Modelling Spatial Distribution of Disability in Older Persons and the Need for Aged Care in New South Wales

Laurie Brown, Sharyn Lymer, Mandy Yap, Mohan Singh and Ann Harding

About NATSEM

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Abstract
Estimating disability levels in older Australians and their demographic and socio-economic profiles is essential for identifying the need for aged care services and for the development and implementation of effective social policy on ageing. However, there is a paucity of such projections in Australia especially at regional levels such as Statistical Local Areas (SLA). This paper describes the spatial microsimulation modelling and small area estimation techniques developed to estimate disability levels and need for aged care in persons aged 55 years or above living in NSW, and presents preliminary results on the geographical variation in these parameters across NSW.

Small area estimates are produced by the spatial microsimulation model ‘CareMod’ which is based on the 1998 ABS Survey of Disability, Ageing and Carers (SDAC) (ABS, 1999), up-rated to 2001. Estimates are generated by reweighting the SDAC confidentialised unit record file to create ‘synthetic’ datasets for each SLA in NSW. The SDAC is reweighted using the ABS optimisation algorithm GregWt against a range of ‘benchmarks’ from the 2001 census. Disability levels and need for age care can be analysed by a wide range of person and family level demographic and socio-economic variables. Additional estimates of individual wealth have been added since it is well known that elderly Australians are usually cash poor but assets rich.

The results show that there are significant variations across NSW in disability levels and the need for aged care services by older persons, and that these individuals have differing levels of social and financial support available to them in their older age. The research findings should assist in the strategic planning and improved targeting of aged care services, especially in identifying areas of unmet need at the small area level.

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General caveat

NATSEM research findings are generally based on estimated characteristics of the population. Such estimates are usually derived from the application of microsimulation modelling techniques to microdata based on sample surveys. These estimates may be different from the actual characteristics of the population because of sampling and nonsampling errors in the microdata and because of the assumptions underlying the modelling techniques. The microdata do not contain any information that enables identification of the individuals or families to which they refer.
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## 1 Introduction

Estimating disability levels in older Australians and their demographic and socio-economic profiles is essential for identifying the need for aged care services and for the development and implementation of effective social policy on ageing. However, there is a paucity of such projections in Australia especially at disaggregated spatial levels such as Statistical Local Areas (SLA). At the moment, neither the Government nor the Aged Care Industry have adequate strategic planning and decision-support tools for forecasting levels of disability in and the future demand for aged care services by older Australians; identifying areas of Australia where the supply of services is unlikely to meet need; estimating the expected cost of such services; and the financial capacity of older Australians to bear a greater share of those costs. Such estimates have not been available at the small area level i.e. at the spatial level in which individuals live and conduct their lives, where services are provided and that is the planning focus of local and State and Territory governments. This is surprising since geographical and financial access to and equity in care services are high on the political agenda (AIHW, 2002; Allen Consulting Group, 2002) and are of central importance to all key stakeholder groups – older persons and their families and carers, the aged care industry and government.

The very large baby boom cohort born post World War 2 will begin to reach 65 years of age from 2011 onwards, resulting in a sharp increase in the number and proportion of the population aged 65 plus during the subsequent 20 years. In 20 years, there will be some 4.2m ‘aged’ Australians - 500,000 of whom will be aged 85 years and over (AIHW, 2002). It is this cohort of old older Australians who will place greatest demand on formal and informal aged care services, especially high dependency aged care facilities.

In 1998, there were some 320,000 Australians aged 65 years and above with a profound disability - 43% of whom lived in residential aged care facilities, 39% lived with at least one other person (usually their carer) and 16% lived alone (ABS, 1999). By 2003, this number had increased to 359,637 individuals with 25% now living alone. At present, there is no evidence that the prevalence of disability in older Australians is declining, especially in terms of severe or profound core activity restrictions (AIHW, 2000). In fact, the age standardised rate of severe or profound core activity restriction for persons aged 65 years and over increased from 16.2% in 1981 to 19.6% in 1998, with the increase being most marked for the very old (AIHW, 2000; AIHW, 2003). The 1998 Survey of Disability, Ageing and Carers (SDAC) (ABS, 1999) shows that 63.5% of persons aged 85-94 years have either a severe or profound disability and 86.6% of those aged 95 or more years (Giles et al, 2003). The number of older persons with severe disability has been projected to increase by 35% over the next 30 years, and those with profound disability by a staggering 70% (Singh, 1995;
Giles et al., 2003; Percival and Kelly, 2004; AIHW, 2004). This is largely due to increases in the number of older Australians with musculoskeletal, nervous system, cardiovascular and respiratory health conditions, and stroke. The expected rise in the number of older persons with dementia, and Alzheimers in particular, over the next few decades is now well documented, with estimates at 1.0% of the current total population reaching 2.8% by 2050 (Henderson and Jorm 1998, AIHW, 2002; Access Economics, 2005). Importantly, the prevalence of dementia rises exponentially with age. At present, more than one in every ten individuals aged 80-84 years is estimated to have dementia and up to one in every four persons aged 85 years and over (AIHW, 2002). The number of older persons i.e. those aged 65 years or over with dementia is expected to increase from 153,800 in 2001 to 242,600 by 2020, representing a near 60% increase over the next 20 years (AIHW, 2002).

Given the projected increase in older persons, and older persons with disability in particular, there is intense and widespread interest in the future socio-economic profile of the older population and the likely economic resources available to the ageing baby boomers (see, for example, the Myer Foundation Report on aged care to 2020 - Allen Consulting Group, 2002). A key question for social policy is the extent to which these older Australians are likely to be able to draw on their own resources to help fund their care needs in later life. Recent research suggests that a significant proportion of ‘baby boomers’ are likely to be financially unprepared, with inadequate accumulated superannuation, for the three or so decades of retirement that faces them (Kelly et al., 2002; King 2001, ABS, 2001). Researchers differ in their assessment of the likely budgetary impact of population ageing (Productivity Commission, 2004). However, it is already clear that population ageing will place increased pressure upon the social security and health and aged care budgets (Treasury, 2002; Productivity Commission, 2004). Older Australians will require access to services that support them in their later life and help alleviate or retard the health and disabling effects of ageing. The likely incomes of the baby boomers in retirement will thus become increasingly important, as Australia looks at possible changes in its health and aged care programs to help shift more of the costs from government to consumers (Brown et al., 2002).

Despite the significance of the high costs of residential care, it has to be remembered that the majority of older Australians live privately within the community. In 2001, for example, it was estimated that some 1.1m older Australians lived as a couple without children; some 690,000 lived alone; and over 360,000 lived with a family member (AIHW, 2002). However, household structures will change in the future. For example, it is projected that in the coming decades, there will be a steady growth in the number of older persons living alone (AIHW, 2003). What level of support will these older Australians require to assist them to live independently within the community? Projecting the demand for formal aged care services must also involve projecting the likely family structures of the baby boomers, as in many cases,
informal care by relatives will substitute for formal care (Percival and Kelly, 2004). Which baby boomers are likely to have spouses and children will be a very important issue – as will the projected health, labour force status and incomes of these possible potential informal carers. In the face of projected longer life spans - but life years not necessarily free from disability - two key questions currently remain unanswered: who will pay for the care and support that will be demanded; and who will provide it? These issues will become critical over the next few years.

As the AIHW observes, “The success of the Australian aged care system depends on, and is characterised by, a mix of types of provision and a high degree of cooperation between all levels of government, service providers and the community” (2002, p74). The residential care sector is already under pressure, as shown by the Commonwealth Government’s attempts to require those entering residential aged care facilities to make a greater financial contribution to means-tested daily care and accommodation fees and payments. This issue was re-examined by the recent review into pricing arrangements for residential aged care within the Commonwealth Department of Health and Ageing. Total government expenditure on residential care alone is expected to grow from 0.71% of GDP to 1.08% by 2020 (Allen Consulting Group, 2002).

Furthermore, the region in which people live profoundly affects the life experiences of all Australians and the economic and social opportunities available to them. The issue of unequal distribution of care needs and funding of services across geographical areas has been a policy concern for some decades (Gibson et al, 2000). The approval of new residential aged care facility placements reflects the strong growth in the aged care industry in some areas, but there is no doubt that access to care in regional Australia will continue to be one of the most important areas of social policy, as there are already major concerns about difficulties in attracting medical and allied health professional staff to rural/remote areas and about lower service standards. Recent research shows that it is the rural and/or remote areas of Australia (and, in particular, NSW) that have a lower than average supply of residential care (although these low levels of residential supply need to be considered in the context of higher levels of home and community care services - Gibson et al, 2000). Issues of spatial equity are likely to become even more prominent in the next two decades — given current trends in the internal migration of older Australians to ‘sunbelt’ and coastal ‘retirement’ regional centres and as the health impacts of the ‘baby boomers’ reaching retirement age start emerging. But the pressures placed on the overall health and aged care budgets by ever-increasing costs will limit the extent to which special regional needs can be met in the future.

Within the policy context of two key themes of ‘Healthy Ageing’ and ‘Independence and Self-provision’ in the ‘National Strategy for an Ageing Australia’ (Bishop, 2002 and 2002a), a number of critical issues need addressing -
• What will the disability status of older Australians be like in the future?
• Who will need aged care support?
• What types of care services will these older Australians need?
• Who can provide these services – formal or informal carers?
• Who can pay for these services – government or individuals and their families?
• Where do these individuals live? and
• Where should support services be provided?

These questions need to be addressed if Australians are to enjoy ‘healthy’ and productive ageing, be financially secure in their old age and have access to ‘world class’ high quality affordable and appropriate care.

These issues underscore the need for much more sophisticated databases and analytical tools that can be used both by Government (Commonwealth and State and territory Governments) and the other key stakeholders to project the future need for services in rural/remote areas, as well as within urban Australia. NATSEM in partnership with the Office for an Ageing Australia and NSW Department of Disability, Ageing and Home Care, via an ARC linkage grant, has developed a spatial microsimulation model – known as CareMod - to assist in addressing these key issues, initially focussing on NSW. The chief aim of CareMod is to produce small area estimates of levels of disability and the need for aged care, broken down by the demographic and socio-economic characteristics of individuals and their families.

The aims of this paper are two-fold: first to describe the spatial microsimulation modelling and small area estimation techniques developed in CareMod to estimate disability levels and need for aged care in persons aged 55 years and above living in NSW. This includes a description of the model’s population and data base, the approach taken to modelling disability levels and need for care, and the regional methodology that has been developed to generate its small area estimates; and second to present preliminary results on the geographical variation in the estimated levels of disability and need for care across NSW. These findings illustrate some basic applications of the model. The paper concludes with some comments on the likely impacts of ageing and implications for age care provision and social policy, and future extensions and applications of CareMod.
2 CareMod – A Spatial Microsimulation Model

CareMod is a complex – both in technical and policy terms - spatial microsimulation model of care needs of older Australians living in New South Wales. Basically, microsimulation is a means of modelling real life events by simulating the actions of the individual units that make up the system where the events occur (Brown and Harding, 2005). Microsimulation models are based on microdata i.e. “low-level” population data – typically the records of individuals from either a national sample survey conducted by a national Bureau of Statistics or large administrative databases. In other words, microsimulation models begin with a dataset that contains detailed information about the characteristics of each person and family (income unit) or household within a sample survey or an administrative database (Brown and Harding, 2002). This is one of the most important advantages of these types of models. Being based on unit records, it is possible to examine the effects of policy changes for narrowly defined ranges of individuals or demographic groups (Creedy, 2001). Further, the models’ databases can mirror the heterogeneity in the population as revealed in the large household surveys.

Thus microsimulation techniques bring a range of benefits to social policy modelling, including the ability to change a greater variety of parameters independently and the capacity to provide considerably more accurate estimates and detailed projections of the distributional effects of changes. Two key strengths of microsimulation models are that: 1) they can replicate the complexity of the policy structures, transfers, and settings; and 2) they can be used to forecast the outcomes of policy changes and ‘what if’ scenarios i.e. the counterfactual where the results describe what, under specified conditions, may happen to particular individuals and groups (Brown and Harding, 2002; Brown and Harding, 2005).

Generation of small area estimates is the key function of CareMod. The census contains detailed regional socio-demographic information but it has key limitations that have constrained regional socio-economic analysis in Australia until now. One limitation is that detailed data on health and disability status and expenditures and incomes are not available in the census. A second important problem is that output for the whole census file is only available as a pre-defined series of tables for area units - the smallest unit being the Census Collection District (CCD) which is approximately 200 households - rather than being in the form of records for each person or family, which is what is required for a microsimulation model. This means that many of the relationships between characteristics of interest cannot be fully explored.

On the other hand, the ABS sample surveys, like the SDAC, contain exceptionally detailed health and disability, and expenditure and income data at the individual and household level, but lack any detailed geographic information. In part, this is to
protect the confidentiality of respondents to the survey. Often the most detailed geographic classification available in the publicly released data is the 'State'.

Spatial microsimulation models aim to combine data from the census and ABS national survey confidentialised unit record files (CURFs) to create synthetic unit record datasets for small areas. In essence, the characteristics of interest unavailable in the census but available in the survey are synthesised at small geographic levels by utilising both data sources. Efforts to develop spatial models are a new initiative internationally in microsimulation modelling, with the UK appearing to be the only other country where attempts to develop comparable synthetic spatially detailed population microdata are well advanced (Huang and Williamson, 2001; Voas and Williamson, 2000, Ballas and Clarke, 1999). Furthermore, microsimulation models have traditionally been used in tax and social security policy, and it has only been in more recent years that they have been extended to the health and aged care fields.

2.1 CareMod’s Basefile

The unit records from the ABS 1998 SDAC provide the base records for the model’s population. One of the key reasons for using the SDAC as CareMod’s base file rather than an alternative ABS national survey was that its top-coding of age is 85 years and above. This allows the ‘older ‘old age groups to be examined in more detail. Being able to categorise older Australians into narrower aged groups, such as ‘75 to 79’, ‘80-84’ and ‘85+’ years enables far more accurate modelling of the likely aged care needs of Australians by region. The person, income unit, family and household structures within the SDAC are retained within the model’s base file. Data on socio-demographic variables, economic factors, disability status, availability of informal carers etc are retained from the SDAC records.

While CareMod retains all records in the SDAC representing the total population, the population of most interest is persons living in households in which there is at least one person aged at or above the model’s minimum age limit of 55 years. Fifty-five years of age was chosen in preference to 65 years to provide a ‘margin’ that would ensure ‘full-capture’ of an appropriate target population as well as adequate numbers for modelling purposes. The SDAC includes both persons living in private dwellings and non-private dwellings (NPDs) i.e. institutions. This is important as it contains information about people living in aged care facilities. Non-private dwellings is divided into two categories – cared accommodation and other non-private dwellings. Cared accommodation consists of hospitals, homes for the aged (nursing homes and aged care hostels) and cared accommodation component of retirement villages. From the 1998 SDAC, among those aged 55 years and over, a total of 3,633,717 (94%) individuals reported they lived in private dwellings and 239,188 (6%) lived in non-private dwellings. For the ‘old’ old (aged 85 years or above), however, the proportion living in institutional accommodation (i.e. NPDs)
increases to 39%. Of those residing in private dwellings, the majority of ‘young’ older individuals (55-74 years of age) live in couple households while the old old (75 years or above) are more likely to live alone. Most of those living in non-private dwellings, resided in residential aged care facilities (Table 1).

Table 1 Breakdown of persons aged 55 years and over by dwelling structure

<table>
<thead>
<tr>
<th></th>
<th>55-64 years</th>
<th>65-74 years</th>
<th>75-84 years</th>
<th>85 years and over</th>
<th>55 years and over</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number</strong></td>
<td>1,580,415</td>
<td>1,248,393</td>
<td>754,620</td>
<td>224,754</td>
<td>3,872,905</td>
</tr>
<tr>
<td><strong>%</strong></td>
<td>98.5</td>
<td>96.8</td>
<td>88.5</td>
<td>61.0</td>
<td>93.8</td>
</tr>
</tbody>
</table>

**Private Dwellings**

<table>
<thead>
<tr>
<th>Residence Type</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person living alone</td>
<td>231,534</td>
<td>14.4</td>
</tr>
<tr>
<td>Couple only</td>
<td>810,928</td>
<td>50.5</td>
</tr>
<tr>
<td>Living with dependent children</td>
<td>409994</td>
<td>25.6</td>
</tr>
<tr>
<td>Other Household</td>
<td>127,959</td>
<td>8.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,580,415</td>
<td>98.5</td>
</tr>
</tbody>
</table>

**Non-private Dwellings**

<table>
<thead>
<tr>
<th>Residence Type</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homes for the aged</td>
<td>3,335</td>
<td>0.2</td>
</tr>
<tr>
<td>Homes-other</td>
<td>975</td>
<td>0.1</td>
</tr>
<tr>
<td>Retirement Homes</td>
<td>635</td>
<td>0.0</td>
</tr>
<tr>
<td>Retired or aged accomm. (Self-care)</td>
<td>1,697</td>
<td>0.1</td>
</tr>
<tr>
<td>Hospital</td>
<td>2,301</td>
<td>0.1</td>
</tr>
<tr>
<td>Other Accommodation</td>
<td>14929</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>23,872</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Source**: 1998 SDAC

### 2.2 Regionalisation Methodology

CareMod’s small area estimates are generated using a methodology that involves the reweighting of an ABS national (or another) survey CURF to create a ‘synthetic’ dataset for each small area of interest. Specifically, in CareMod, small areas estimates are generated by reweighting the 1998 SDAC CURF to create ‘synthetic’ datasets for each statistical local area (SLA) in NSW. A national weight is provided by the ABS in the SDAC CURF for each person level record. A weight represents the likelihood of finding persons with a similar set of characteristics in the Australian population.

Conceptually, the SDAC national weight for each record is turned into a ‘synthetic’ SLA weight, so that the new weight now represents the likelihood of finding persons...
with a similar set of characteristics in the local area population. After reweighting, the weighted characteristics of the survey records should mirror those of the SLA population as revealed by the 2001 census.

The SDAC is reweighted against a range of ‘benchmarks’, using data from the census (Table 2). Benchmarks are based on a selection of ‘linkage’ variables that are common to both the SDAC and census. It is important that these linkage variables adequately represent the socio-demographic attributes of each SLA population and address the main issues of concern — in the case of CareMod, the drivers of the need for aged care and the income and assets of older Australians. Literature on aged care was reviewed to identify key drivers of the need for aged care — i.e. variables that predict the need for care (or more typically, the use of aged care services). These variables may not be direct determinants of the need for care but rather are good predictors acting through simple or complex relationships with disability status. For example, the fact that an individual is elderly does not mean that that particular individual will need aged care services, but age is a key predictor of the need for age care, since physical and mental impairment increases exponentially with age. Hence, the need for and rates of utilisation of aged care services are strongly predicted by age through its relationship with disability status.

Review of the literature indicates that a number of socio-demographic factors are important drivers for the need for care: age, sex, and ethnic background; income and wealth; family composition and household type; home ownership and accommodation arrangements; mobility and transport (e.g. car ownership). Age is the predominant determinant of the need for care - the relative importance of other variables is not clear. Although a number of factors drive the need for care, only those proxy variables that exist in both the Census and survey can be incorporated in the reweighting as benchmarks. Logistic regression modelling was undertaken to check the nature of the statistical relationships between putative drivers of the need for care and various outcome measures such as Activities of Daily Living (ADLs).

As shown in Table 2, the final benchmark variables used included age, sex, relationship in household (family type), individual income, tenure type (housing arrangements) and level of education. Because of the importance of age to predicting the functional status of individuals, every person-based benchmark was cross-tabulated against four broad age groups (0-54, 55-64, 65-84, 85+ years).
Table 2  **Benchmarks**

<table>
<thead>
<tr>
<th>Benchmark – variables (classes)</th>
<th>Number of Targets (Cells)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM01 Age by Sex (8X2)</td>
<td>16</td>
</tr>
<tr>
<td>BM02 Relationship in household by Age by Sex (7X4X2)</td>
<td>56</td>
</tr>
<tr>
<td>BM03 Individual income by Age (6X4)</td>
<td>24</td>
</tr>
<tr>
<td>BM04 Tenure Type (5)</td>
<td>5</td>
</tr>
<tr>
<td>BM05 Level of education by Age (2X4)</td>
<td>8</td>
</tr>
<tr>
<td>Total 5</td>
<td>109</td>
</tr>
</tbody>
</table>

The reweighting process involved five major steps:

1. identification and specification of desirable benchmarks and target variables i.e. selection and definition of relevant linking variables and their classes;
2. data pre-processing and preparation
   a. obtaining customised census tables from the ABS against which SDAC data are reweighted (i.e. data was requested to be made available in finer age groups for people 55 years and over). The census counts for persons in these tables are based on usual resident persons;
   b. preparation of census data, which largely involved the ‘balancing’ or reconciliation of the census tables.
   c. preparation of SDAC data involving recoding and up-rating data;
3. mapping of SDAC98 variables to the census benchmark variables;
4. use a optimisation algorithm to generate new weights for each SLA to create the synthetic small area populations; and
5. validation of the small area estimates produced through the regionalisation process.

These steps are outlined in more detail in another publication (Brown et al, 2004).

### 2.3 Generating Small Area Estimates

The ABS optimisation algorithm GregWt was used to re-weight the SDAC records (Bell, 2000). The optimisation process finds a reweighted selection of the records in the SDAC CURF that match the class totals within each benchmark for each SLA in NSW. One of the major challenges of the generation of small area weights is the extent to which the weights ‘converge’ on variable and class constraints. In essence, convergence tests the extent to which the weights, when summed, return the count of
constrained (i.e. the linkage) variables. The expectation is that if convergence occurred in the optimisation algorithm then the synthetic weights should reproduce the benchmark characteristics of each of the small area populations.

Insofar as reweighting is capable of returning results which reflect the actual combination of characteristics (as opposed to simply a set of weights which satisfy the constraining counts), reweighting may be regarded as providing useful estimates of other characteristics in the survey data that are not constrained against benchmarks. An important question in terms of the validity of this regional estimation methodology then is ‘how well do the area weights predict unconstrained variables i.e. those not included in the benchmarks, or replicate administrative data?’ For example, will the application of the regional weights accurately predict the number of elderly persons living in different areas of NSW who have particular impairments in core activities? Such prediction is a fundamental goal of this methodology.

Overall, the methodology performed well for variables ‘constrained’ in the reweighting process when convergence was achieved. However, validation of the initial weights indicated that for unconstrained variables – variables on the SDAC but not used in the benchmarks – especially rare events such as the presence of disability, the reweighting led to overestimation. Validation was undertaken by examining the proportions of disabled in NSW by taking a weighted average across the NSW SLAs and comparing it to NSW estimates from SDAC (where NSW estimates weren’t publicly available Australian values were used. In 1998, for disability variables where we had both NSW and Australian estimates, the NSW estimates seem to be closely aligned to the Australian estimates). Considering disability status, the estimated percentage of the NSW population with at least a moderate restriction in at least one core area was 9.6% from the SDAC but the average from the NSW SLA reweighted estimates was 13.4%.

Hence, post-processing was undertaken to refine the estimation at SLA level to vary around the NSW average. This involved various methodologies including cloning records with large weights (multiple records of the same person in the dataset are made for these records. The new records have proportionally smaller weights so that the dataset weights still sum to represent the Australian population) and adjustment of the probabilities of a characteristic being present (scaling).

Logistic regression methods were used to allocate the level of disability and some disability profile information such as number of core area restrictions and which core areas were restricted onto the base file. The constrained variables from the reweighting process were used as predictors. Scaling of the probabilities prior to allocation of the characteristic was then used to ensure that NSW level estimates were maintained.
2.4 Modelling Need for Aged Care – CareMod’s Care Modalities

Aged care services currently range from informal support from family and friends to high dependency residential care. The type of aged care services used and required by the elderly will depend on their need for care, personal and family circumstances and the supply of care.

Extended family and friends are the main providers of in-home support or assistance for the aged in Australia. According to the SDAC98, 83% of aged Australians living in community receive care from informal sources, and 59% from formal care providers. Forty three percent received assistance from both informal and formal providers (PC, 2003). Informal care is provided mainly for ADLs such as mobility, paper work, meal preparation and self-care.

The formal care sector consists of: residential (accommodation and related services) services either low dependency care (formerly hostel care) and high dependency care (formerly nursing homes); and home and community care and support, ranging from basic services such as delivered meals to complex specialist medical services. There are two main community aged care programs – Home and Community Care (HACC) services which are jointly funded by the Federal and State/Territory governments and provide the bulk of home and community-based aged care services; and Community Aged Care Packages (CACPs) which were initiated in 1992 as a Commonwealth funded program to provide an alternative to low level residential aged care for older people living in the community (AIHW, 2004a). These two programs aim to enable frail older people to continue living in the community and delay or prevent the need for residential care. Other types of services include hospitals, retirement villages, assisted living arrangements, flexible services and day care centres although there are not many facilities currently offering care for older people for a couple of hours during the day and many of these services are typically funded by HACC. In addition, the Extended Aged Care at Home (EACH) Package is a more recent Commonwealth funded program that aims to provide nursing and personal care at a standard equivalent to high level residential care to clients in their own homes (AIHW, 2003; AIHW, 2004b).

In CareMod, the aim has been to map functional status measured by level of disability to the need for different ‘modalities’ of care. While these modalities of care may, in turn, map to current aged care services and programs, as mentioned above, the intention is to avoid defining the type of care required in terms of the services currently available. Rather, the type of care needed has been defined using a sliding scale ranging from no or minimal assistance required through to high dependency. This approach aims to separate the need for care from the existing organisational structure of age care support and supply of services as described above. It therefore provides the opportunity of mapping the need for care to new forms of service delivery and support that may be developed in the future i.e. the needs of elderly
Australians may be met by a very different looking age care sector in 10 to 20 years time depending upon future public policy options, community preferences and demands, and industry goals and initiatives.

The CareMod classification of care modalities is provided in Figure 1. This involves a five point scale where:

- **Care Modality 1** ≈ no (or very minimal) assistance;
- **Care Modality 2** ≈ low level of need which could be met within the family/community from a low level of support from informal carers for example;
- **Care Modality 3** ≈ low medium level of need which maps to higher demand on either informal or formal care providers within the home or community setting;
- **Care Modality 4** ≈ high medium level of need which translates to high demand on either informal or formal care providers within the home or community, or lower dependency institutional (residential) type services; and
- **Care Modality 5** ≈ high levels of need requiring high dependency institutional type care and support.

In theory, the demand for aged care then could be modelled as a function of need, supply effects and care preferences. However, it should be kept in mind that the initial intent of CareMod was to model the need for care, with the later possibility of modelling the demand for and use of specific aged care services.
2.5 Creation of Disability Variables and Imputing Need for Care

The aim in CareMod is to use measures of disability to identify the need for care and more specifically to assign a CareMod care modality to each person. Initially we aimed to identify whether or not an individual had a disability, the core areas that were restricted and how many activities they needed assistance with. Figure 2 illustrates this approach, showing the interrelations of the various disability characteristics we thought would be useful in predicting need for care.

First, we collapsed an SDAC disability status variable, into 2 levels: (1) has a disability and moderate, severe or profound restrictions in core activities, and (2) the rest which includes has a disability and mild restriction in core activities, has a disability and no restriction in core activities but restricted in schooling and employment, has a disability and not restricted in core activities, schooling or employment, has a long term health condition without disability and no long term health condition.

There are 3 core areas where an individual may be restricted:

- self care;
- mobility; and
- communication.

In CareMod, each of these core areas were then classified into two levels of restrictions - profound, severe and moderate restrictions versus mild and no restriction. There is an inherent assumption that if a record is classified as having at least a moderate core activities restriction in the top-level variable it will have at least one core area with at least a moderate restriction. Conversely, it was assumed that a record with at least a moderate restriction in one core area would have a least a moderate restriction overall. The number of core area restrictions is simply the sum having a restriction in self care and/or mobility and/or communication.

Within each core area there are a variety of activities that restriction maybe experienced. For example, in self care core area, activities include ability to shower or bath, ability to dress, ability to eat, ability to toilet and ability to control bowel or bladder. These variables in their original form in the SDAC generally had four levels of possible restriction. These four levels of difficulty and assistance have been grouped into two levels: (1) always needs assistance and has difficulty, sometimes needs assistance and has difficulty, and sometimes needs assistance with or without difficulty; and (2) not needing assistance whether has difficulty or not, and not needing assistance and has no difficulty.
Our aim was to use this approach to assign a care modality to each person in CareMod’s base population. This method performed reasonably well for a number of variables, for example,

- percentage of individuals with a disability and at least a moderate restriction in one core area
- percentage distribution across the number of core areas with at least a moderate restriction
- percentage distribution of core areas where at least a moderate restriction was present

However, trying to allocate the number of activities that assistance was required and which activities assistance was required performed poorly. Consequently, we re-examined the definition of the disability variables and the requirements of the disability variables to allocate care modalities. This resulted in a more simplistic method for linking disability and care modality to be developed. This is shown below in Figure 3. In essence, level of disability is acting as a disability index.
The use of this linkage meant that only one disability variable - level of disability – is required to allocate the need for care. The consequence of this is it removed the need for complex, iterative imputations of disability characteristics to allow scaling of these characteristics to continue maintaining the state average of the occurrence of these characteristics.

This variable was imputed and scaled using ordinal logistic regression methods. This method allowed us to obtain the probabilities of a record with the given demographic characteristics falling into a particular disability status category. Based on the amount and distribution of overestimation, these probabilities were scaled so that our regional estimates fluctuate around the State mean. The results are presented in Table 3 showing the weighted NSW average proportion for each level of disability status from the SDAC and the CareMod State level estimate. As can be seen, the estimates produced by CareMod closely match those from the SDAC.

**Figure 3: Linkage of Disability Levels to Modalities of Care**

<table>
<thead>
<tr>
<th>Levels of Disability (DIS402)</th>
<th>Health Care Modality*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has disability and profoundly restricted in core activities</td>
<td>Modality 5</td>
</tr>
<tr>
<td>Has disability and severely restricted in core activities</td>
<td>Modality 4</td>
</tr>
<tr>
<td>Has disability and moderately restricted in core activities</td>
<td>Modality 3</td>
</tr>
<tr>
<td>Has disability and mildly restricted in core activities</td>
<td>Modality 2</td>
</tr>
<tr>
<td>Has disability and not restricted in core activities, but rest. in school or employ.</td>
<td>Modality 1</td>
</tr>
<tr>
<td>Has disability and not restricted in core activities, schooling or employment</td>
<td></td>
</tr>
<tr>
<td>Has a long term health condition without disability</td>
<td></td>
</tr>
<tr>
<td>No long term health condition</td>
<td></td>
</tr>
</tbody>
</table>

*Modalities of care range from 5 – requiring high levels of formal care down to 1 – no care required.
Table 3: Weighted average proportion for NSW in each disability category (total population).

<table>
<thead>
<tr>
<th>Disability Status</th>
<th>SDAC</th>
<th>CareMod State Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disability and profound restriction in core area</td>
<td>2.88</td>
<td>3.23</td>
</tr>
<tr>
<td>Disability and severe restriction in core area</td>
<td>3.21</td>
<td>3.98</td>
</tr>
<tr>
<td>Disability and moderate restriction in core area</td>
<td>3.53</td>
<td>2.94</td>
</tr>
<tr>
<td>Disability and mild restriction in core area</td>
<td>5.52</td>
<td>3.79</td>
</tr>
<tr>
<td>Disability and no restriction in core area, but restriction in school or employment</td>
<td>1.76</td>
<td>1.18</td>
</tr>
<tr>
<td>Disability, no restriction in core area or school or employment</td>
<td>2.44</td>
<td>1.84</td>
</tr>
<tr>
<td>No disability but Long Term Condition</td>
<td>16.62</td>
<td>16.73</td>
</tr>
<tr>
<td>No Long Term Condition</td>
<td>64.02</td>
<td>66.31</td>
</tr>
</tbody>
</table>

2.6 Imputing Wealth - Income and Assets

One of the advantages of CareMod is that given its base dataset, the small area estimates of disability and need for aged care can be analysed by a wide range of individual and family (income unit) characteristics. The SDAC contains several variables on individual and income unit levels and sources of income. However, given that elderly Australians are usually cash poor but assets rich, and eligibility criteria to social security support such as the age pension and subsidised residential aged care fees are income and assets tested, additional estimates of individual wealth such as superannuation, income from interest bearing deposits, shares and investment properties, and housing assets are being added to the database.

The ABS national 2001 Survey of Income and Housing Costs (SIHC) is being used to impute wealth data on to CareMod’s SDAC derived base file. The SIHC 2001 contained detailed information on superannuation as well as on a range of income variables. The relationships that exist between assets and wealth variables and other variables, e.g. socio-economic factors, in the SHIC were identified through regression analyses. These relationships were then used to obtain the probability that a person on the SDAC base input dataset has a particular wealth and asset. After carrying out the regression analyses, results indicated that total weekly cash income from all sources, age of person, highest level of post school qualifications, labour force status were significant predictors of income from interest yielding assets and income from superannuation. The value of the underlying assets is then imputed from earned income using an income capitalization method, for example, a known interest
income and the estimated interest rate are used to calculate the value of the underlying asset, which in this case is an interest bearing deposit.

The term and the values of income from superannuation were derived from NATSEM’s dynamic microsimulation model DYNAMOD (Kelly, 2003) which models the accumulation of superannuation assets at the individual level based on sex, age and labour force status. The amount of superannuation and the value of the deposits derived from the methods above were then imputed on to the existing SDAC dataset to enable further analysis of capacity for self-provision.

For estimating housing assets, data on median strata and non-strata house price values were obtained from NSW Department of Housing. House values will be imputed on to the CareMod base dataset by SLA according to tenure and dwelling type. These values will be combined with the other income estimates to approximate individual wealth. This information will provide a basis for computing the likely economic resources available to older Australians to contribute to the costs of their care.

3 Preliminary Findings

Overall, the regionalisation methodology performed very well in generating regional weights that when applied to the SDAC reproduced the census benchmark data for the SLAs. However, the reweighting process worked better for some areas than others. ‘Poor convergence’ (i.e. where the reweighting process yielded unsatisfactory results), occurred for only four of the 198 SLAs in NSW. These four areas were Sydney, both Inner and Remainder, South Sydney and Inner Newcastle. These SLAs are non-typical and have exceptional concentration of some characteristics. These SLAs could not be modelled and thus were dropped from the analyses.

In NSW, around 20% of the population aged 55 years and over were found to have a disability with at least a moderate restriction in at least one core area, this proportion rising to nearly 50% for those aged 85 years or over. These rates do, however, vary significantly between local areas, ranging between 14 and 30% for those aged 55 years or over, and 30 and 70% for the very old (85 years or over).

Given there are significant geographical variations in levels of disability, how does the need for aged care vary around the State? The spatial patterns of CareMod’s four care modalities where individuals’ may require some assistance are given in Figures 4 to 7. Recall that care modality two represents a low level of need based on an individual having a disability and being mildly restricted in core activities or not restricted in core activities but needing assistance at school or work. This need could be met, for example, from within the family or community. Care modality five
CareMod represents the highest level of dependency, equating to nursing home care for example, reflecting an individual having profound disability. Both the numbers of persons aged 55 years and over and the percentage of individuals in each area requiring each level of care are shown in the maps. The former reflects the potential pool of clients for aged care services while the later measures relative differences in the levels of need on a population basis. The SLAs are classified by quintile. Variations across the SLAs are very noticeable for all four care modalities with clear west-east gradients in the numbers of individuals requiring care. In terms of care modality four (e.g. severe disability placing high demand on care providers within the home or community, or lower dependency residential type services), there are only seven areas with fewer than 20 individuals with modality four level of need and 20 areas with fewer than 40 individuals identified in the CareMod modelling as needing these types of care services. Areas in the bottom quintile have fewer than 65 individuals with severe disability while those in the top quintile have more than 845 persons with severe restriction in core activities. For care modality five (profound disability leading to the highest level of care such as nursing home care) again there are only seven areas with fewer than 20 individuals with high dependency needs, and 12 areas with fewer than 40 individuals identified in the CareMod modelling as needing high level care – all of these areas are located in rural or remote NSW. Compared to modality four, areas in the bottom quintile for modality five have fewer than 93 individuals with profound disability while those in the top quintile have more than 1125 persons with profound restriction in core activities. However, these patterns do not simply reflect population distribution. There are significant regional differences in the proportion of the local community populations needing care. This is particularly so for care modality five where the percentage of individuals aged 55 years or over requiring high level care varies between 2% in the rural area of Cabonne to 27% in the Snowy Mountains. Of the 39 areas in the highest quintile, 30 (77%) are rural SLAs or regional centres, many of which are located in the southern part of the State. Interestingly, there is much less variation in the proportions of local populations requiring moderate to lower high levels of care (modalities 3 and 4), reflecting a more spatially even prevalence rate for moderate and severe disability. Further analyses are currently being undertaken for different age and gender groups with a view to understanding the extent to which disability levels and care modalities vary by gender and increasing age. For example, the number of persons aged 85 years and over living in each SLA who according to the modelling have profound disability and may need high dependency care ranged between 0 (Windouran, Cabonne (pt B), Yarrowlumla, Lord Howe Island) and 1,240 persons.
(Hornsby). Only 21 SLAs in NSW were identified as having fewer than ten very elderly residents with high level aged care needs. In contrast, 15 areas were estimated to have more than 500 very elderly residents with profound restrictions in core activities and high care needs, these areas being the high population SLAs in Sydney and the coastal retirement areas such as Wollongong, Newcastle, Wyong, Lake Macquarie, Gosford and Hornsby. CareMod indicates that the median number of persons aged 85 years or over with high care needs per area is 72 individuals.

The proportion of SLA populations aged 85 years and over with profound disability and high dependency needs (modality five) varies between 0 and 68 percent (Hunters Hill in Sydney) - only 13 SLAs in NSW were seen to have fewer than 20% of their very elderly residents with high level aged care needs. In contrast, 10 areas appear to have more than half of their very elderly residents with high care needs. The median percentage for the 194 SLAs analysed was estimated at 37%.
Figure 4 Distribution of Care Modality 2 within NSW

POPULATION AGED 55 YEARS AND OVER WITH CARE MODALITY 2

PERCENTAGE OF POPULATION AGED 55 YEARS AND OVER WITH CARE MODALITY 2
Figure 5 Distribution of Care Modality 3 within NSW

POPULATION AGED 55 AND OVER WITH CARE MODALITY 3

PERCENTAGE OF POPULATION AGED 55 YEARS AND OVER WITH CARE MODALITY 3
Figure 6 Distribution of Care Modality 4 within NSW

**POPULATION AGED 55 AND OVER WITH CARE MODALITY 4**

Quintiles (Numbers)
- 2 - 65
- 65 - 138
- 138 - 382
- 382 - 845
- 845 - 3292

**PERCENTAGE OF POPULATION AGED 55 AND OVER WITH CARE MODALITY 4**

Quintiles (Percent)
- 3.2 - 6.3
- 6.3 - 6.8
- 6.8 - 7.0
- 7.0 - 7.4
- 7.4 - 9.9
Figure 7 Distribution of Care Modality 5 within NSW

POPULATION AGED 55 AND OVER WITH CARE MODALITY 5

PERCENTAGE OF POPULATION AGED 55 YEARS AND OVER WITH CARE MODALITY 5


4 Discussion and Conclusions

The rationale for building CareMod was to be able to provide much more detailed answers to possible questions about the current and likely future need for, affordability of, and private and public capacity to fund aged care for older Australians. The small area forecasting capabilities of CareMod offer a new spatial estimation tool to assist in forward planning and decision-making on service provision, including what types of services are needed, what balance will be needed between formal and informal care, where should services be located and how could the costs of these services be met by Government and users.

The preliminary results from CareMod indicate that the prevalence of disability and need for aged care varies significantly across NSW both in absolute and relative terms. Further, it appears that the greatest spatial variability occurs in the prevalence of older persons with profound restriction in core activities. It is these individuals who place demand on high dependency residential aged care facilities or programs such as EACH. It is acknowledged that these patterns represent only part of the picture, namely the demand side. This information needs to be combined with data on the existing provision of services and likely changes in supply to be able to identify areas of unmet need now and in the future. It is the areas where current service provision is lacking and the areas in which demand will grow strongly in the future that will need to be identified and then targeted in terms of planning and resource allocation.

The maps provided illustrate the basic application of the modelling available within CareMod. These results can (and will) be further analysed by a wide range of demographic and socio-economic variables at the person and family level. For example, the type of income unit to which an elderly disabled individual belongs and whether or not they own and live within their own home strongly influence the likelihood of them entering residential aged care facilities. The availability of support from family is a crucial issue. Currently, one in three NSW residents aged 65 years or over live alone. In the next two decades, there will be a significant rise in the number of older Australians living by themselves, many of who will have some impairment in core activities and will require assistance. The increasing numbers of older persons with disability but the relative decreasing numbers of younger persons that may be able to act as care givers poses a very real challenge to the ability of the informal sector to continue to provide, at current levels, this key welfare support role (AIHW, 2004; Percival and Kelly, 2004). Furthermore, research indicates that there also will be an increase in the proportion of carers that are elderly themselves (Percival and
CareMod has been constructed to provide small area estimates of disability, to identify modality of care and in a second planned phase of work to provide regional projections of older Australians living in NSW over the next 20 years. Such estimates have enormous potential for informing social policy development and assisting in addressing the pressing issues that are arising through Australia’s population ageing. The model offers detailed micro level data at the small area level and allows the analysis of these data in a range of different ways for further understanding the characteristics and care needs of older Australians.

A number of extensions to and advanced applications of CareMod are planned in a follow-up stage of this research. The records within CareMod’s base dataset can be ‘aged’ over time (i.e. the data up-rated) to provide projections over the next couple of decades. Such projections will allow us to answer questions like:

- how many elderly persons will live in different SLAs of NSW in 5, 10, 15 or 20 years time;
- what will be their disability status and need for care;
- what will be their family status, living arrangements and availability of informal care;
- what income from both government (e.g. age pension) and private sources (e.g. superannuation, returns on investment) and assets including housing will they have at their disposal to contribute to their costs of care?

In addition, the model is being built such that key parameters can be changed so that the distributional consequences of possible policy changes and the significance of key assumptions to the modelling outcomes can be assessed. For example, what would be the distributional impact of different social security eligibility criteria and user-pay contributions to the costs of care or the impact of lower levels of disability due to medical advances? Because microsimulation models operate at the level of individuals and their families, it is possible to model complex policy options and to assess their distributional and revenue consequences. Given that governments are likely to be under significant budgetary pressure in the ageing portfolio and other policy areas, greater attention will be devoted to the financial costs to government of supporting care services and the possibility of greater independence and self-provision by older Australians. Therefore, a key element of CareMod is its functionality to simulate the distributional impact of changes in the public and private distribution of care costs — that is, what will be the likely costs of the different care modalities and how will these costs be divided between private contributions compared with government outlays under different policy settings?
The results produced by CareMod to date indicate that the potential offered by the socio-spatial methodology trialled in this model can be realised. It has become increasingly evident that such models do assist in policy debates on the affordability and funding of both home and community based and residential aged care services but more specifically in informing regional resource allocation-location decisions. The local areas in which individuals live are unique in their social and physical fabric. Small areas are spatially diverse and planning tools such as CareMod can contribute to the understanding of local needs and to providing solutions to allow older Australians to undergo healthy and productive ageing.
References


ABS, 2001. Superannuation and financial characteristics Apr to Jun 2000, ABS Cat 6360.0, Canberra, ABS.


