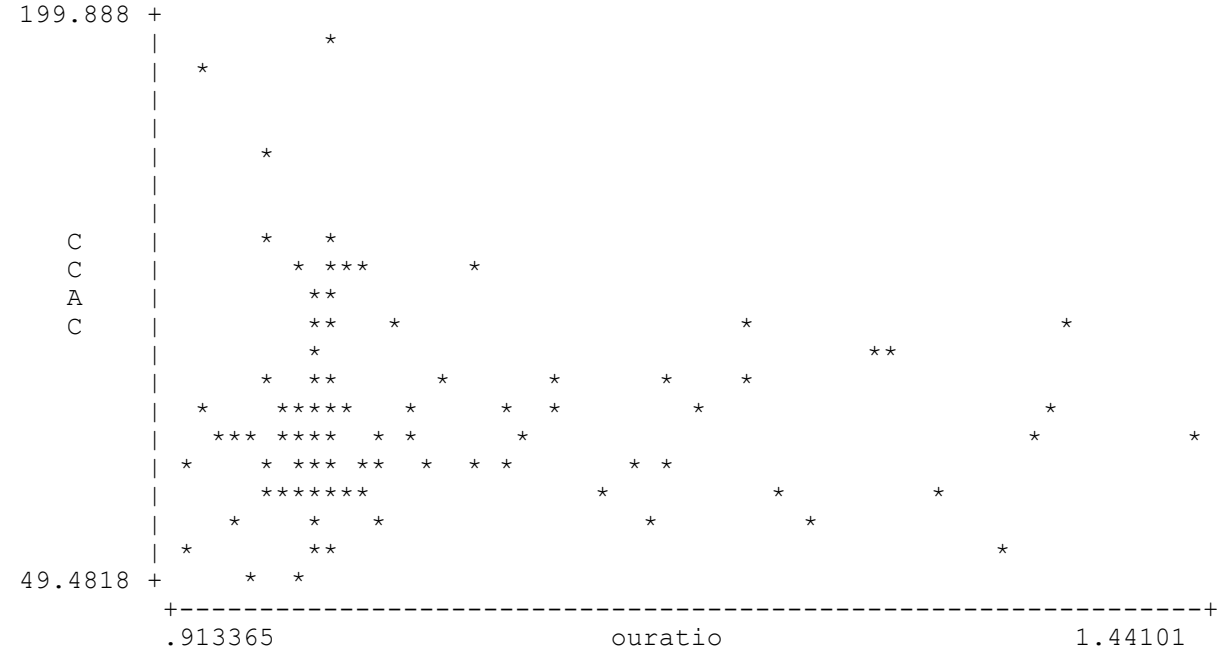
(b) Plot: Average Cost of Nursing Services vs. Ratio of CCAC Region Actual to Equity Funding



(c) Plot: Average Cost of Physiotherapy Services vs. Ratio of CCAC Region Actual to Equity Funding



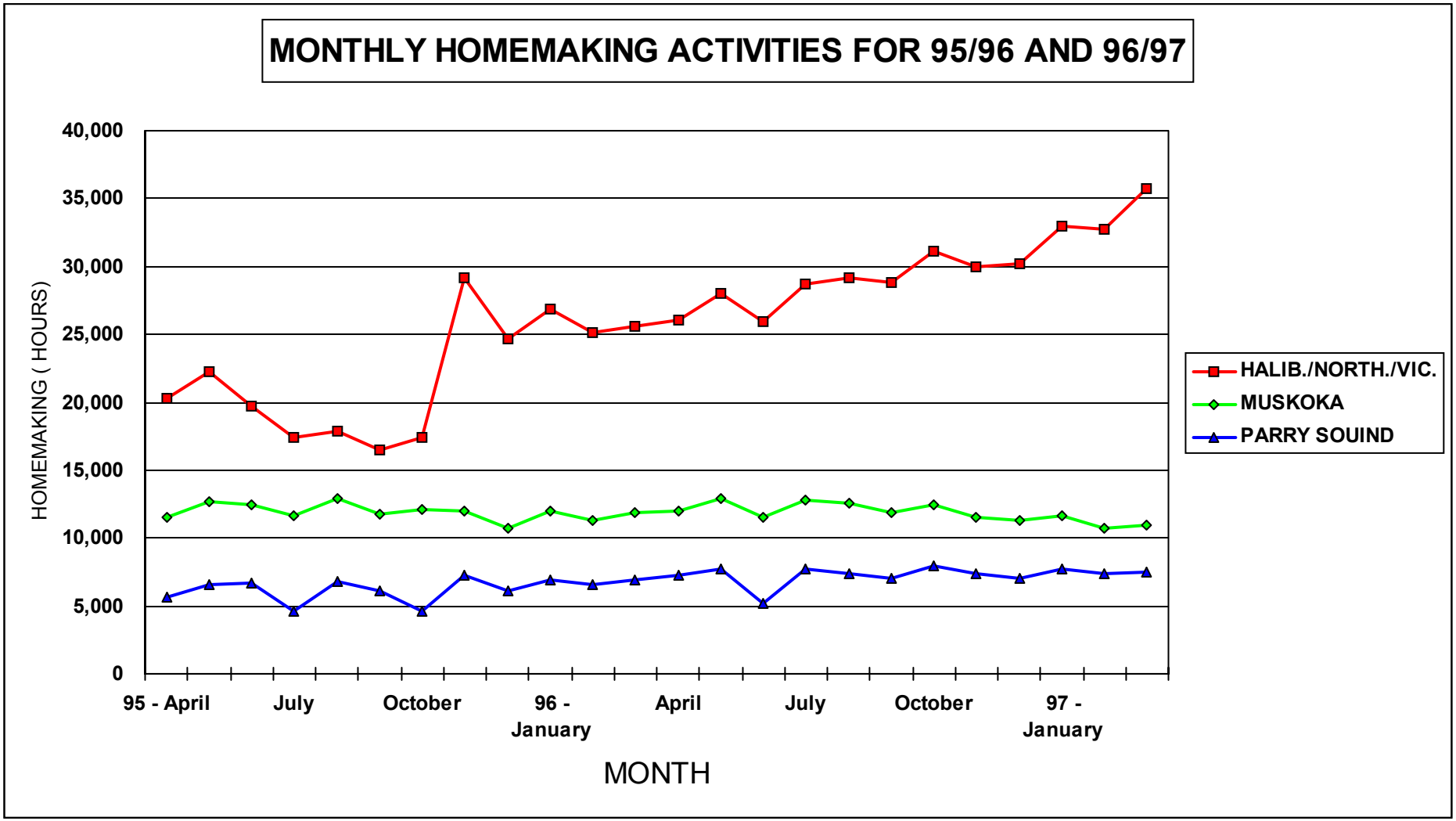
(d) Plot: Average Cost of Occupational Therapy Services vs. Ratio of CCAC Region Actual to Equity Funding



11.0 "COTTAGE COUNTRY" EFFECT

It has been suggested that those CCAC regions that experience an influx of summer residents may require additional resources than would be indicated by the characteristics of the permanent residents. An initial analysis carried out by the original Community Funding Review Committee suggested that was not the case. The Committee analyzed the total monthly number of hours of homemaking/personal support and nursing visits delivered during fiscal years 1995-96 and 1996-97 in the following three CCAC regions: Haliburton, Northumberland and Victoria Counties, Muskoka, and (West) Parry Sound County. The analysis revealed no substantial changes in the total amount of homemaking/personal support and nursing activities during the summer months. Figure 11.1 shows the trend in monthly homemaking/personal support activities for the 3 CCAC regions. On the basis of this analysis, it was concluded that no adjustment was required for those CCAC regions with large numbers of seasonal residents.

Figure 11.1: Cottage Country CCAC Region - Monthly Homemaking/Personal Support Activities during fiscal years 1995-96 and 1996-97



Source: Ontario Ministry of Health and Long-Term Care. July 1998.

12.0 OPTIONS FOR REVISING THE METHOD FOR ALLOCATING HOME CARE AND COMMUNITY SUPPORT SERVICE RESOURCES

The analysis reported herein leads to a number of conclusions:

1. There is substantial variation in home care needs across CCAC regions that is not captured by age and sex adjustment alone. This supports the concern that a funding formula that adjusts only for the age-sex distribution of the population lacks validity and is inequitable.
2. This variation is highly correlated with demographic, health status and socio-economic characteristics measured in Canadian health surveys. This supports the contention that it is possible to develop a formula that adjusts for needs beyond those captured by age and sex adjustment. It also supports the potential of an approach based on individual, population-based data available in health surveys.
3. The point estimates for CCAC region needs-based shares indicate that substantial reallocation from current budgets and from the current equity funding formula are required to allocate home care funds in line with relative needs across CCAC regions. Because home care use is a relatively rare event among the general population, however, the sample size associated with the 1996 Ontario component of the NPHS provides estimates of needs-based resource share for some CCAC regions that are less precise than might be desired.
4. Adjustment of CCAC region resource shares to reflect differences across CCAC regions in the average cost of providing home care services is not necessary.
5. Adjustment of CCAC region shares for regions that experience seasonal fluctuations in the number of residents is not necessary.

Conclusions 1- 3 raise difficult issues regarding how to proceed with home care funding reform. Conclusions 1 and 2 imply that the current equity formula, which is based on age and sex adjustment only, is inequitable and inadequate, and that the inadequacy is not simply random error. Conclusion 3 implies that although the approach presented in this report can serve as a basis for the needs-based allocation of home care and community support resources, the samples contained in currently available linked health surveys are not sufficient to provide the level of precision required for each CCAC region's needs-based relative resource share. We identify the following options for consideration.

12.1 Long-run options

The problem of insufficient power that leads to imprecise point estimates of CCAC region shares can be resolved through larger health survey sample sizes. Two national health surveys are now conducted on a regular basis in Canada: the National Population Health Survey (NPHS) and the recently launched Canadian Community Health Survey (CCHS). The NPHS is conducted biannually and is designed to provide valid inferences at the provincial level unless a province chooses to buy into a larger sample to allow inference at the sub-provincial level (as Ontario did for the 1996-97 NPHS). The CCHS is in the field every month and has a two-year data collection cycle which includes two distinct surveys conducted in alternate years: a survey designed to allow valid inference at a sub-provincial level (total sample size of approximately 130,000) and a provincial-level survey (total sample of approximately 30,000). Either the NPHS or CCHS provide a platform for collecting the required data in a sample of sufficient size to obtain CCAC region shares estimated with the required level of precision. The sample size for this analysis was 22855. Based on the standard errors, we estimate that a sample size of approximately 54,973 is required to increase the precision so that the difference between the 95% confidence limit and the share estimates for all CCAC regions is within 30%, and a sample size of approximately 79,000 is required to bring all of the differences within 25%. Although these sample sizes are approximately two to three times the number of individuals whose survey data were linked to MOHLTC administrative data in the 1996-97 Ontario component of the NPHS, as data from successive waves of the Canadian Community Health Survey (which also has linkage capability) become available, combining data from multiple surveys can substantially improve precision. In addition, there were several problems in the 1996-97 NPHS linking individuals' survey data with their administrative data. As experience with such linkage grows, presumably a greater proportion of matches will be achieved within a survey.

Increasing the sample size would also produce substantial benefits beyond the calculation of needs-based funding shares for home care and community support services. This application is only one example of how such data can be used to improve health system planning and the allocation of health care resources. A larger Ontario buy-in that allows valid inferences using high-quality health survey information at the level of, for instance, the 54 census (sub) divisions (counties) in Ontario, would allow maximal flexibility to link survey data with census and other data that are collected at this level that can aid planning and resource allocation across the health care system. Survey data combined with administrative claims data offer a powerful planning and research tool to support the

work of the Ministry in improving the effectiveness and efficiency of Ontario's health care system.

All of this requires that the Ministry continue to request health number information from respondents to allow linkage with administrative claims data. In this context, it is important to emphasize that while the validity and accuracy of the hospital discharge, OHIP and ODB databases are well documented, data quality appears highly variable in a number of other potentially useful databases. This was particularly the case for the Community Support Service database and the Ontario Home Care Administration System databases, which were central to this work and which will be central to any revisions to the formula. Therefore, important improvements in resource allocation can potentially arise from improving the quality of already-collected Ministry data used for such applications.

12.2 Intermediate Options

There are a number of options that could potentially improve the allocation in the intermediate term before the larger sample sizes discussed above could become available.

12.2.1 Pool Ontario Health Survey Data Across Cycles of the NPHS and CCHS

As described above, both the NPHS and the CCHS are (or are planned to be) conducted regularly. Each survey draws an independent sample of Ontario residents. One can increase the precision of the share estimates obtained using the analytic approach used in this report by pooling the data across surveys. Data collection for the 2000-01 CCHS is complete, public use files are expected to be released in the summer of 2002. Although at present no release date for the linked micro-files has been set, assuming it is within the next 18-24 months, it will be possible within two years to re-estimate CCAC region shares by pooling the 1996-97 NPHS (which was the basis of this analysis) with the 2000-01 CCHS. This will not only approximately double the sample size on which the share estimates are based (increasing precision), but it will allow the share estimates to be based on more recent data that will better reflect current population distribution and patterns of usage in the population.

12.2.2 Estimate CCAC Region Allocations on Diagnosis-related Information from Administrative Databases

The development of diagnosis-based grouping systems, such as Ambulatory Care Groups (ACGs) and the Diagnostic Cost Grouping/Hierarchical Co-existing Condition Methodology (DCG/HCC) allow the possibility of basing resource allocation on diagnostic information drawn from administrative databases. Recent work has explored their application to home care

funding.[Hall 2001] The main concerns with diagnosis-based funding methods in such context include the following [Hutchison et al. 1999]:

Data Quality. Although basic utilization information is of high quality in administrative databases maintained by the Ministry, the quality of the diagnosis information in the physician claims file is more questionable.

Not-population-based. Because these methods rely on claims records, they are not truly population-based as they exclude any information on those members of the population who do not use health care services.

Validation. Although there has been considerable work conducted validating diagnosis grouping system against actual utilization, the approaches have not been validated against a population-needs-based reference standard. It is crucial that such a validation be conducted as part of any assessment of the potential for diagnosis-based funding for home care in Ontario. Such a validation is possible using data from the NPHS to develop the population-based reference standard allocation.

12.3 Short-run Options

Even the intermediate options discussed above would take at minimum 12-24 months to develop. We therefore identify the following option that can be implemented immediately while awaiting the implementation of either an intermediate or long-run option discussed above and which will allow the allocation of home care and community support service resources to reflect better the relative needs across CCAC regions.

12.3.1 The Adjusted Equity Share Method

The work of the CFRC has been motivated by the concern that the current equity formula, which is based on age-sex adjustment only, does not adequately allocate home care and community support resources in line with relative needs across CCAC regions. This analysis has confirmed that there is important variation in needs across CCAC regions beyond those captured by age-sex adjustment. The proposed option is to adjust the current equity formula for needs beyond those accounted for by age and sex. The current equity formula could be adjusted as follows.

1. Use the NPHS data to estimate a model that includes age and sex adjusters. This provides an estimate of age-sex adjusted shares (analogous to the equity formula shares) derived from the sample information.[44]

[44] The share estimates derived from the NPHS age-sex model will differ from the 2000-01 equity shares for two reasons: (1) the NPHS is a sample while equity shares are based on the entire population; and (2) the NPHS

2. Estimate the full needs-based model developed in this analysis. This represents the full needs-based share, taking into account both the age-sex distribution and needs-related factors beyond age and sex (e.g., SAHS, hospitalizations, etc.).
3. Calculate the percentage difference in the shares between the NPHS-based age-sex model and the NPHS-based full model. This represents the needs adjustment beyond that achieved by age and sex alone. Let AS_share be the CCAC region shares estimated from the NPHS age-sex model [(2) above] and FULL_share be the CCAC region shares estimated from the NPHS full model [(3) above]. The adjustment required beyond age and sex is as follows:

   NEED_ADJ = (FULL_share - AS_share)/(AS_share)

4. Apply this percentage difference between the NPHS-based age-sex model and the NPHS-based model to the current equity shares. That is,

   ADJEQ_share = EQ_share + (EQ_share*NEED_ADJ)[45].

As an interim adjustment formula, the adjusted equity share has a number of desirable properties.

a. It can be implemented immediately
b. It bases the age-sex adjustment on the best available information for this component of the needs-based formula:

- The age-sex adjustment is based on the full population rather than a sample
- The age-sex adjustment is based on the most current data available, which reflects not only the current age-sex population distribution, but also the current patterns of home care utilization across age and sex groups in the population
- The age-sex component can be updated[46] annually

c. It bases the adjustment need-adjustment beyond age and sex on the best available data, which is the most recent population health survey linked to administrative databases. This component can be re-calibrated as additional survey data become available until survey information provides sufficient precision to serve as a basis for the full allocation formula.

Table 12.2 presents adjusted equity per-capita dollar allocations based on the age-sex and the full needs-adjusted models estimated using the 1996 NPHS. As previously, the share estimates from the models were applied to the 1999-00 total budget and the 2001 population estimates to obtain

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utilization data refer to a different period than do the 2000-01 equity data.

[45] This is normalized to ensure that the sum of the adjusted equity shares equals 1.0.

estimates of the per-capita dollar allocations. Column (a) lists the per-capita dollar allocations estimated from an NPHS age-sex model; column (b) lists the per-capita dollar allocations from the NPHS full need-adjustment model (presented previously); column (c) lists the adjustment factor (the percentage difference between the age-sex and full models); column (d) presents the adjusted equity per capita dollar allocations; and columns (e) and (f) present the % differences between the full and actual allocation models and the adjusted equity and actual allocation models respectively.

The adjusted equity estimates, like the full needs-based model estimates, call for substantial re-allocation from the current allocations, though the range of re-allocation under the adjusted equity is somewhat smaller than for the full needs-based model.[47] This is primarily because some of the previous outliers are pulled closer to the mean share estimate. In comparing the adjusted equity and the full model share estimates against actual funding, both the mean percentage difference from actual and the standard deviation of the difference across CCAC regions are smaller for the adjusted equity estimates than for the full-model estimates. But there remain regions that would see their budgets doubled and regions that would see them halved.

Table 12.3 presents the adjusted equity shares with their associated confidence intervals. It appears that there has been no gain in precision over the full needs-based model (which is based wholly on sample information). The mean percentage difference between the confidence interval limit and the share estimate as well as the standard deviation of the distribution of these differences are very similar (52.3 vs. 58.4%; 21.3% vs. 26.5%). Similarly, as was the case for the full needs-based model, there is considerable imprecision in a number of the estimates.

Although the precision of the estimates does not differ between the full model and the adjusted equity model, on balance we believe that, at this time, the adjusted equity estimates may have greater validity because they are based on the whole population for the age-sex adjustment and because the age-sex adjustment is based on the most up-to-date utilization data.

[46] By update we mean simply substituting more recent data into a formula. By re-calibrate (see below) we mean re-estimate the formula parameters.

[47] Both models imply about the same absolute dollar reallocation among CCAC regions - - approximately 130 million out of a total budget of just over $1.3 billion.

Table 12.1: Estimated Sample Sizes Needed to Achieve Desired Levels of Precision

Current Analysis	
Sample size:	22855
% difference between 95% confidence interval limit (CI) and share estimate	
Mean: 58.4%	
Minimum: 23.8%	
Maximum: 153.3%	
Sample Sizes Required to Attain Stated Levels of Precision	
Confidence Interval within ± 30% of share estimate in every CCAC region:	54,973
Confidence Interval within ± 25% of share estimate in every CCAC region:	79,161

Table 12.2: Adjusted Equity Dollar Per Capita Allocations

CCAC region	NPHS Age-sex model $/cap	NPHS Full model $/cap	% diff. from Age-sex to Full Model	Adjusted Equity $/cap	% diff. Full Model vs Actual	% diff. Adjusted Equity vs Actual
	(a)	*(b)*	*(c)*	*(d)*	*(e)*	*(f)*
13	$154.09	$69.47	-54.9%	$56.84	-44.1%	-54.3%
9	$97.93	$55.74	-43.1%	$60.72	-50.0%	-45.5%
34	$123.44	$91.04	-26.2%	$90.95	-38.7%	-38.7%
37	$128.09	$111.54	-12.9%	$124.88	-33.2%	-25.2%
42	$91.88	$71.59	-22.1%	$78.12	-27.5%	-20.9%
29	$140.21	$114.26	-18.5%	$92.09	2.6%	-17.3%
5	$94.28	$77.40	-17.9%	$76.13	-15.3%	-16.7%
36	$112.57	$93.45	-17.0%	$93.95	-16.2%	-15.8%
4	$67.87	$56.20	-17.2%	$63.25	-25.0%	-15.6%
18	$125.33	$105.34	-15.9%	$106.55	-15.9%	-14.9%
12	$101.68	$85.55	-15.9%	$87.35	-16.2%	-14.4%
15	$102.51	$87.85	-14.3%	$99.28	-23.1%	-13.1%
27	$142.13	$123.72	-13.0%	$113.85	-4.1%	-11.8%
40	$184.99	$162.35	-12.2%	$135.79	6.5%	-10.9%
33	$118.03	$109.86	-6.9%	$114.79	-14.0%	-10.2%
21	$125.75	$112.17	-10.8%	$111.14	-9.1%	-10.0%
22	$76.95	$68.07	-11.5%	$62.29	-1.6%	-9.9%
14	$106.71	$96.48	-9.6%	$115.30	-23.3%	-8.4%
26	$123.14	$111.45	-9.5%	$95.13	7.5%	-8.2%
38	$94.11	$85.25	-9.4%	$90.38	-13.4%	-8.2%
31	$129.00	$116.88	-9.4%	$125.76	-14.5%	-8.0%
17	$91.76	$84.59	-7.8%	$87.28	-9.0%	-6.1%
41	$106.25	$100.19	-5.7%	$97.47	-1.6%	-4.3%
19	$149.50	$144.76	-3.2%	$126.24	12.7%	-1.8%
1	$105.40	$106.64	1.2%	$122.01	-12.7%	-0.1%
8	$114.91	$142.19	23.7%	$161.59	-9.5%	2.8%
16	$111.71	$119.09	6.6%	$155.16	-17.0%	8.1%
3	$127.98	$161.86	26.5%	$156.85	13.2%	9.7%
10	$125.86	$138.20	9.8%	$148.48	3.5%	11.1%
6	$146.23	$162.34	11.0%	$163.97	11.5%	12.6%
2	$122.00	$140.07	14.8%	$171.46	-5.1%	16.2%
32	$171.13	$198.77	16.2%	$165.83	41.2%	17.8%
25	$164.65	$197.32	19.8%	$162.30	47.7%	21.5%
7	$157.46	$190.64	21.1%	$173.44	34.5%	22.4%
39	$119.56	$149.47	25.0%	$153.96	20.6%	24.2%
11	$188.34	$243.59	29.3%	$181.51	75.9%	31.1%
30	$112.02	$146.14	30.5%	$147.38	30.7%	31.8%
23	$127.13	$189.47	49.0%	$199.46	43.6%	51.2%
28	$133.22	$273.83	105.5%	$267.47	64.1%	60.3%
24	$161.93	$274.61	69.6%	$211.80	122.9%	71.9%
20	$87.77	$166.07	89.2%	$224.80	41.8%	92.0%
35	$136.87	$303.13	121.5%	$335.62	102.5%	124.2%
43	$128.29	$317.27	147.3%	$250.66	217.0%	150.4%
		Mean	10.1%		10.7%	8.6%
		S.d.	41.7%		48.9%	40.7%

Table 12.3: Adjusted Equity Shares with Confidence Intervals

CCAC region	Adjusted Equity Share	Standard error	95% Confidence Interval		% difference between upper CI and estimate	Actual $/cap	Equity $/cap
9	$60.72	$9.32	$40.82	$76.59	26.1%	$111.43	$106.66
26	$95.13	$12.22	$74.03	$121.25	27.5%	$103.63	$105.09
4	$63.25	$9.55	$43.21	$80.92	27.9%	$74.98	$76.39
31	$125.76	$16.82	$98.08	$162.52	29.2%	$136.68	$138.79
17	$87.28	$11.95	$66.25	$113.32	29.8%	$92.97	$94.67
38	$90.38	$13.86	$66.96	$121.16	34.1%	$98.41	$99.76
1	$122.01	$18.53	$92.24	$164.43	34.8%	$122.19	$120.58
42	$78.12	$12.88	$57.57	$106.60	36.5%	$98.77	$100.25
29	$92.09	$16.36	$63.41	$126.64	37.5%	$111.40	$113.00
14	$115.30	$20.78	$80.43	$158.97	37.9%	$125.86	$127.52
30	$147.38	$25.40	$104.69	$203.18	37.9%	$111.82	$112.96
5	$76.13	$15.93	$47.19	$105.92	39.1%	$91.40	$92.72
33	$114.79	$19.74	$83.09	$160.04	39.4%	$127.77	$123.31
34	$90.95	$16.79	$62.35	$127.49	40.2%	$148.43	$123.30
18	$106.55	$20.06	$77.20	$149.75	40.5%	$125.22	$126.76
32	$165.83	$31.31	$117.16	$233.34	40.7%	$140.82	$142.76
12	$87.35	$16.56	$61.47	$123.49	41.4%	$102.10	$103.80
6	$163.97	$35.91	$105.87	$237.46	44.8%	$145.64	$147.68
15	$99.28	$22.24	$61.35	$143.87	44.9%	$114.29	$115.84
21	$111.14	$22.62	$76.00	$162.54	46.2%	$123.43	$124.58
16	$155.16	$37.32	$86.99	$228.34	47.2%	$143.47	$145.53
7	$173.44	$37.29	$111.90	$255.81	47.5%	$141.69	$143.24
41	$97.47	$20.70	$66.33	$144.20	47.9%	$101.83	$103.37
19	$126.24	$26.69	$87.90	$186.79	48.0%	$128.50	$130.35
23	$199.46	$61.04	$68.60	$295.29	48.0%	$131.92	$133.81
39	$153.96	$36.67	$98.76	$228.46	48.4%	$123.99	$123.13
22	$62.29	$13.56	$38.72	$93.13	49.5%	$69.16	$70.41
25	$162.30	$37.49	$99.77	$243.09	49.8%	$133.58	$135.41
13	$56.84	$14.38	$31.48	$86.37	51.9%	$124.36	$126.08
11	$181.51	$44.75	$104.71	$284.26	56.6%	$138.48	$140.32
8	$161.59	$42.98	$97.01	$257.04	59.1%	$157.14	$130.57
10	$148.48	$37.23	$89.40	$237.46	59.9%	$133.59	$135.21
24	$211.80	$62.66	$101.36	$339.56	60.3%	$123.20	$124.88
37	$124.88	$34.08	$71.86	$201.74	61.6%	$166.90	$143.39
40	$135.79	$37.15	$75.70	$220.02	62.0%	$152.39	$154.70
36	$93.95	$30.87	$46.08	$163.48	74.0%	$111.56	$113.17
2	$171.46	$55.46	$89.22	$300.15	75.1%	$147.60	$149.33
27	$113.85	$32.81	$63.81	$202.54	77.9%	$129.07	$130.77
20	$224.80	$91.13	$72.54	$406.53	80.8%	$117.11	$118.80
35	$335.62	$130.27	$121.71	$614.07	83.0%	$149.68	$151.53
3	$156.85	$53.21	$101.72	$306.41	95.4%	$143.00	$124.00
28	$267.47	$127.39	$91.48	$564.82	111.2%	$166.83	$130.11
43	$250.66	$130.05	$64.26	$547.31	118.3%	$100.10	$101.35
				Mean	52.3%		
				S.d.	21.3%		

13.0 CONCLUSIONS

Home care and community support services are becoming an increasingly important component of our health care system as the population ages and as changes in health care technologies and treatment patterns shift care out of traditional care settings. Both efficiency and equity objectives call for resources to be allocated in line with the relative needs for such care across the province. This analysis has demonstrated that:

- The concerns that motivated the work of the CFRC are valid. The current age-sex adjusted equity formula fails to capture variation in need for home care across CCAC region populations.
- Using data from the Ontario component of the NPHS, which includes detailed information on the demographic, health-related, and socio-economic characteristics of a representative sample of Ontarians, linked to administrative data from the MOHLTC, we were able to construct a statistical model that accounted for substantially more of the variation in the relative need for home care services across CCAC regions than does a model based on age and sex adjustment alone.
- This model can provide a valid basis for a needs-based allocation formula that incorporates adjustment for a wide variety of needs-related characteristics of the population.
- Estimates of the 43 CCAC region needs-based resource shares (of the overall budget for home care and community support services) indicate that substantial reallocation from current funding is required to achieve an equitable sharing of the budget in line with relative need for resources across CCAC regions.
- The sample size available in the 1996-97 Ontario component of the NPHS provided estimates of needs-based resource shares for some CCAC regions that may not have the desired degree of precision.
- This can be addressed through larger sample buy-in by Ontario of on-going regular national health surveys conducted in Canada. The benefits of doing this extend beyond the application to allocating funds for home care and community support services; such data can support a wide variety of population-based planning activities to improve the efficiency and equity of the Ontario health care system.
- In the intermediate and short-term it is possible to develop funding approaches based wholly

on the population-based health survey data or an integration of such data with the traditional equity approach that will better allocate home care and community support service resources in Ontario in line with relative needs across CCAC regions.

APPENDICES

Appendix A: Approaches to Funding Home Care and Community Support Services in Jurisdictions Outside Ontario

A.1 Definition of Home Care and Community Support Services

This section describes the approaches that are currently being used or that have been proposed for allocating funds for home health care and community support services in jurisdictions outside Ontario. Information was collected from Canada's ten provinces and three territories, the United States, Denmark, Sweden, the United Kingdom and Japan. We focus the review on funding methods used by governments to allocate funds to health regions (e.g., Prince Edward Island's 5 Regional Health Boards, Alberta's 17 Regional Health Authorities, the U.K.'s 100 Health Authorities)[48]. Because no public program in the U.S. allocates funds for home care to geographical areas, and the multi-payer system of financing makes it impossible to present a comprehensive picture, we limit our consideration of funding in the U.S. to Medicare at-risk HMOs.

An immediate challenge is to define what is meant by home care and community support services. There is no homogeneity among jurisdictions regarding the set of services included under the home care umbrella. This is also reflected in our Canadian health care system which has no national framework to guide standards for home care [Coyte P 2000; Canadian Institute for Health Information 1999] and each province or territory defines its own set of services covered under their provincial/territorial health plan. By the end of the 1980s, all Canadian provinces had initiated a provincial home care program[49] and starting in the 1990s Canadian commentators on home care have raised concerns about the need for a national framework to guide home care and/or elder care programs.[Federal-Provincial-Territorial Working Group on Home Care 1990; Coyte P 2000] The Canadian Institute for Health Information (CIHI) has worked with home care stakeholders from the provinces and territories and has developed [Canadian Institute for Health Information 1999; Canadian Institute for Health Information 2000a] "a core set of national priority indicators to support the evaluation of home care services at the provincial/territorial/regional levels".[Canadian Institute for Health Information 2000b]

[48] Special programs such as Health Canada's First Nations and Inuit Home and Community Care Program or arrangements for home care service delivery to veterans are not dealt with in this paper.

[49] See [Dumont-Lemasson M, Donovan C, and Wylie M 1999] for details on legislation, eligibility and user charges regarding each provincial/territorial program and [Federal-Provincial-Territorial Advisory Committee on Health Services (AHCS) Working Group on Continuing Care 2000] for details on the organization and responsibilities of delivering home care in the Canadian provinces and territories.

Given the audience of this paper, our reference point for defining "home care" and "community support" services are those services included in Ontario Ministry of Health's definition. Home care includes the following basket of services:

- assessment, case management (including information and referral services) and placement coordination
- nursing care
- physiotherapy
- occupational therapy
- speech and language therapy
- palliative care
- dietetic services
- social work
- personal support (such as bathing, dressing, meal preparation and feeding)
- personal support/homemaking (such as cleaning and laundry)
- school health support services program
- medical supplies
- medical equipment rental
- laboratory services
- respiratory therapy
- transportation
- respite

Community support services include meals on wheels, friendly visiting, respite services and other services offered to the elderly, frail and physically disabled members of the community.

A.2 Strategy Adopted for the Literature Search

Two main sources were used to obtain the home care funding information summarized in this report:

- publications (i.e., provincial, territorial and federal reports, journal articles, international reviews of long-term care service delivery) obtained through literature searches, web searches, bibliographies, etc.;
- personal communications with contacts in each of the provincial and territorial governments.

A preliminary search of the literature on funding approaches for home care was conducted using the Medline, HealthSTAR and Social Sciences Index databases[50]. This search provided

[50] For the Medline search, the following MeSH subject headings were used: home care services / economics/ standards /statistics & numerical data / supply & distribution / utilization; health services / for the aged. For the search on HealthSTAR, the following MeSH terms were used: home care services / community health planning. For searching the Social Sciences Index database, the following DEs were searched: home care services; community. The titles and, if necessary, abstracts, were visually scanned and eventually included in a sub-set of documents deemed eligible for further consideration.

relatively little information on funding arrangements for home care in other jurisdictions (though it did identify many articles investigating the characteristics of individuals at-risk for home care use or on population-based patterns of home care service provision; see section 5 of this report on candidate adjusters). The World Wide Web was used to locate pertinent documents relating to home care from the following sources:

- Canadian provincial and territorial government websites;
- the University of Toronto's Home Care Evaluation and Research Centre (NHERC) Annotated Home Care Bibliography; [University of Toronto 2000]
- McMaster University library catalogue;[McMaster University 2000]
- the Canadian Institute for Health Information (CIHI) online list of topics;[Canadian Institute for Health Information 2000c]
- Health Canada's library catalogue [Health and Welfare Canada 2000a] and online list of health topics;[Health and Welfare Canada 2000b]
- the Organization for Economic Co-Operation and Development's online list of documents;[Organization for Economic Co-operation and Development 2000] and
- the World Health Organization's library catalogue (WHOLIS).[World Health Organization 2000]

We clarified missing and contradictory published information regarding home care funding in the Canadian provinces and territories through personal contact with a representative from each of the respective home care programs. To confirm that the information was correctly interpreted, the present section was circulated to our provincial and territorial contacts for feedback and comments.

A.3Definition of Home Care and Community Support Services in Canada

As was mentioned in paragraph 4.1, there is no consistency across provinces and territories with respect to what is defined as "home care services". Tables A.1A and A.1B describe how the Canadian provinces and territories define home care and specifically, what services are included under the funding envelope of each provincial/territorial home care program[51].

[51] The only two exceptions being the provinces of New Brunswick and Newfoundland and Labrador. In the former, there are two main funding envelopes associated with home care and community support services. Firstly, long-term care services and non-professional home care services are administered by Family and Community Social Services (FCSS), a Division of the new Department of Family and Community Services. Secondly, the Extra Mural Program is administered by New Brunswick Health and Wellness and is responsible for the delivery of professional home care services.[New Brunswick Health and Wellness 1999; New Brunswick Department of Family and Community

The tables are organized by how Ontario defines services that fall under its home care and community support services umbrella. Table A.1A lists the service elements that the province of Ontario calls "home care services". By reading the table vertically by jurisdiction, we can see which of Ontario's home care service components are also included under each province's/territory's home care program (indicated with a "Yes"). Cells with a "No" indicate a service element included in the Ontario home care envelope that the province/territory does not fund through its home care program[52].

Table A.1B lists the service elements that the province of Ontario calls "community support services". By reading the table vertically by jurisdiction, we can see which of Ontario's community support services are also included under each the province's/territory's home care program (indicated with a "Yes"). Cells with a "No" indicate a service element included in the Ontario home care envelope that the province/territory does not fund through its home care program[53]. Since we are defining service elements included in provincial and territorial funding envelopes, the tables do not, of course, give a full picture of the extent of service provision. For example, although home oxygen services are delivered by CCACs in Ontario, they are not included in the provincial home care funding envelope because they fall under the Assistive Devices Program envelope. For a list of more detailed service elements for each province and territory see [Dumont-Lemasson M, Donovan C, & Wylie M 1999].

Across all provinces and territories, the most consistently provided home care services include client assessment and case coordination and management as well as nursing care, personal support, homemaking and family relief/respite services. Community support services that are frequently offered under the home care umbrella are family relief and meals on wheels. Over and above this "baseline" service pool, there is great variation in the services covered by each of the provincial/territorial home care programs.

Services 2000]

Similarly, in Newfoundland and Labrador, where there are currently three separate funding envelopes: one for professional home care services (e.g., nursing care, OT/PT), one for non-professional home support services (e.g., homemaking, personal support, respite care) to the elderly and one for non-professional home support services to the disabled. The two funding envelopes for non-professional home support services are currently being merged into one.[Nova Scotia Department of Health. 2000] See Tables 1A and 1B for details on service elements included in the funding envelopes.

[52] That service may be publicly funded through an alternative program, but the information is not available.

[53] Again, the service may be publicly funded through an alternative program, but the information is not available.

Tables A.1A and A.1B: Services Included in the Provincial/Territorial Home Care Program Funding Envelope, by Canadian Province and Territory*

Table A.1A: Service Elements Offered in the Ontario CCAC Funded Program and Delivered by CCACs *

Service element	AB ●	BC	MB	NB	NFL ¤	NS	NT ⊠	NU ‡ Baffin	NU ‡ Kitikmeot	ON	PEI	QC ■	SK ⌂	YK
Assessment and case management	Yes	Yes	Yes	Yes (both)	Yes	Yes	Yes	Yes	Very limited	Yes	Yes	Yes	Yes	Yes
Nursing care	Yes	Yes	Yes	Yes**	Yes	Yes	Yes	Yes	Limited	Yes	Yes	Yes	Yes	Yes
Physio-therapy	Yes	Yes	Yes	Yes**	Limited	No	Yes	No	Very limited	Yes	No	Not in all CLSCs	Not in all districts	Whitehorse only
Occupational therapy	Yes	Yes	Yes	Yes**	Limited	No	Yes	No	Very limited	Yes	Yes	Not in all CLSCs	Not in all districts	Whitehorse only
Speech and language therapy	Rarely provided in the home	Very limited	Very limited	Yes**	Very limited	No	Limited	Very limited	Very limited	Yes	No	No	No	No
Palliative care	Yes	Yes	Yes	Yes**	Very limited	No	Yes	Yes	Limited	Yes	Yes	N/A	Yes	No
Dietetic services	Rarely provided in the home	Yes	No	Yes**	Limited	No	Limited	No	Limited	Yes	Yes ^	No	Limited	Yes
Social work	No	Very limited	Yes	Yes (both)	Yes	No	Limited	No	Limited	Yes	Yes	Yes	Not in all districts	Partly available

Tables A.1A and A.1B: Services Included in the Provincial/Territorial Home Care Program Funding Envelope, by Canadian Province and Territory* (cont'd)

Service element	AB ●	BC	MB	NB	NFL ¤	NS	NT ⊠	NU ‡		ON	PEI	QC ■	SK ⌂	YK
								Baffin	Kitikmeot					
Personal support	Yes	Yes	Yes	Yes***	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Personal support/home making	Yes	Yes	Yes	Yes***	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Medical supplies and equipment	No	§	Yes	Yes**	Yes	No	Yes	Yes	Very limited	Yes	No	Yes	Yes	Yes
Prescription drugs	Limited	Yes	No	Yes**	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Family relief and respite	Yes	Yes	Yes	Yes (both)	Yes	Yes	Yes	No	Limited	Yes	Yes	Yes	Yes	Yes

* Sources: [Alberta Health and Wellness 2000a; Alberta Health and Wellness 2000b; Anctil H and Belanger L 2000; Béland F 1999; British Columbia Ministry of Health and Ministry Responsible for Seniors 2000; Community Funding Review Committee 2000; Dumont-Lemasson M, Donovan C, and Wylie M 1999; Federal-Provincial-Territorial Advisory Committee on Health Services (AHCS) Working Group on Continuing Care 2000; Government of Nova Scotia 1999; Manitoba Advisory Committee to the Continuing Care Program 1996; New Brunswick Department of Family and Community Services 2000; New Brunswick Health and Wellness 1993; New Brunswick Health and Wellness 1999; Newfoundland and Labrador Health and Community Services 2000; NFL HCS (Linda Doody) 2000; Northwest Territories Social Services 1988; Northwest Territories Health and Social Services 1998; Northwest Territories Health and Social Services 1999; Northwest Territories Health and Social Services 2000; Nova Scotia Department of Health 1994; Nova Scotia Department of Health 1997; Nova Scotia Department of Health. 2000; Nova Scotia Department of Health 2000; Nunavut Health and Social Services 2000; Ontario Ministry of Health 2000; Prince Edward Island Health and Social Services 2000a; Prince Edward Island Health and Social Services 2000b; Quebec Ministère de la Santé et des Services sociaux 2000; Saskatchewan Health 0 AD/10/20; Saskatchewan Health 1998; Thiele 2000; Winnipeg Regional Health Authority 2000; Yukon Council on Aging and Yukon Government 1989]

Table A.1B: Other Community Support Services (as Defined in Ontario and Delivered by CCACs) Included in the Home Care Funding Envelope*

Service element	AB ●	BC	MB	NB	NFL ¤	NS	NT ⊠	NU ‡		ON ♧	PEI	QC ■	SK ⌂	YK
								Baffin	Kitikmeot					
Family relief	Yes	Yes	Yes	Yes**	Yes	Yes	Yes	No	Limited	Yes	Yes	Yes	Yes	Yes
Medical equipment	No	§	Yes	Yes**	Yes	No	Yes	Yes	Very limited	Yes	No	Yes	Limited	Yes
Other		- Home oxygen -Respiratory services - Meals on wheels §	- Home oxygen -Respiratory services - Dialysis - Self and family managed care -Meals on wheels	- Home oxygen** -Respiratory services** - Meals on wheels***	- Meals on wheels	- Dialysis - Home oxygen	- Home oxygen - Meals on wheels		- Home oxygen		- Dialysis -Respiratory services	- Dialysis -Respiratory services - Info-Santé CLSC - Meals on wheels	- Home oxygen and respiratory services (not in all districts) - SAIL (SK Aids to Independent Living) - Meals on wheels	- Meals on wheels

Legend:
Yes The service is included in the provincial/territorial home care program funding envelope
No The service is not included in the provincial/territorial home care program funding envelope
N/A Information not available

Notes:

* The purpose of Tables A.1A and A.1B is to describe, relative to the reference case of Ontario, the services included in home care funding envelopes. The tables therefore do not give a full picture of the extent of service funding and provision in each province and territory (see Section A.3 for more details). Some provinces and territories provide services within their home care envelope that are not included in Ontario's home care and community support service envelope. These services are listed under "Other" in the last row of Table A.1B. Other home care and community support services publicly funded in the provinces and territories have been excluded from these tables if funded through another program. The tables also exclude publicly funded services that neither they nor Ontario officially call home care, but which support individuals in their homes. The tables do not apply to proposed funding models; they define service pools as they are currently funded. Numbers in square brackets indicate the reference.

● Alberta: services associated with children with complex needs are excluded. These are provided by Home Care but are funded through the Province-Wide Services Program so as not to place an undue burden on any one Regional Health Authority.

§ British Columbia: other community support services included in the home care funding envelope are: Adult Day Programs, Security Calls Systems, Transportation and Self-managed Care. Medical equipment and supplies will soon be included under the community support services umbrella as part of the palliative care program (the change is currently in progress).

** New Brunswick: services that fall under the Extra Mural Program (EMP), New Brunswick Health and Wellness.

Tables A.1A and A.1B Cont'd.

*** New Brunswick: services that fall under the Family and Community Social Services (FCSS) Division, Department of Family and Community Services (FCS). There are two main funding envelopes: one for the FCSS program (services indicated with ***) and another for the Extra Mural Program (services indicated with **). Assessment, case management, social work and family relief and respite are provided by both EMP and FCSS programs and are included in each of their funding envelopes.

¤ Newfoundland and Labrador: There are currently 3 separate funding envelopes: one for professional home care services (e.g., nursing care, OT/PT), one for non-professional home support services (e.g., homemaking, personal support, respite care) to the elderly and one for non-professional home support services to the disabled. Home oxygen is funded separately. The two funding envelopes for non-professional home support services are currently being merged into one.

⊠ Northwest Territories: beginning fiscal year 2001-02, territorial governmental funding to the Regional Health Boards will be merged with funding from Health Canada's First Nation and Inuit Home and Community Care Program . Consequently, the funding for home care in this Territory will more than double and there is a plan to enhance current services.

‡ Nunavut: the delivery of home care services varies in each of the three regions. Currently, there is no "formal" definition of home care in Nunavut, although there is the intention to work toward one in the near future. Information on two of the three regions is included in these tables: The Baffin and Kitikmeot regions. In Baffin communities other than Iqaluit, home care services are available through the Regional Home Support Program through local Community Health Centres.

♧ Ontario: services listed in Table 1B are provided by community support agencies other than CCACs. Medical equipment provided by community support agencies is available in some communities to some degree.

^ Prince Edward Island: in the two largest of the five regions, the provincial home care includes remuneration for a nutritionist/dietician. In the three smaller regions the dietitian/nutritionist services are referrals across the regional budget (i.e., included in another funding envelope).

■ Quebec: Personal support/homemaking is offered mostly outside the public program; the Centres Locaux de Services Communautaires (CLSCs) "dropped" the provision of personal support/homemaking in the 1980s.[Anctil H & Belanger L 2000] Nursing and personal support services are the services that are most fully covered by a CLSC. The range of services offered varies across CLSCs for historical reasons. There are differences in budgets allocated, whereby the more recently formed CLSCs generally receive less funds than the older CLSCs. [Anctil H & Belanger L 2000; Béland F 1999]

⌂ Saskatchewan: for nursing care, homemaking and for meals on wheels there are no defined service limits in any of the continuing care services. In practice however, many district health boards put limits on community support services when the costs of these services to the health district for an individual client meet the average cost of a resident in institutional supportive care.

Appendix B: The Two-Part Health Care Utilization Model

Individual-level health care utilization and expenditure data commonly have the following characteristics:

- The values are all non-negative
- A high proportion of zero-valued observations
- A high degree of skewness among those observations with a positive value
- Thick-tailed distributions of observations with a positive value
- The error distributions are heteroskedastic, varying as some function of one or more explanatory variables

To obtain consistent, efficient estimates of the determinants of health care utilization and predictions of expected utilization, E[y|x], we must use estimation approaches that take the data structure into account. Simple OLS methods are not adequate. A variety of approaches have been suggested to deal with the data structure. One of the most commonly employed is the two-part utilization model.

B.1 The Two-Part Utilization Model

The two-part utilization model breaks the utilization process into two independent parts, the probability of some use; and, conditional on some use, the quantity of use. We can write this as follows:

$$E(y|x) = Pr(y>0 \mid x)*E(y \mid y>0, x) \qquad (1)$$

where: y = home care expenditure

x = a vector of individual and regional-level variables that influence utilization of home care

$E()$ = the expectations operator, i.e. meaning the expected value of what is in the parentheses

B.1.1 Part 1 - Use/Non-use

We can write the statistical model as follows. Suppose there is some underlying continuous index, I, that represents likelihood of using home care. Let

$$I_i = x_i\delta + u_i$$

where u_i is a normally distributed random variable.

Let D be an observed indicator variable representing whether person i uses home care. D takes on a value of 1 (home care use) when I > 0 and a value of 0 (no home care use) otherwise:

$D = 1$ if $I_i > 0$

$D = 0$ otherwise

The probability of home care use for person i is as follows:

$$\text{Prob}(D = 1) = \text{Prob}(u_i > - x_i\delta)$$

To estimate this model we need only posit a distribution for u_i. When u_i is assumed to be normally distributed, the resulting model is a probit. When u_i is assumed to follow the logistic distribution the resulting model is a logistic, or logit, model. Either of these models can normally be estimated in a straightforward manner.

A basic statistical model to represent the second part of the model is as follows:

$$y_i = x_i\beta + \eta_i$$

where y_i is the expenditure on home care for user i and η_i is a random variable. At this second stage it is essential to take account of skewness, kurtosis and heteroskedasticity in the distribution of η_i. This raises a number of difficult issues.

B.1.1.a Model based on the Log-transformation

The most common approach is to adjust for skewness (the most prominent and obvious problem) by doing a log transformation of y. That is, estimate the following model:

$$\ln(y) = x_i\gamma + \epsilon_i$$

where ϵ_i is again a random error term. This transformation often addresses the problem of skewness. It, however, creates new problems. The resulting parameter estimates predict an individual's logged expenditures [$E(\ln(y) \mid y > 0, x)$], i.e., they describe the relationship between x_i and $\ln(y_i)$. They do not directly predict $E(y \mid y>0, x)$, which is what is sought. This requires that we retransform the predicted values back into the original scale. Simply exponentiating the ln(y) values, however, is not sufficient because the $E(y \mid y>0, x)$ depends on both $E(\ln(y) \mid y>0, x)$ and the $\text{Var}(\ln(y \mid y>0, x)$.

a. The most straightforward case is if ln(y) is distributed normal and homoskedastic (i.e., $\epsilon \sim N(0,v)$. In this case:

$$E(y \mid y>0, x) = \exp(x\beta + 0.5v)$$

b. If ln(y) is non-normal but homoskedastic use the smearing estimator as proposed by Duan et al (1983). The smearing estimator for E(exp(ϵ)) is the average of the exponentiated residuals from the ln(y) regression. If ϵ is homoskedastic, this provides a consistent estimate of E(exp(ϵ)). If we denote the smearing factor as S, then:

$$E(y|\ y>0,\ x) = S*\exp(x\beta).$$

c. If ln(y) is log normal but heteroskedastic: $\epsilon \sim N(0, v(x))$, we must identify how the variance varies with x, and include this in the adjustment. In this case:

$$E(y|\ y>0,\ x) = \exp(x\beta + 0.5v(x)).$$

d. Finally, if ln(y) is non-normal and heteroskedastic, we again need to identify how the variance varies with x (or some other relevant factor) and adjust using the heteroskedastic smearing estimator.

$$E(y|\ y>0,x) = S(x)*\exp(x\beta)$$

The key problem with both c and d is identifying the structure of the error distribution. This is essential because if the data truly are homoskedastic, either approach a or b does very well -- both estimators are consistent and efficient. But if the data are heteroskedastic and one uses approach a or b, the estimator performs very badly -- it is inconsistent and inefficient. Because of the difficulties in identifying this error structure, some have recently suggested an alternative, single-step approach to the overall estimation problem.

B.1.1.b Models based on the General Linear Model

Recently single-step approaches have been formulated within the class of generalized linear models (GLM) with a log-link function. Manning and Mullahy (2001) have explored three specific variants of the GLM. In all three models, the following holds true:

$$E(y|\ y>0,\ x) = \exp(x\beta)$$

The first, proposed initially by Mullahy (1998), is a non-linear least-squares model in which the error term is additive in the raw scale and has a variance that does not depend on either E(y|x) or x. The second assumes the raw-scale error variance is proportional to E(y| y >0, x), which is a Poisson-

like assumption with over-dispersion. The third model assumes that the raw-scale error standard deviation is proportional to E(y| y>0, x), which is a gamma-like assumption.

B.2 Comparing the Alternative Approaches

The only published work comparing the alternative models outlined above is that of Manning and Mullahy (2001). They use Monte Carlo methods to assess each estimator under different data generating processes. They reach the following conclusions based on the Monte Carlo results.

B.2.1 Skewness only problem in the error distribution

If the only problem with the data (beyond zeros) is skewness, then all of the estimators are consistent for estimating the slope parameter, β. The OLS estimator is the most precise (followed by the gamma, Poisson and NLS versions of the GLM). The differences in the precision of the estimators increase as the log-scale error variance increases, and can be quite substantial. Therefore, if there is solid reason to believe that the major data problem is skewness, then OLS-based models are to be preferred.

B.2.2 Skewness and kurtosis in the error distribution. The presence of kurtosis in the log-scale error distribution does not cause consistency problems for any of the estimators, but once again, the GLM-based estimators are less precise. The efficiency losses of the GLM estimators relative to the OLS-based estimators are substantial and are larger the greater is the kurtosis for the distribution of the log-scale error.

B.2.3 Heteroskedasticity in error distribution. If heteroskedasticity is present in the log-scale error distribution, although all of the estimators produce consistent estimates of β, if OLS is used on ln(y) without proper retransformation it can produce biased estimates of E(y| y >0, x). If one can accurately capture the dependence of the variance on x and implement the heteroskedastic smearing approach, the OLS-based model is both consistent and most precise; but knowing the variance structure is not easy.

Manning and Mullahy recommend the following approach to choosing an estimator. First estimate a GLM model and generate both the raw-scale and log-scale errors.

a. If the log-scale residuals are heavy-tailed (kurtosis > 3), consider an OLS model with ln(y) as dependent variable.
b. If there is no or only low-level kurtosis (k < 3), use a Park-test on the raw-scale residuals to select one of the GLM models.
c. If the raw-scale variance does not depend on the raw-scale prediction ($\lambda = 0$ in Park test approach), consider the NLS.
d. If the raw scale variance is proportional to the raw-scale prediction ($\lambda = 1$), consider the Poisson-like estimator.
e. If the raw scale variance is quadratic in the raw-scale prediction ($\lambda = 2$), consider the gamma-like estimator or the homoskedastic log model.
f. If the raw scale variance is cubic in the raw-scale prediction ($\lambda = 3$), consider the inverse gaussian estimator.

Appendix C: Imputing Missing Values

Overall, the Ontario Health Survey attained a high response rate and the rate of missing values was low for nearly all the variables used in this analysis. Table C1 lists the number of observations with missing values for each of the variables used in the utilization analysis. Not surprisingly, the variable with the most missing values was household income. Given the relatively small number of home care users in our sample, we felt it was important to retain as many observations as was reasonable given the pattern of missing values. Our approach to the problem of missing values was as follows:

- Impute a value for observations with a missing value for two or fewer variables;
- Drop observations with missing values for three or more variables, or for a missing location variable that would allow us to identify the person's CCAC region.

Based on these criteria and the pattern of missing values, we therefore had to impute a single missing value for 4097 observations, and two missing values for 501 observations.

Imputation Process

There are a number of approaches for imputing missing values (see, e.g., Rubin 1987). We employed regression-based imputation, whereby we predicted a value for those with a missing value based on their individual characteristics and the characteristics of the census enumeration area in which they live, using a model estimated with those observations in the sample without missing values. In doing so, it was important to take into account the measurement properties of the variables to be imputed. When the variable was binary, we used a standard logit model; when the variable was discrete and ordinally measured (e.g., income category, education level, level of social support, etc.), we used an ordered logit model. Table C2 presents the variables used to predict missing values for each variable.

When an observation had two missing values we proceeded sequentially. When the two missing values were unrelated, this was straightforward. In those cases in which the two variables entered the prediction equations (e.g., education and income), we first predicted the missing value for the variable with the better fitting model and then imputed the second variable.

Table C1: Breakdown of Missing Data, by Variable and Number of Variables

	(A) #	%	Cumulative Sum	(B) Missing values imputed	(A) - (B)
No data missing	**18,275**	**79.24%**	18,275		
Missing 1 variable only	**4,097**	**17.76%**	22,372	**4,080**	17
Income	3,819			3,803	16
Social support index	131			131	0
Education	69			69	0
Contact with neighbours	62			61	1
Aboriginal	13			13	0
Marital	2			2	0
Lives alone	1			1	0
Missing 2 variables only	**501**	**2.17%**	22,873	**500**	1
Contact with neighbours, social support	309			308	1
Education, income	76			76	0
Social support, income	52			52	0
Contact with neighbours, income	38			38	0
Income, aboriginal	8			8	0
Marital, income	8			8	0
Income, language	3			3	0
Social support, education	3			3	0
Income, activities needing help	2			2	0
Education, language	1			1	0
Education, aboriginal	1			1	0
Missing 3 variables	**165**	**0.72%**	23,038	**0**	
Missing 4 variables	**18**	**0.08%**	23,056	**0**	
Missing 5 variables	**4**	**0.02%**	23,060	**0**	
Missing 6 variables	**2**	**0.01%**	23,062	**0**	
	23,062	**100.00%**		**4,580**	
				18,275	
	Total sample			**22,855**	

Table C2: Specifications for imputation by regression for missing values

					inc1 inc2 inc3 inc4	educ1 educ2 educ3 educ4	sahs1 - sahs5	chron0 - chron7	soc0 - soc4	contact0 contact1 contact2		avfaminc	avg_edu1 avg_edu2 avg_edu3 avg_edu4				
Variable with missing value	Regr. Eq.	Sex	Age	Age^2	Income (4 dummy vbls)	Educ (4 dummy vbls)	SAHS (5 dummy vbls)	# Chronic Cond (7 dummy vbls)	Social Supp (5 dummy vbls	Contact (3 dummy vbls)	Living Arrang	EA Mean Family Income	EA Mean Educ (4 dummy vbls)	EA Prop Own House	Abo-riginal	Marit status	House-hold size
Income*	Ordered Logit	x	x	x		x educ1	x sahs5	x chron0				x	x avg_edu1	x	x	x	x
Social support	Ordered Logit	x	x	x			x sahs5	x chron0		x contact2	x	x	x avg_edu1			x	
Educ	Ordered Logit	x	x	x	x inc1		x sahs5	x chron0				x	x avg_edu1	x	x		
Contact	Ordered Logit	x	x	x			x sahs1	x chron0	x soc0		x	x	x avg_edu4	x		x	
Race	Logit	x	x	x	x inc4	x educ4	x sahs1	x chron0			x	x	x avg_edu4	x			
Need help	Ordered Logit	x	x	x			x sahs1	x chron0	x soc2		x					x	
Marital	Logit	x	x	x	x inc1	x educ4	x sahs5		x soc0		x						x
Languag e	Ordered Logit	x	x														

Appendix D: Possible Variables to Represent Identified Adjusters and Rationale for Inclusion and Exclusion

The list of potential variables available from the 1996/97 NPHS public use datafile was reviewed to identify which variables could represent the set of potential adjusters listed in Table 5. This list of potential variables was culled by the investigators using the following criteria:

- The strength of correspondence between the specific question asked in the survey and the underlying concept we desired to represent empirically. For example, the NPHS question regarding having contracted AIDS refers only to cases where the disease had been contracted sexually. Therefore, the HIV/AIDS variable was discarded because it provides information on only a sub-set of individuals with HIV/AIDS.
- Among variables that represent similar concepts, select the variable that best captures the underlying relationship between the concept and home care use. For example, functional status could be represented by information derived from the Health Status Classification System or by information derived from a series of questions related to "activities for which help from another person is needed". We believe that the latter better captures functional status as it relates to need for home care.
- Allow multiple variables to represent different dimensions of the same concept. For example, general health can be represented by both self-assessed health status variable and information on the presence of chronic conditions, each of which captures slightly different aspects of general health.
- Acute home care and chronic home care are two distinct dimensions that may drive home care need. It is therefore likely that the two may have (some) different adjusters.
- There had to be a reasonable way to measure the factor empirically.

Table D.1 details the rationale for inclusion or exclusion of each of the variables considered.

The variables in this subset were then examined empirically (using descriptive statistics, cross-tabulations and correlation analysis of the Ontario component of the NPHS public use file) to assess: (1) their relationship with home care use; and (2) their relationship with other variables. This process identified whether there was at least the expected bi-variate relationship between an adjuster and home care use; it identified potential problems of multicollinearity among adjuster variables; and it suggested how best to empirically specify each variable.

Table D1: Candidate Variables and Rationale for Inclusion In or Exclusion From the Analysis

Broad variable category	Variable	Rationale for Inclusion	Rationale for exclusion
INDIVIDUAL-LEVEL NEED INDICATORS			
Demographic characteristics	Age	Arguably the most important adjuster for need for home care services	
	Sex	Together with age, sex is one of the 'common denominator' adjusters that capture need for any type of health care services	
Ethnicity	Aboriginal status	Aboriginals are marginalized in society and often have greater needs, even controlling for health status. Variable suggested by CFRC.	
Health status	General health	Self-assessed health status (SAHS) -- the simplest and the best indicator for general health status	
	Derived health utilities index		Has been subject to less validation than SAHS
	ICD-9 code for main health problem		Desire to avoid use of detailed utilization information
	Presence of chronic condition	Clear link between chronic illnesses and need for home care services	
	Main health problem - 7 groups, grouped		Strongly correlated with chronic condition variable, which is a better adjuster
	Main health problem - 12 groups, grouped		Strongly correlated with chronic condition variable, which is a better adjuster
Health status (cont'd)	Main health problem - 25 groups, grouped		Strongly correlated with chronic condition variable, which is a better adjuster

Broad variable category	Variable	Rationale for Inclusion	Rationale for exclusion
	Has HIV/AIDS		The survey question refers to sexually transmitted cases of AIDS only
	Number of hospital admissions during study period	- Individuals who have been overnight patients are at elevated risk for home care - This variable captures short-term need for home care, a growing and changing component of home care need (as opposed to chronic long-term home care need).	
	Number of physician visits during study period	Greater number of visits may indicate need; may also indicate ability to access services and facilitate access	
ENABLING AND PREDISPOSING INDICATORS			
Functional status	Health Status Classification System (HSCS) variables		- Categories are fairly crude - Functional status can be better represented by activities of daily living (ADL)
	Has long-term disabilities or handicaps		Measures of need for home care services with respect to ADL are more specific than this generic disability variable
	Derived need for help in series of tasks		Variable not very useful as it indicates any 'yes' for the need for help in ADL questions
Functional status (cont'd)	Limited in the kind or amount of activity at home		This question is too generic. More specific 'need for help' questions in ADL provide better information

Broad variable category	Variable	Rationale for Inclusion	Rationale for exclusion
	Need help of another person in activities of daily living (ADL): - in preparing meals	Clear link between need for help in ADLs and need of home care services.	
	Need help of another person in ADL: - in shopping for groceries or other necessities	Same as above	
	Need help of another person in ADL: - in doing normal everyday housework	Same as above	
	Need help of another person in ADL: - in doing heavy household chores, e.g., washing walls, yard work		These chores are not considered to be activities of daily living, but work that is performed on an occasional basis
	Need help of another person in ADL: - in personal care such as washing, dressing or eating	See above for 'need for help in preparing meals' variable.	
	Need help of another person in ADL: - in moving about inside the house	Same as above	
Marital status	Presently married or non-married (legal or common law)	Other things equal, those with spouse are less likely to require home care.	
Social support	Derived social support index	Other things equal, individuals with no social support are likely to require more home care services	
	Derived living arrangements of the selected respondent	Individuals living alone are more likely to require home care than those living with others	

Broad variable category	Variable	Rationale for Inclusion	Rationale for exclusion
	Frequency of contact with neighbours	Similar to rationale to social support	
Education	Derived highest level of education	An individual's education level may influence whether he/she has the knowledge to seek home care services and/or whether he/she needs the services	
	Highest level of post-secondary school		The highest level of education variable provides more information
	Number of years of elementary school		The highest level of education variable provides more information
Income	Derived per capita household income from all sources	An individual's income level may influence his/her need for home care services as well as access to the private home health care system and availability of informal care	
Language	Indicator representing whether individual speaks in English, French only or only other language	May be correlated with differential access and uptake	

Broad variable category	Variable	Rationale for Inclusion	Rationale for exclusion
ENVIRONMENTAL INDICATORS			
Hospital-sector activity in CCAC region	Level and pattern of hospital-based acute care activity in the individual's CCAC region	A growing component of home care use is generated by activity in the acute hospital sector.	
Supply of residential care/institutional beds	Number of LTC facility (nursing home/ homes for the aged) beds in region	Strains on the home care delivery system will be influenced by the presence of nursing homes and homes for the aged in the region. Variable suggested by CFRC	
	Number of chronic care beds in region	Same as above	
	Number of retirement home beds		Data not available
	Number of lodging home beds		Data not available
	Number of acquired brain injury treatment centre beds	Strains on the home care delivery system will be influenced by the presence of acquired brain injury treatment centres in the region. Variable suggested by CFRC	
Supply of other health care services	Number of family physicians/general practitioners in region	May facilitate access to home care	
	Number of children's treatment centre spaces	Strains on the home care delivery system will be influenced by the presence of children's treatment centres in the region. Variable suggested by CFRC	

Appendix E: Construction of the Variable Measuring a CCAC Region's Hospital-Induced Short-term Home Care Days per Capita

The data used to create the variable measuring the number of acute care-induced home care (ACIHC) days in each CCAC region originated from administrative databases within the Ministry of Health and Long-Term Care. The data were accessed for this project through the Central West Health Planning Information Network (CWHPIN). Ontario day procedure and in-patient separation data, obtained from the CIHI Discharge Abstract database for the period November 1, 1995 to October 31, 1996, were linked to home care utilization data (obtained from the OHCAS Service Advice file) for the period November 1, 1995 to February 6, 1997. This linked datafile allowed us to identify home care utilization that was related to an acute hospital event. A home care admission was defined as related to an acute care event if the home care admission occurred within seven days of the day-procedure or in-patient separation. A home care episode defined as acute if its duration was 90 days or less. (Both of these were defined in consultation with the members of the CFRC).

The three-digit ICD-9 code for the most responsible diagnosis was used to group both day-procedures and in-patient events. Any ICD-9 groups with fewer than five events related to home care were dropped. For both day procedure and in-patient events the provincial mean home care duration for each ICD-9 group was calculated as the total number of acute home care days related to acute care events in the ICD-9 group divided by the number of acute care events in the ICD-9 group.

For each CCAC region the number of separations by ICD-9 category was tabulated for day procedure and in-patient events. This number was multiplied by the provincial mean home care duration to obtain the expected number of acute care-induced home care days by ICD-9 for the CCAC region. These days were summed for each area and then divided by the population of the area to obtain the expected number of acute care-induced home care days per capita. The final formula is given below.

$$\mathrm{ACIHC}_R = \frac{\sum_{i=1}^{I} \mathrm{sep}_{iR}\, \mathrm{mhcd}_i^{prov}}{\mathrm{pop}_R}$$

where:

i	=	ICD-9 three-digit diagnosis category
R	=	CCAC region
sep_{iR}	=	Number of separations *s* in ICD-9 category *i* in CCAC region *R*
$mhcd_i^{prov}$	=	Provincial mean number of acute home care days related to acute care events per acute care separation in ICD-9 category *i*
$sep_{iR} \cdot mhcd_i^{prov}$	=	Expected number of acute care-induced home care days for diagnosis *i* in region *R*
pop_R	=	Population in region *R*
$ACIHC_R$	=	Acute care-induced home care days per capita in region R.

The resulting estimates are provided in the following table.

Table E.1: Population, Acute Care-Induced Home Care Days and Acute Care-Induced Home Care Days Per Capita

CCAC Region	Population*	Acute Care-Induced Home Care Days	Acute Care-Induced Home Care Days per Capita
Pres. Russ/Stormont/Gleng./Dundas	191,744	47,595	0.248
Ottawa-Carleton	742,969	134,455	0.181
Lanark, Leeds, Grenville	160,447	44,940	0.280
Frontenac/Lennox/Addington	180,723	40,721	0.225
Hastings/Prince Edward	149,040	43,748	0.294
Haliburton/Northumberland/Victoria	169,362	50,788	0.300
Peterborough	126,728	35,251	0.278
Durham	472,754	92,264	0.195
York	611,659	99,019	0.162
Toronto East York	111,197	24,944	0.224
Toronto Etobicoke	338,888	65,599	0.194
Toronto North York	608,051	118,252	0.194
Toronto Scarborough	576,500	103,709	0.180
Toronto (City of)	676,593	130,438	0.193
Toronto York	151,281	29,947	0.198
Peel	881,794	128,105	0.145
Wellington/Dufferin	223,745	49,219	0.220
Halton	350,180	64,689	0.185
Hamilton-Wentworth	481,531	102,921	0.214
Niagara	414,774	103,819	0.250
Haldimand-Norfolk	106,137	28,266	0.266
Brant	123,451	34,493	0.279

Table E.1: Population, Acute Care-Induced Home Care Days and Acute Care-Induced Home Care Days Per Capita (cont'd)

CCAC Region	Population*	Acute Care-Induced Home Care Days	Acute Care-Induced Home Care Days Per Capita
Waterloo	418,334	82,149	0.196
Perth	74,129	20,469	0.276
Oxford	99,883	29,010	0.290
Elgin	81,364	21,993	0.270
Kent	112,626	37,078	0.329
Essex	361,311	90,343	0.250
Lambton	133,255	40,506	0.304
Middlesex	403,547	81,585	0.202
Huron	61,740	20,980	0.340
Bruce/Grey	157,854	58,485	0.371
Simcoe	339,925	85,245	0.251
Muskoka	51,989	15,900	0.306
Renfrew	99,252	31,584	0.318
Nipissing	87,085	27,591	0.317
Parry Sound	41,055	13,906	0.339
Sudbury/Manitoulin	207,591	53,230	0.256
Timiskaming	38,771	13,786	0.356
Cochrane	95,875	29,220	0.305
Algoma	131,449	35,599	0.271
Thunder Bay	162,949	45,685	0.280
Kenora/Rainy River	91,344	26,749	0.293
Ontario	**11,100,876**	**2,434,275**	**0.219**

* Population estimates are 1996 post-censal estimates, Statistics Canada.

Appendix F: Rationale for Classification of Variables as Needs-related versus Control for Purposes of Development of the Needs-based Funding Formula

Needs-Related Variables

Age: Age is highly correlated with need for both assistance with activities of daily living and health care needs.

Sex: It is not clear that sex will exert an independent influence on home care need if one has fully controlled for health and functional status. But because we cannot perfectly control for health and functional status and because gender roles often mean that men a less able to provide assistance to aging spouses than are women, we include sex as a need variable.

Marital Status: The presence of a spouse, who can assist with activities of daily living and basic health care can reduce the need for home care.

Aboriginal Status: Aboriginals are marginalized members of society who often have higher health and social needs.

Self-Assessed Health Status: The best single-item measure of general health.

Number of Chronic Conditions: Need for home care rises with the presence and number of chronic conditions from which an individual suffers.

Number of Hospital Separations: Acute injury or illness that requires hospitalization often generates a short-term need for home care services upon discharge.

Number of Activities of Daily Living for which Help is Required: Those who require greater assistance with the ADL are in greater potential need of home care services.

Living Arrangement: Living with another person, who may be able to assist with activities of daily living and basic health care, can reduce a person's need for home care.

Level of Social Support: Those with a stronger social support network may also be more able to draw on the help of others to assist with activities as is required, and to maintain a more active lifestyle, reducing need for home care other things equal.

Contact with Neighbours: Similar in rationale to that for social support.

Number of GP/FP visits: The number of GP visits may reflect unmeasured aspects of health status. It may also be the case that those with a greater number of GP visits have better access to home care services (either because they more aggressively seek services or because of assistance provided by their GP). To the extent that this is beyond the control of a CCAC, the formula should also adjust

for this effect.

Number of Hospital Admissions: Post-acute-hospital care is an increasing source of need for home care. The level of acute hospital admissions is also beyond the control of a CCAC. The number of hospital admissions is therefore a legitimate indicator of need for home care services.

Acute-Care-Induced Home Care Days per Capita: Those CCAC regions with higher levels of acute care hospital activity face higher demands for home care services.

Control Variables

Language: If not speaking English increases barriers to access to home care services, we expect such individuals to have lower levels of utilization other things equal (i.e., relative to an English-speaking individual with the same needs). Inclusion of this variable in the funding model would therefore potentially penalize CCAC regions with higher proportions of non-English speakers. Hence, it is treated as a control variable and is not included the allocation formula.

GP/FP Physicians per 10,000 Residents: Conditional on having controlled for individual-level GP visit rates, the region's supply of GP/FPs may be associated with increased access to home care (and other health care services) unrelated to need.

CCAC Region's Relative Funding Level: Other thing equal, those in CCAC regions that have historically been generously funded may have higher rates of home care use than those in underfunded CCAC regions. Inclusion of this effect in the funding formula would perpetuate this.

Uncertain

See text of report for a detailed discussion of these variables.

Appendix G: Data Quality Checks for CSS Data used in the Analysis of the Relationship Between the Average Cost of Providing a Unit of Home Care and CCAC Region Characteristics

Data extracted from the Community Services Budgeting System (CSS data) for 1997-98, 1998-99 and 1999-2000 were used: i) in our analysis of the relationship between the average cost of providing a unit of home care and CCAC region characteristics, and ii) in the calculation of the average provincial cost for each of the service categories found in the OHCAS Service Advice File and used in our main utilization analysis.

As mentioned earlier, the CSS data, especially the older data, suffer from possible quality problems which are suggested by large swings in the number of total units of service reported. We therefore conducted a data checking exercise on the CSS data used in our analyses with the objective of identifying, through comparison with other home care services data sources, whether questionable values could be deemed reasonably "true" or whether such values should be treated as a possible data entry error. We obtained the following data against which to compare the CSS data with respect to the number of units of service delivered:

- The total number of units of service delivered, by CCAC region and by home care service category, OHCAS, fiscal years 1997-98, 1998-99 and 1999-2000;
- The total number of units of service provided by internal (CCAC) and external staff, by CCAC and by home care service category, OHCAS, fiscal years 1997-98, 1998-99 and 1999-2000;
- Information on the history of divestment of services by CCAC and by service category as follows:
    - Number of FTE service providers immediately prior to the beginning of divestment;
    - Number of FTE service providers as of March 31 in each of 1998, 1999 and 2000;
    - The date on which divestment started;
    - The date on which 50% of pre-divestment FTE providers had been divested;
    - The date of completion of divestment and if not completed as yet, the number of FTE service providers to date.

The data were requested and collected by the Ontario Ministry of Health and Long-Term Care through the 7 regional offices in December 2001.

We defined as questionable any value for units of a service provided for which a year-to-year percentage change was greater than or equal to 30%. Based on this definition, we identified 215 questionable values. We checked these questionable values in two phases. In the first phase, each value was compared against its corresponding value in the OHCAS database. When the discrepancy between the CSS and the OHCAS values was less than or equal to 5%, the values were considered consistent and the value was taken as valid. 115 of the 215 flagged values were consistent across the CSS and OHCAS databases.

For the remaining 100 values for which the CSS and OHCAS databases did not agree we assessed:

- The trend in expenditures in the CSS database in surrounding years to determine which of the two values better fits the trend in expenditures reported;
- The divestment history;
- The OHCAS number of units provided by internal and external providers.

We substituted the OHCAS value for the original CSS value if:

- The OHCAS value better reflected the trend in the number of units reported in CSS databases;
- The OHCAS value was more consistent with the trend in expenditures reported in CSS;
- The OHCAS value was higher than the CSS value (over-reporting was less likely a problem than under-reporting);
- The OHCAS value better reflected the information provided by the divestment history.

Based on these criteria, for 16 of the 100 inconsistent values we substituted the OHCAS value for the original CSS value.

References

Aday LA and Andersen R. (1974) A Framework For The Study of Access. *Health Services Research* 9(3):208-220.

Alberta Health and Wellness. (2000) Personal communication, November.

Alberta Health and Wellness. (2000) *Regional Health Authority Funding Global Funding Manual: 2000-2001 Funding*. March 2000.

Anctil H and Belanger L. (2000) *Rapport d'evaluation sur la place des entreprises d'aide domestique du secteur de l'économie sociale dans les services à domicile*. Québec Ministère de la Santé et des Services sociaux.

Andersen R. (1995) Revisiting the Behavioral Model and Access to Medical Care: Does It Matter? *Journal of Health and Social Behaviour* 36(1):1-10.

Andersen R and Newman J. (1973) Societal and Individual Determinants of Medical Care Utilization in the United States. *Milbank Memorial Fund Quarterly* 51:95-124.

Béland F (1999) CLSCs as Neighbourhood and Social Service Centres in Quebec. In: F.D.Powell and A.F.Wessen (Eds), *Health Care Systems in Transition: An International Perspective* (pp. 173-198). Sage, Thousand Oaks.

British Columbia Ministry of Health and Ministry Responsible for Seniors. (2000) Personal communication, October.

British Columbia Ministry of Health and Ministry Responsible for Seniors. (1996) *Regional Funding Formula. A Resource Allocation Initiative to Support the Regionalization of Health Care Services*. British Columbia Ministry of Health and Ministry Responsible for Seniors. Regional Funding and Support, Regional Programs. November 16, 1996.

Campbell JC. and Ikegami N. (2000) Long-Term Care Insurance Comes To Japan. *Health Affairs* 19(3):26-39.

Canadian Institute for Health Information. (1999) *Consensus Workshop on National Priority Information Requirements for Home Care. Final Report*. November. Ottawa.

Canadian Institute for Health Information. (2000) *Development of National Indicators and a Reporting System for Home Care. Revised - Data Definitions and Coding Specifications for Home Care National Pilot Test*. Canadian Institute for Health Information (CIHI). Ottawa.

Canadian Institute for Health Information. (2000) *Home Care. National Indicators and Reports Development*. World Wide Web. http://www.cihi.ca/Roadmap/Home_Care/start.htm.

Canadian Institute for Health Information. (2000) *List of topics*. World Wide Web. http://www.cihi.ca/azmain.htm#tocH.

Community Funding Review Committee (2000). Personal communication., October.

Coyte P. (2000) *Home Care in Canada: Passing the Buck*. May 1, 2000.

Davies AR and Ware JE Jr. (1981) Measuring Health Perceptions in the Health Insurance Experiment. The Rand Corporation, Santa Monica, California.

Duan,N. (1983) Smearing Estimate: A Non- Parametric Retransformation Method. *Journal of the American Statistical Association* 78(383):605-610.

Dumont-Lemasson M, Donovan C, and Wylie M. (1999) *Provincial and Territorial Home Care Programs: A Synthesis for Canada*. Minister of Public Works and Government Services Canada. June 1, 1999. Ottawa.

Efron B. & Tibshirani R. (1993) *An Introduction to the Bootstrap*. Chapman & Hall, New York.

Evans R (1984) *Strained Mercy: The Economics of Canadian Health Care*. Buttersworth, Toronto.

Evans R.G. and Barer M. (1994) Why are Some People Healthy and Others Not? In: T.Marmor (Ed), *The Determinants of Health in Populations* . De Grutyer, New York.

Federal-Provincial-Territorial Advisory Committee on Health Services (AHCS) Working Group on Continuing Care. (2000) *The Identification and Analysis of Incentives and Disincentives and Cost-Effectiveness of Various Funding Approaches for Continuing Care - Technical Report 5: An Overview of Continuing Care Services in Canada*. Hollander Analytical Services Ltd. May 2000. Victoria, BC.

Federal-Provincial-Territorial Working Group on Home Care. (1990) *Report on Home Care. A Report of the Working Group of the Federal/Provincial/Territorial Subcommittee on Long Term Care*. Health and Welfare Canada. Ottawa.

Fillenbaum GG. (1979) Social Context and Self-Assessments of Health Among the Elderly. *Journal of Health and Social Behavior* (20):45-51.

Friedsam HJ and Martin HW. (1963) A Comparison of Self and Physician's Health Ratings in an Older Population. *Journal of Health and Human Behavior* 4:179-183.

Government of Nova Scotia. (6-16-1999) *Health -- Task Force to Move Ahead with Continuing Care Investment*.

Government of Ontario. (2000) *Ontario Confirm Priority Areas for Additional Federal Funding*. World Wide Web. http://www.newswire.ca/government/ontario/english/releases/September2000/14/c3288.html.

Grossman M. and Kaestner R. (1997) Effects of Education on Health. In: J.Berhman and X.Stacey (Eds), *The Social Benefits of Education* (pp. 69-123). University of Michigan Press, Ann Arbor.

Hall R. (2001) *Predicting Home Care Expenditures in Ontario.* Unpublished Ph.D thesis, University of Toronto.

Health Affairs (Special Edition). (2000) Care for the Elderly: How The World Is Coping. Health Affairs May/June 2000.

Health and Welfare Canada. (2000) *Health Canada departmental library catalogue*. World Wide Web. http://www.ils.ca/hc/cgi/swebmnu.exe?act=3&ini=hc_e.

Health and Welfare Canada. (2000) *Online list of topics*. World Wide Web. http://www.hc-sc.gc.ca/english/care.htm.

Health Canada, Policy and Consultations Branch. (1998) *Public Home Care Expenditures in Canada, 1975-76 to 1997-98: Fact Sheets*. March 1, 1998.

Hutchison B, Hurley J, Reid R, Dorland J, Birch S, Giacomini M and Pizzoferrato G. (1999) *Capitation formulae for Integrated Health Systems: A Policy Synthesis*. McMaster University Centre for Health Economics and Policy Analysis Policy Commentary, C99-02.

Jones A (2000) Health Econometrics. In: Culyer AJ and Newhouse JP (Eds), *Handbook of Health Economics* . Elsevier, Amsterdam.

Kaiser Permanente, Portland Oregon. Personal communication. September 2000.

Kaplan GA and Camacho T. (1983) Perceived Health and Mortality: A Nine-Year Follow-Up of the Human Population Laboratory Cohort. *American Journal of Epidemiology* (117):292-304.

LaRue A, Bank L, Jarvik L, Hetland M. (1979) Health in Old Age: How do Physician Ratings and Self-Ratings Compare? *Journal of Gerontology* 14:687-691.

Linn BS and Linn MW. (1980) Objective and Self-Assessed Health in the Old and Very Old. *Social Science and Medicine* (14A):311-315.

Linn MW, Hunter KI, Linn BS. (1980) Self-Assessed Health, Impairment and Disability in Anglo, Black and Cuban Elderly. *Medical Care* (18):282-288.

Maddox GL and Douglas E. (1973) Self-assessment of Health: A Longitudinal Study of Elderly Subjects. *Journal of Health and Social Behavior* (14):87-93.

Manitoba Advisory Committee to the Continuing Care Program. (3-1-1996) *Home Care Reform: Challenge and Opportunity / Advisory Committee to the Continuing Care Program Response to Strategic Redirection of Home Care*.

Manning,W. (1998) The Logged Dependent Variable, Heteroskedasticty, and the Retransformation Problem. *Journal of Health Economics* 17(3):283-295.

Manning,W and Mullahy,J. (2001) Estimating Log Models: To Transform or Not to Transform? *Journal of Health Economics* 20(4):461-494.

Marmot, M. (1997) Social Differentials in Health Within and Between Populations. *Daedalus* 87:1484-1490.

McMaster University. (2000) *McMaster University library catalogue*. World Wide Web. http://morris.mcmaster.ca/.

Mossey JM and Shapiro E. (1982) Self-Rated Health: A Predictor of Mortality Among the Elderly. *American Journal of Public Health* (72):800-808.

Mullahy,J. (1998) Much Ado about Two: Reconsidering Retransformation and the Two-Part Model in Health Econometrics. *Journal of Health Economics* 17(3):247-281.

Murtaugh C, Sparer MS, Hollander Feldman P, Lee JS, Basch A, Sherlock A, and Clark AL. (1999) *State Options for Allocating Resources to Home and Community-based Care*. Center for Home Care Policy & Research, Visiting Nurse Service of New York. September 1999 Research Report. New York, NY.

Mustard C and Derksen S. (1997) *A Needs-based Funding Methodology for Regional Health Authorities: A Proposed Framework.* Manitoba Centre for Health Policy and Evaluation, University of Manitoba. October 1997.

Nagi SQ. (1976) An Epidemiology of Disability Among Adults in The United States. *Millbank Quarterly* :439-467.

National Health Service. (1999) *Resource Allocation: Weighted Capitation Formulas*. National Health Service Executive. July 1999.

New Brunswick Department of Family and Community Services. Personal communication. October 2000.

New Brunswick Health and Wellness. (1999) *Health Services Review: Report of the Committee*.

New Brunswick Health and Wellness. (1993) *Long Term Care Strategy*.

Newfoundland and Labrador Health and Community Services (2000). Personal communication, November.

Newfoundland and Labrador Health and Community Services. (2000) *Long-Term Care Services - Newfoundland and Labrador*. November 3.

Northwest Territories Health and Social Services. (1998) *Shaping Our Future: A Strategic Plan for Health and Wellness*. Yellowknife, Northwest Territories.

Northwest Territories Social Services. (1988) *Programs and Services for Senior Citizens*.

Northwest Territories Health and Social Services. (1997) *Funding Allocation Formula. Preliminary Board Allocations*. Northwest Territories Health and Social Services. Yellowknife.

Northwest Territories Health and Social Services. (1999) *Geographic Tracking of Expenditures Western Expenditure Data For the Year Ended March 31, 1998*.

Northwest Territories Health and Social Services. Personal communication. November 2000.

Nova Scotia Department of Health. (2000) *Programs for Seniors 11th Edition - 2000. Home Care & Support Services*.

Nova Scotia Department of Health. Personal communication. October 2000.

Nova Scotia Department of Health. (1997) *Home Care Nova Scotia: Update*. March 1.

Nova Scotia Department of Health. (1994) *Home Care Nova Scotia. A Plan for Implementation.* Nova Scotia Department of Health. Halifax, N.S. October 10.

Nunavut Health and Social Services. Personal communication. November 2000.

Ontario Ministry of Health. (1999) *Long-term Care Community Equity Funding Formula Review Committee. Status Report.*

Ontario Ministry of Health. (2000) *Long-Term Care – In-Home Services*. World Wide Web. http://www.gov.on.ca:80/MOH/english/program/ltc/ltc_mn.html.

Ontario Ministry of Health. (2000) *Terms of Reference. Study of the Long-Term Care Community Services Equity Funding Formula*. July. Toronto.

Organization for Economic Co-operation and Development. (1996) *Caring for Frail Elderly People: Policies in Evolution*. OECD. Social Policy Studies No. 1. Paris, France.

Organization for Economic Co-operation and Development. (2000) *Organization for Economic Co-Operation and Development's online list of documents*. World Wide Web. http://www.oecd.org/products/.

Phillips KA, Morrison KR, Andersen R, Aday LA. (1998) Understanding the Context of Healthcare Utilization: Assessing Environmental and Provider-Related Variables in the Behavioral Model of Utilization. *Health Services Research* 33(3):571-596.

Prince Edward Island Health and Social Services. (2000) *Home Care Support*. PEI governmental website.
http://www.gov.pe.ca/infopei/Seniors/Services_for_Seniors/Home_Care_Support/index.php3.

Québec Ministère de la Santé et des Services sociaux. (2000) *Funding: Current Situation and Outlook*.

Québec Ministère de la Santé et des Services sociaux. (2000) *Organization of Services. Current situation and outlook*.

Saskatchewan Health. Personal communication.

Saskatchewan Health. (1993) *Introduction of Needs-Based Allocation of Resources to Saskatchewan District Health Boards for 1994-95*.

Saskatchewan Health, Community Care Branch. (1998) *Overview of Home Care Programming in Saskatchewan*. Saskatoon.

Statistics Canada. (1998) *NPHS Public Use Microdata Documentation*. Statistics Canada. Ottawa.

Statistics Canada. (2002) *Variance Estimation Using Bootstrap Weights: BOOTVAR.S4S Program User's Guide for Use with the 1998-99 NPHS Share File*.

Thiele, Frank. (2000) *LTC Community Services Equity Funding Formula*. June 23.

Tissue T. (1972) Another Look at Self-Rated Health in the Elderly. *Journal of Gerontology* (27):91-94.

University of Toronto. (9-11-2000) *University of Toronto's Home Care Evaluation and Research Centre Annotated Home Care Bibliography*. World Wide Web. http://www.hcerc.utoronto.ca/pages/02elect.html.

Winnipeg Regional Health Authority. (2000) Personal communication, September.

World Health Organization. (2000) *World Health Organization's library catalogue (WHOLIS)*. World Wide Web. http://www.who.int/hlt/.

Yukon Council on Aging and Yukon Government. Information Please... A Handbook for Yukon Seniors.

Yukon HSS. (2000) *Social services - Home Care Program*. World Wide Web. http://www.hss.gov.yk.ca/ssframe.html.