2 August 2010

Mr Mike Woods
Commissioner, Inquiry into Caring for Older Australians
Productivity Commission
GPO Box 1428
Canberra City ACT 2601

Dear Mr Woods

Submission to Inquiry into Caring for Older Australians

1. Summary

Planning the provision of aged care services across Australia will require long-term projections, taking into account the changing patterns of diseases amongst the aged. Separate projections will be needed for many areas, with providers needing site-specific projections. This submission suggests that household microsimulations can help meet the needs of planners and providers.

Trial microsimulations of care residents are in appendix B, using AIHW disease models for 584 disease subtypes. The results compare poorly with available data on care residents. As shown in appendix C, the assumed disease models poorly replicate survey data on diseases amongst Australians.

Much better simulations would be feasible, given more detailed data on the characteristics of persons entering and leaving aged care, and disease models reconciled with survey data. Co-operation between ABS, AIHW and DoHA is needed to ensure that appropriate disease data are available.

Trial microsimulations of residential care are needed before a large-scale model can be safely built. Consideration should be given to obtaining these by commercial tender.

2. Personal background

As a consulting actuary, I have had some experience in financial modelling for retirement villages and residential care facilities. I am completing a PhD at the ANU actuarial school, titled “New techniques for household microsimulation, and their application to Australia.” This submission represents my own views, and not those of any client or interest group. I am very grateful for the help given to me by Anna Howe and Andrew Smith while preparing the submission.

3. Relevant terms of reference for the inquiry

The inquiry is asked "to develop detailed options for redesigning Australia's aged care system to ensure that it can meet the challenges facing it in the coming decades". This will need long-term demand projections for aged care services, taking into account the changing patterns of diseases among the aged.

The inquiry has to develop regulatory and funding options that "include appropriate planning mechanisms for the provision of aged care services across rural, remote and metropolitan areas". These planning mechanisms will need demand projections for many different geographic areas.

These options are to allow providers to "earn a return that will attract the investment, including capital investment, needed to meet future demand". Providers will need long-term demand projections for proposed facilities, and quantification of the uncertainties in these projections. These projections may need to be site-specific, taking into account the ability of potential residents to meet entry charges.

4. Household microsimulations

Australian population projections are normally made by deterministic projections, taking into account expected fertility, mortality, emigration, immigration and migration rates for each sex at each age. The results are expected values for each combination of age, sex, area and projection year, and there is no statistical variability between repeated projections.

By contrast, microsimulations model individuals, rather than the numbers of persons with particular combinations of characteristics. For each person in each projection period, random variables are generated to see whether they experience events such as death or migration. As a result of this random event generation, there is statistical variability between repeated projections. Because individuals are not grouped into combinations, many more different personal characteristics can be taken into account, such as diseases and wealth.

The flexibility of microsimulations allows projections to be made of the households in which individuals live. This is particularly relevant for residential care projections, as persons with partners are less likely to need residential care than single persons.

APPSIM is an Australian household microsimulation model, developed by NATSEM with funding from 13 Commonwealth agencies (Percival 2007), and based on the 1% sample from the 2001 population census. The model developed as part of my PhD is similarly based, and provides simulations of disease development for each person, using AIHW disease models for 123 diseases, with 584 subtypes. An extension is planned, using a 10% sample of the 2006 census, and modelling each SLA.

5. Household microsimulations needed for residential care projections

The website of the Department of Health and Ageing (www.health.gov.au) provides lists of the aged care services within each statistical local area (SLA), and 25 year population projections for each SLA. Potential investors are likely to need projections at the SLA level, and at least this level of geographic detail should be available from the microsimulations. To provide reasonable projections for each Australian SLA, a sampling density of at least 1 in

10 would be needed. This is well within the capacity of modern computers - the SVERIGE model simulated 8.6 million persons (Holm et al 2002).

Most persons entering residential care have multiple disease conditions, sometimes needing special forms of care (particularly for dementia). Residents typically have mortality rates well above normal population rates, and allowances need to be made for these high rates when projecting separation rates. As residential facilities have operational lifetimes of perhaps 30 to 50 years, projections should be available for about 50 years.

6. Use of SDAC 2003 data to simulate aged care admissions and exits

Appendix B1 gives the results of logistic analyses of the probabilities of being in aged care, obtained from the SDAC 2003 unit records. As persons with dementia have high probabilities of being in care, separate analyses were made for persons without and with dementia. Probabilities of being in aged care were found to increase linearly with age, and to be substantially lower for married persons.

Probabilities of entry to care, broadly based on the results of the logistic analyses, were used to simulate persons in care in June 2003. Table B1 shows that the results compare poorly with available data on care residents. The simulated persons are 2.8 years older on average, and a larger proportion is male. Disease patterns vary substantially from the limited ACFI data available at 30/6/08. Simulated admissions to care, and deaths in care, are both about half the actual levels.

7. Improving disease information on aged care admissions and residents

Data on admissions, residents and separations, subdivided by Residential Classification Scale, (RCS) are available from “Residential aged care in Australia 2007-08” (AIHW 2009) and earlier annual publications. ACFI replaced RCS assessments from 20/3/08, and analyses of main physical conditions and dementia/mental illness are available for most of the 47,337 residents with ACFI assessments at 30/6/08 (AIHW 2009a table 4.34). The 10 physical conditions and 3 dementia/mental illness categories are potentially helpful, but unfortunately the data available to 30/6/08 are a mixture of recent admission and longer-term residents, and do not adequately reflect either. The 2008-09 data will be more useful, as all the admissions will have been under ACFI, and nearly all the existing residents should have had ACFI assessments.

Information on many different disease subtypes will be needed to usefully model entry to residential care, and progression through to death after entry. ABS, AIHW and DoHA currently use disease classifications with differing levels of detail, making it hard to combine their data and models. Greater co-operation between these agencies would be valuable.

8. Trial microsimulations of residential care

I am not aware of any household microsimulation models currently able to model residential aged care systems similar to Australia’s. Microsimulation models are complex, and costly to build and maintain. Trial microsimulations of residential care are needed before a large-scale model can be safely built. DoHA should consider commissioning some short-term exploratory developments. Given the rapidly increasing microsimulation skills in Australia, commercial tendering should be feasible.

9. Further information about this submission

I would be happy to provide further information about this submission, to the Commissioners or to the inquiry's support staff. Assumption and calculation details could be supplied for the microsimulation model.

Yours sincerely

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Appendix A: Characteristics of persons in residential aged care

A1 Persons in residential aged care in 2003

Table A1 Persons in residential aged care in 2003

Description	Persons not in care m	Persons in care m	Total m
Without dementia	19.537	0.081	19.617
With dementia	0.037	0.065	0.102
Total	19.574	0.145	19.719

The estimates in table A1 were obtained as weighted totals of the SDAC unit records (ABS 2005). The unit records include 4,039 persons recorded as living in a home for the aged, or in accommodation for the retired or aged, and these were taken as being in residential aged care. The estimated 145,000 in residential aged care is close to the 142,846 permanent and respite residents at 30/6/03 (AIHW 2009 table A1.1). The average age of persons in residential care was estimated from the SDAC unit records as 83.4 years, compared with 83.9 (AIHW 2004 table 2.1).

A2 Logistic analysis of probabilities of being in residential care in 2003

Table A2 Coefficients of logistic models for probability of being in residential care in 2003

Variable	Coefficient without dementia	Coefficient with dementia
Age	0.1428	0.0581
Sex		0.417
Married	-1.693	-0.647
Cerebral palsy	2.854	
Congenital	1.527	
Depression	2.145	
Diabetes	0.416	
Epilepsy	1.632	1.422
Genitourinary	1.204	
Head injury		0.814
Heart disease	0.755	0.603
Multiple sclerosis	4.963	
Neoplasm	0.686	0.623
Paralysis	3.727	3.130
Parkinson	2.737	1.480
Retardation	2.099	
Schizophrenia	3.508	1.642
Stroke	0.875	
Constant	-15.119	-5.129
Observations	39086	2142
Log likelihood reduction	0.528	0.105

The coefficients in table A2 were obtained by weighted logistic analyses of the probabilities of being in residential care, using the 41,233 person records in the SDAC 2003 data. Of these, 2,142 were recorded as having dementia or Alzheimer's, and both groups were

treated as having dementia. Stepwise backwards regression was used, with variables above the 10% significance level being dropped.

Logistic regression fits probability models of the form

score = $\beta_0 + \sum \beta_i x_i$

probability = exp(score) / (1 + exp(score))

where β_i are the fitted parameters, and x_i the explanatory variables.

For example, the score for an 85-year old unmarried female with dementia and no other health conditions would be calculated as

0.0581 * 85 + 0.417 - 5.129 ie 0.227.

The estimated probability of a female with these characteristics being in aged care is

exp(0.227) / (1 + exp(0.227) ie 0.556.

The log likelihood reduction of 52.8% obtained with the model fitted to persons without dementia is reasonably high for a logistic model. The 10.5% obtained with the model fitted to persons with dementia is much lower. From table A1, about 64% of persons with dementia are in residential aged care, and other data appear to be of marginal value in predicting whether particular persons with dementia will be in care.

A3 Difficulties with using ABS disease categories

SDAC 2003 recorded 84 different disease conditions for each person (ABS 2005 44-45). A trial logistic analysis of the probabilities of being in care showed that 55 of these disease conditions were significant. As a result of poor reporting or poor definition, many of these conditions were dropped from the analysis, or combined into larger categories.

The explanatory notes to the survey comment that some conditions may not have been reported because of lack of comprehensive medical information kept by their cared-accommodation establishment (ABS 2004 p60).

The trial analysis showed that “nervous tension/stress” and “migraine” had large negative coefficients. It seems likely that these conditions are often not recorded for persons in aged care, and they were omitted from further analyses. The trial also showed large negative coefficients for noise induced deafness and congenital deafness, and a small positive coefficient for deafness. Aged care staff may not have been aware of the source of deafness, and recorded it under the general category. Subsequent analyses were done with all deafness categories combined.

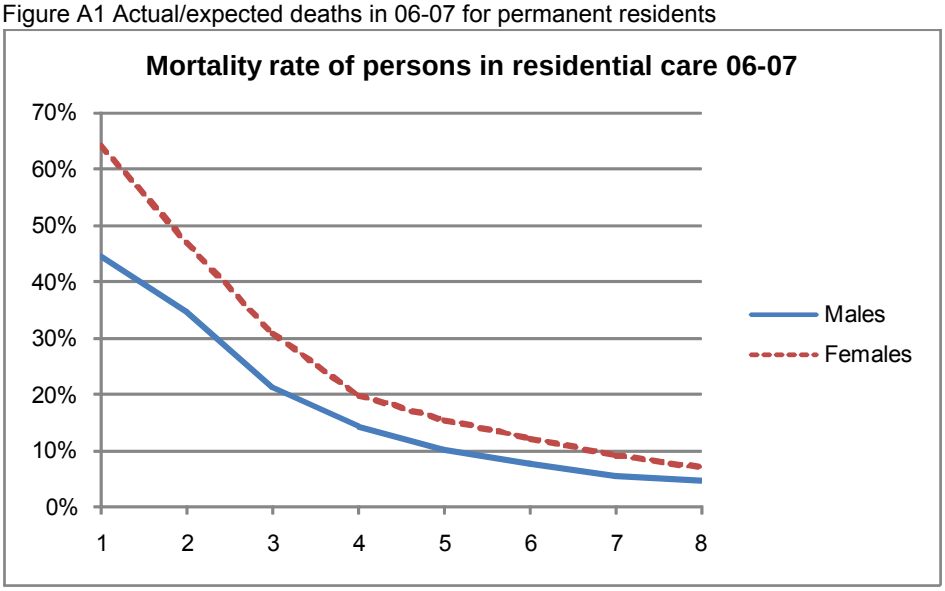
The SDAC data showed “dementia” and “Alzheimer’s disease” as separate conditions, both of which gave large positive coefficients in the trial analysis. Interestingly, persons in private dwellings were more likely to be described as having Alzheimer’s rather than dementia, while persons in care were more likely to be described as having dementia. AIHW provides a disease development model for “Alzheimer’s and other dementias”, so the two SDAC categories were combined into “dementia” for the analyses in A2.

The SDAC conditions included “high cholesterol” and “hypertension”. These were omitted from the analyses in A2, as they appear to be disease symptoms rather than diseases.

"Angina" was also omitted, as the trial analysis suggested it was not significant or not properly recorded. This left four SDAC conditions, "heart disease", "myocardial infarction", "other heart diseases" and "other diseases of the circulatory system", which were combined into "heart disease" for the analyses in A2.

A4 Mortality rates of persons in permanent residential care in 06-07

Figure A1 Actual/expected deaths in 06-07 for permanent residents



The mortality in figure A1 were obtained by

- Averaging the numbers of permanent residents of each sex in the RCS group at 30/6/06 and 30/6/07
- Obtaining the reported numbers of deaths in each RCS group in 06-07
- Dividing the reported numbers of deaths by the average numbers of residents.

Residents tend to enter at high RCS groups, and progress to lower groups, so that they often die in lower groups than their entry group. The above procedure compares numbers dying in each group with the average number of residents in that group during the year, and should thus give reasonable estimates of mortality rates for each RCS group. The overall mortality rate for all permanent residents in 06-07 was 28.7%, reflecting actual deaths about 4.1 times those expected from population mortality rates (ABS 2009).

Appendix B: Trial simulations of persons in residential care

B1 Simulation method

The microsimulation model described in appendix C is based on a 1% sample of the 2001 census data. For each person in the baseline data, their diseases and aged care residence at 30/6/01 were simulated, allowing for their exposure from birth or since immigration into Australia. These simulations were initially done using the logistic probability models in A2 to model entries to care, and found to give too many persons in residential care at 30/6/01. To give approximately the right numbers in residential care without and with dementia, the regression constant for persons without dementia was reduced by 0.8, and that for persons with dementia was reduced by 0.2. Using the adjusted logistic probability models, the diseases and aged care residence of Australians at 30/6/01 were resimulated, and then projected to 30/6/03.

B2 Disease coefficients assumed in logistic models of entry probabilities

The logistic coefficients assumed for each of the 584 disease subtypes modelled were based on the coefficients in table A2, modified to account of the characteristics of the subtype. For example, Parkinson's disease was modelled as a three-stage disease, with a zero coefficient for the mild stage, a coefficient equal to that in table A2 for the moderate stage, and a coefficient equal to double that in table A2 for the severe stage. The coefficients for Parkinson's disease were also assumed for Huntington's chorea and multiple sclerosis. All neoplasms were assumed to have the coefficients in table A2, regardless of stage. Persons with spinal cords injured in accidents were assumed to have the coefficients for paralysis. As coefficients for 584 disease subtypes were derived from 15 fitted disease coefficients, many of them are necessarily subjective. Importantly, the assumed coefficients are based on fitted probabilities of being in care, but are being used to model probabilities of entry to care. Much better models of entry to care should be obtainable by analysing entry data.

B3 Comparisons of care simulations with other data at 30/6/03

The comparisons in table B1 show that the simulation results compare poorly with available data on persons in residential aged care. The simulated persons are 2.8 years older on average, and a larger proportion is male. The proportion with dementia is close to the 44.5% estimated from the SDAC unit records, but well below the 63.5% reported for the 47,337 persons with ACFI assessments at 30/6/08 (AIHW 2009 table 4.35). ACFI assessments were introduced on 20/3/08 (AIHW 2009 p126), so the limited data available on 30/6/08 may not be representative of all residents. Comparisons of main physical conditions are also affected by the short period of ACFI data, but the simulated data show too few persons with a circulatory disease as their main condition, and two many with an eye condition.

Table B1 Comparisons of care simulations with other data at 30/6/03

Personal characteristics	Simulated	Actual	Source
Average age of persons in care	86.2	83.4	AIHW 2005 table 2.1
% of all persons in care	0.75%	0.72%	AIHW 2005 table 2.1
% in care who are male	32.4%	27.8%	AIHW 2005 table 2.1
% in care with dementia	43.0%	44.5%	SDAC
% in care with a mental condition	16.0%	27.7%	AIHW 2009 table 35
% with circulatory as main physical condition	7.6%	29.6%	AIHW 2009 table 34
% with digestive as main physical condition	1.3%	2.9%	AIHW 2009 table 34
% with endocrine as main physical condition	6.1%	9.4%	AIHW 2009 table 34
% with external as main physical condition	5.7%	2.7%	AIHW 2009 table 34
% with eye as main physical condition	21.2%	5.1%	AIHW 2009 table 34
% with genitourinary as main physical condition	7.0%	3.9%	AIHW 2009 table 34
% with musculoskeletal as main physical condition	11.7%	17.3%	AIHW 2009 table 34
% with neoplasm as main physical condition	5.1%	3.6%	AIHW 2009 table 34
% with nervous as main physical condition	5.4%	7.2%	AIHW 2009 table 34
% with respiratory as main physical condition	2.4%	4.4%	AIHW 2009 table 34
% with other as main physical condition	19.6%	13.9%	AIHW 2009 table 34
% with no main physical condition	7.2%	0.0%	AIHW 2009 table 34
Admissions to care pa, as % of those in care	17.4%	36.0%	AIHW 2004 table 3
Deaths in care pa, as % of those in care	14.5%	28.7%	A4

Simulated admissions to care, and deaths in care, are both about half the actual levels. Excluding neoplasms, only a few disease sub-types have mortality rates as high as those experienced on average by care residents. The AIHW disease development patterns, other than for neoplasms, generally only give mortality rates for the disease as a whole, and not for its sub-types. Better simulations of resident deaths would need more detailed data on the disease conditions of care residents, and on the conditions underlying their deaths.

B4 Conclusions from these simulations of persons in residential care

These trial simulations suggest that

- Detailed microsimulations of persons entering and leaving residential aged care, on fine geographic scales, are feasible with current computers and microsimulation techniques
- Assumed entry models should be based on detailed data on persons entering residential care
- Assumed exit models should be based on detailed data on the disease conditions of care residents, and on the conditions underlying their deaths
- Most of the necessary data on admissions and residents should be readily available as part of the ACFI assessment process
- Disease data on persons dying in residential care should be available from death certificates
- Greater co-ordination is needed in the disease descriptions used in AIHW disease patterns, ABS disability surveys and ACFI assessments.

Appendix C: Disease microsimulation model for Australia

C1 Australian household microsimulation used as base for disease microsimulations

The model used here has been developed at the ANU actuarial school (Cumpston 2009). Baseline data are derived from the 1% unit record sample of the 2001 census (ABS 2003). For each projection period, births, deaths, emigrants, immigrants, household exits and household moves are randomly simulated. Education, training, occupation, employment, income, housing, superannuation and other assets are simulated. The model is broadly similar to the APPSIM model developed by NATSEM (Percival 2007), except its modelling of occupations, and of movements between statistical divisions, may go a little beyond APPSIM. To help make submissions to the Productivity Commission's disability and aged care inquiries, the model has recently been extended to model 123 diseases, subdivided into 584 subtypes.

C2 Disease incidences, durations and prevalences

Table C1 Disease groups with AIHW incidence estimates

Chapter	Description	Diseases	Incidence m	Duration years	Prevalence m
A	Infectious and parasitic diseases	23	17.566	*0.12*	*2.091*
B	Acute respiratory infections	3	29.460	*0.01*	*0.419*
C	Maternal haemorrhage	3	0.072	*6.92*	*0.498*
D	Birth trauma and asphyxia	3	0.012	*11.09*	*0.131*
E	Nutritional deficiencies	3	0.943	*1.02*	*0.962*
F	Malignant neoplasms	26	0.470	*0.74*	*0.349*
G	Other neoplasms	2	0.021	*0.23*	*0.005*
H	Diabetes mellitus	2	0.097	12.07	1.171
I	Endocrine and metabolic disorders	3	0.001	52.23	0.028
J	Mental disorders	13	0.495	7.72	3.818
K	Nervous system and sense organ disorders	24	1.001	6.87	6.879
L	Cardiovascular disease	9	0.121	6.37	0.770
M	Chronic respiratory disease	2	0.099	17.63	1.744
N	Diseases of the digestive system	9	0.368	0.69	0.255
O	Genitourinary diseases	4	0.106	4.14	0.437
P	Skin diseases	4	0.200	2.59	0.519
Q	Musculoskeletal diseases	6	9.355	0.19	1.771
R	Congenital anomalies	10	0.004	*42.34*	*0.177*
S	Oral conditions	4	7.387	0.40	2.970
T	Unintentional injuries	12	0.290	*1.15*	*0.334*
U	Intentional injuries	3	0.041	*0.34*	*0.014*
Z	Ill-defined conditions	1	0.005	6.31	0.029
Total		169	68.113	0.37	25.369

Table C1 shows summary details of 169 diseases, grouped into chapters. Nearly all the incidence numbers are from annex table 15 to Begg et al (2007), and are estimates of the numbers of new incidents in 2003. Prevalence figures not in italics are from annex table 16, and are estimates of the numbers of persons with that condition at the middle of 2003. Durations not in italics were derived by dividing prevalences by incidences. Unfortunately, chapters A to G, R, T and U were not included in annex table 16. For these diseases, average duration estimates were obtained from the spreadsheets available on

www.aihw.goc.au/bod as part of "The burden of disease and injury in Australia 1996". Prevalence estimates were then obtained by multiplying incidences by durations.

The average duration of infectious and parasitic diseases is about 6 weeks, with most of the order of a week, and a few more serious infections, such as HIV/AIDS and chronic hepatitis being much longer. Unintentional injuries have an average duration of 1.15 years, as they are based on accidents resulting in hospital admissions or treatment in emergency departments. Data on intentional injuries are similarly based on hospital records.

C3 Diseases and disease stages simulated

Many of the 169 diseases in table C1 can be subdivided by type or development stage. For example, the spreadsheets available as part of "The burden of disease and injury in Australia 1996" include 3 types of breast cancer, each with 4 development stages:

Table C2 Breast cancer types and stages

Type	Stage Number	Stage	Disability weight	Recovery constant	Transition constant
Tumour <2 cm	1	Diagnosis & primary treatment	0.26		4.62
Tumour <2 cm	2	Remission	0.26	0.29	0.10
Tumour <2 cm	3	Disseminated cancer	0.79		0.57
Tumour <2 cm	4	Terminal stage	0.93		
Tumour 2-5 cm	1	Diagnosis & primary treatment	0.69		2.83
Tumour 2-5 cm	2	Remission	0.26	0.28	0.23
Tumour 2-5 cm	3	Disseminated cancer	0.79		0.57
Tumour 2-5 cm	4	Terminal stage	0.93		
Tumour >5 cm	1	Diagnosis & primary treatment	0.81		1.50
Tumour >5 cm	2	Remission	0.26	0.23	0.55
Tumour >5 cm	3	Disseminated cancer	0.79		0.57
Tumour >5 cm	4	Terminal stage	0.93		

Disability weights are those assumed by Begg et al (2007, 17). They are intended to "quantify societal preferences for health states in relation to the societal idea of good health". Other examples are 0.07 for diabetes, 0.125 for a slipped disc with chronic pain, 0.27 for mild dementia, 0.43 for blindness, 0.57 for paraplegia and 0.76 for unremitting unipolar major depression. These disability weights are inherently subjective, and may not be appropriate as admission criteria for disability benefits.

The only pathways assumed from each disease stage are recovery, transition to the next stage of the disease, and death. Probabilities of each of these events occurring for each event for each disease stage are assumed to be constants depending only on sex and age. If f(x) is the probability of being in a particular disease stage at time x, given the person is in that state at time 0, then

$$df(x)/dx = - (\lambda_m + \lambda_r + \lambda_t) f(x) \qquad (C1)$$

where λ_m is the mortality constant, λ_r the recovery constant and λ_t the transition constant. With this notation

$$f(x) = \exp[- (\lambda_m + \lambda_r + \lambda_t) x] \qquad (C2)$$

Mortality, recovery and transition constants were estimated a range of information in the "The burden of disease and injury in Australia 1996" spreadsheets, including average stage durations, relative mortality rates and 5-year survival rates.

In all, 123 of the 169 diseases were chosen for simulation, with the omitted diseases being those with durations under 6 months or very low disability weights. These 123 selected diseases were identified as having a total of 584 subtypes. For all but one of these subtypes, disability weights and recovery, transition and mortality parameters were estimated from the spreadsheets. The exception was a one-stage disease called "back problems", where the spreadsheet assumed high incidences, each with an average duration of 0.011 years. Incidence rates for chronic back pain, assuming no recovery or extra mortality, were estimated from the unit record data for SDAC 2003 (ABS 2005).

C4 Continuous time disease simulation within projection periods

Some of the average durations for disease stages are very short. For example, the average duration assumed for the terminal stages of most cancers is one month. To allow for short durations without excessive calculation times, continuous time simulation is used for disease events within projection periods. From equation C2, the time x since entering a disease state is

$$x = - \ln(f(x)) \ / \ (\lambda_m + \lambda_r + \lambda_t) \qquad \text{(C3)}$$

For example, a person in remission from breast cancer with tumours under 2 cm has a recovery time constant of 0.29, and a transition time constant of 0.10. The mortality constant is zero, as no deaths from cancer are assumed until the terminal stage. The time until either remission or transition occurs is simulated by selecting a random number r between 0 and 1, and calculating the time as - ln(r) / 0.39. If this simulated time is less than the time remaining to the end of the simulation period, an event is assumed to occur. If more than one type of event is possible, then the choice between event types is made by selecting another random number, and choosing in proportion to the time constants of the possible events.

C5 Constructing base diseases in 2001 using AIHW disease models

The initial diseases and disease stages for each of the 175,044 persons in the baseline data at 30/6/01 were simulated by an iterative process

- For persons born in Australia, the occurrence of a congenital or birth-related defect was simulated
- Stepping forward a year at a time from their birth or immigration date, the occurrence of new diseases, and the development of existing diseases, was simulated
- Each year, death from each disease was simulated, taking into account only the extra risks of death from disease
- If death from disease occurred, the process was restarted at the birth or immigration date.

This process assumes that the age-specific incidence, recovery, transition and mortality risks from each disease have remained unchanged up to 2001. ABS (2004 3) noted that there was "little change in the disability rate between 1998 (20.1%) and 2003 (20.0%)". Begg et al (2007 33-34) noted the considerable increase in the incidence of type 2 diabetes, and the lack of any data suggesting trends in mental health, hearing loss, vision loss and musculoskeletal disorders. Given the reductions in road accident deaths, assuming current accident rates may underestimate the numbers of long-term disabilities at 30/6/01 from head injuries.

The above process also assumes that immigrants come to Australia with no diseases. Kennedy, McDonald and Biddle (2007) provide evidence of the "healthy immigrant effect" in the US, Canada, UK and Australia. For Australia, they show that the incidence of chronic conditions is substantially lower for all immigrant regions, self-assessed health generally better, and obesity and smoking rates lower. Chronic hepatitis B prevalence rates are however higher in some immigrants, particularly those from the Asia-Pacific region (Butler, Korda, Watson & Watson 2009 11). More exact allowances for immigration effects could be included.

The above process assumes that existing diseases are uncorrelated with a person's employment and household status. In practice, however, persons with severe disabilities are less likely to be employed, and less likely to be in partnerships or living in private dwellings. Adjustments to the above process are needed to approximately allow for the observed patterns of employment and household status of persons with disabilities.

C6 Comparing simulated diseases with 2003 survey data

Table C3 compares the numbers of each disability estimated from the unit records SDAC 2003 with those simulated as at 2001, and then projected forward two years allowing for births, deaths, immigration and emigration, and for disease incidence and development. As in the baseline projection to 2001, immigrants are assumed to come to Australia with no diseases.

Table C3 Observed and simulated numbers of persons with each disability

ICD10 Chapter	Description of main cause of death	Simulated conditions m	SDAC conditions m
I	Infectious & parasitic diseases	0.024	0.060
II	Neoplasms	0.262	0.202
III	Diseases of the blood & blood-forming organs	0.607	0.049
IV	Endocrine, nutritional & metabolic diseases	0.632	1.515
V	Mental & behavioural disorders	3.883	1.873
VI	Diseases of the nervous system	0.226	0.962
VII	Diseases of the eye & adnexa	0.821	0.320
VIII	Diseases of the ear & mastoid process	1.642	1.405
IX	Diseases of the circulatory system	0.341	3.073
X	Diseases of the respiratory system	1.331	1.746
XI	Diseases of the digestive system	0.093	0.433
XII	Diseases of the skin & subcutaneous tissue	0.558	0.130
XIII	Musculoskeletal	2.352	4.246
XIV	Diseases of the genitourinary system	0.416	0.190
XV	Pregnancy, childbirth & the puerperium	0.000	0.000
XVI	Certain conditions originating in the perinatal period	0.015	0.006
XVII	Congenital malformations	0.027	0.110
XVII	Symptoms, signs and abnormal findings, nec	0.000	0.704
XX	External causes of morbidity & mortality	1.876	1.399
Total		15.107	18.421

The numbers of each main condition were estimated from the unit record file DAC03CON.DTA, using the person weights in that file. They are thus estimates of the numbers of persons in Australia suffering from that main condition at 30/6/03. The simulated numbers were obtained by the process described in 15.5, and multiplied by 19.719/ 0.178

(the ratio of the Australian population at 30/6/03 to the simulated numbers of persons at 30/6/03). The disease chapters are those used in ABS 2009.

Some of the possible reasons for the differences between simulated numbers and those estimated from the SDAC 2003 records are:

- As the simulated numbers were obtained by Monte Carlo simulation, random variations in simulation results will occur
- The SDAC estimates are weighted samples, and have statistical uncertainties
- Some persons may not have reported certain conditions because of the sensitive nature of the condition – eg alcohol and drug-related conditions, schizophrenia, mental retardation or mental degeneration (ABS 2004b 60)
- Some conditions may be episodic or seasonal – eg asthma, epilepsy
- Lack of awareness of the presence of a condition, such as mild diabetes
- Lack of comprehensive medical information kept by cared-accommodation establishments, who completed survey returns on behalf of their residents
- The simulations rest on incidence, recovery, transition and mortality assumptions separately derived for each of 123 diseases, together with the assumption that these rates have not changed in the past.

Even given these possible reasons for differences, the differences in several important disease chapters are disturbingly large.

C7 Comparisons between simulated and actual deaths

Table C4 Main cause of death for simulated and actual deaths

ICD10 chapter	Description of main cause of death	Simulated deaths	Actual deaths
I	Infectious & parasitic diseases	1.2%	1.3%
II	Neoplasms	22.4%	28.7%
III	Diseases of the blood & blood-forming organs	0.0%	0.3%
IV	Endocrine, nutritional & metabolic diseases	6.6%	3.5%
V	Mental & behavioural disorders	1.8%	2.4%
VI	Diseases of the nervous system	19.1%	3.5%
IX	Diseases of the circulatory system	32.2%	37.6%
X	Diseases of the respiratory system	8.1%	8.7%
XI	Diseases of the digestive system	0.7%	3.3%
XII	Diseases of the skin & subcutaneous tissue	0.0%	0.2%
Xiii	Musculoskeletal	0.3%	0.8%
XIV	Diseases of the genitourinary system	1.6%	2.2%
XV	Pregnancy, childbirth & the puerperium	0.0%	0.0%
XVI	Certain conditions originating in the perinatal period	0.0%	0.5%
XVII	Congenital malformations	0.2%	0.4%
XVII	Symptoms, signs and abnormal findings, nec	0.0%	0.6%
XX	External causes of morbidity & mortality	5.8%	5.8%
Total		100.0%	100.0%

Simulated deaths are for the projection period 1/7/01 to 30/6/03. Actual deaths are those recorded in calendar year 2002 (ABS 2008). As in C6, the differences are large.

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Glossary

ABS	Australian Bureau of Statistics
ACFI	Aged Care Funding Instrument
AIHW	Australian Institute of Health and Welfare
DoHA	Department of Health and Ageing
SDAC	Survey of Disability Ageing and Carers
SLA	Statistical local area