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The probability of nursing home use over a lifetime

Abstract

This paper further develops the life table models used in the USA by taking advantage of the superior data available in Australia. The probabilities of nursing home use over a lifetime are estimated for various ages by sex. The results show that over one-third of the members of a female birth cohort will eventually enter nursing homes for long-term care at least once. The corresponding probability for males is one in five. A woman at age 65 faces a probability as high as 39% of using a nursing home for permanent care before her death compared with 25% for a man at age 65.

Introduction

How much does an average person use nursing home services over his or her lifetime? This question is of a considerable interest to many members of society. An individual may be interested in this information for his or her own retirement planning, or in considering the likely care needs of a family member. Government policy makers find this information useful for long-term planning purposes, insurance companies in formulating and appraising long term care insurance products, and superannuation funds in considering inclusion of provision for long-term care in future. Service providers, too, may be interested in knowing the answer to this question in order to develop long-term service delivery strategies. While undoubtedly an important and interesting question, it has remained largely neglected by Australian demographers, gerontologists and health services researchers.

Nursing homes provide frail older people with accommodation, 24-hour nursing care and personal care. Traditionally, nursing home care dominated the aged care system in Australia. Since the mid 1980s, the government has gradually shifted the balance toward less costly services such as hostel and community-based care (AIHW 1995; Gibson 1996, 1998). Currently, there are about 74,000 nursing home beds available to frail older Australians. This level of provision equates to about 49 beds per 1,000 people aged 70 and over, compared with over 68 beds per 1,000 people aged 70 and over in 1985. The provision ratio is set to be further reduced to 40 beds per 1,000 people aged 70 and over (DHFS 1996; Gibson 1996). In 1995–96 the Commonwealth Government spent about $2.0 billion on nursing home care, comprising over 60% of total expenditure on aged care services in that year. In addition to government expenditure, resident fees totalled over $1.2 billion (SCRCSSP 1997). At least in terms of expenditure, nursing home care can still be seen as dominating the aged care system.

The utilisation of nursing home care is a function of both probability of admission and duration of stay. The 'risk' of nursing home use is conventionally perceived as being measured by the proportion of older people in nursing homes at a point in time. For example, it was reported that 5% of people aged 70 and over were in a nursing home on any one day in 1994–95 (SCRCSSP 1997). This cross-sectional measurement strategy systematically underestimates the use of nursing home care by the older population over a lifetime. Some commentators go so far as to brand the point in time (prevalence) data as a 'fallacy', warning that it could seriously distort our perceptions of the need for nursing home care (Kastenbaum & Candy 1973; Palmore 1976; McConnel 1984). Such misperceptions could significantly undermine service planning and provision, and misinform individuals attempting to plan for a range of eventualities in later life. A more realistic appraisal of the lifetime risk of nursing home use is clearly required.

This paper employs life table models to fulfil this task. The paper develops the life table model used by previous studies. Two conceptually different measurements are outlined.

1. The probability of a person at a given age entering a nursing home at least once at and beyond the given age if this person has never used a nursing home before.
2. The probability of a person at a given age residing in a nursing home at least once at and beyond the given age regardless of this person's previous use of nursing home care.

Previous studies

Although something of a neglected area in Australia, US researchers have devoted considerable attention to the probability of nursing home use over a lifetime. Murtaugh and his associates (1990) described three broad sets of methods employed in estimating the lifetime risk of nursing home use. The first uses place of death derived from death certificates to establish the probability rate. The second strategy involves the construction of an institutional history through longitudinal follow-up studies. The third employs life table techniques to model lifetime experience based on cross-sectional data.

Kastenbaum and Candy (1973) initially developed the death certificate method. By extracting place of death from a sample of death certificates registered over a period of time (normally a year), the ratio of nursing home deaths to total deaths is calculated to represent the lifetime probability of nursing home use. Based on all death certificates in the metropolitan Detroit area during the 1971 calendar year, Kastenbaum and Candy estimated that there was about one chance in five that people aged 65 would use a nursing home at least once prior to death. This method was subsequently used by a number of other people in the USA, yielding results ranging from 20% to 33% (Ingram & Barry 1977; Lesnoff-Caravaglia 1978; Zappolo 1981; Murtaugh 1990). Only one such study has been done in Australia. Based on an analysis of death certificates in Victoria, Anna Howe (1982) reported that 12% of deaths at age 50 and over were recorded in nursing homes, rising to 32% of deaths at age 85 and over.

Kastenbaum and Candy's methodology has a serious weakness that has been widely criticised (Vicente 1979; McConnel 1984; Cohen et al. 1986; Liang & Tu 1986; Murtaugh et al. 1990). The approach is based on the assumption that people who have used a nursing home at least once would eventually die in a nursing home, and that nursing home use would thus be accurately reflected on the death certificate. This is not, however, the case; many people who have used a nursing home may die in either a hospital or another place. This group of people are necessarily excluded from the calculation, therefore leading to an underestimate of the probability of nursing home use.

Keeler et al. (1981) reported that 50% of all discharges in 1976 died shortly after leaving a nursing home. In Australia, Liu (1996) found that about one-quarter of the members of an admission cohort left nursing homes alive within one month from the admission and one-third within four months. Both these sets of evidence cast serious doubts over the usefulness of the annual incidence estimates based on death certificates, as they suggest that a substantial proportion of persons who have been resident in nursing homes will die elsewhere.

Palmore (1976), using a 20-year longitudinal study of 207 persons (aged 60 and over), re-estimated the total chance of admission to a long-term care institution of older people before death as about one in four. He believed that his finding was compatible with Kastenbaum and Candy's when those who returned home before death were taken into account. Palmore also pointed out that his calculation might miss some cases in which a person was in a long-term care institution during the study period but returned home before death. Vicente et al. (1979) used a more sophisticated follow-up study and found that the risk of admission to a long-term care institution was 46% for people aged 65 and over. Murtaugh et al. (1990) used data from the 1982–1984 National Long-Term Care Surveys to estimate the risk of nursing home use and reported that 37% of individuals dying between 1982 and 1984 used nursing home care sometime after turning 65.

The longitudinal approach, however, also has its critics. McConnel (1984) claimed the approach ignored the vast changes in the environment that conditions the nursing home admission decision over the period of measurement. These changes are difficult to take into account in the computation of risk and obscure the interpretation of what the risk refers to. McConnel (1984:195) argued that, 'prospectively, we are afforded the luxury of assuming invariance in the future environment or predicting specific structural changes which will condition our extrapolation of outcomes. Retrospectively, such a methodological position is hardly justified'.

Since the 1980s, the life table technique has been used to estimate the lifetime risk of nursing home admission. This method uses cross-sectional data to simulate the lifetime experience of a population cohort. As a result, it avoids the type of underestimation associated with the use of death certificates. Furthermore, it does not require the lengthy time periods involved in a longitudinal design.

McConnel (1984) applied a double-decrement (death and nursing home admission) life table to national data in order to estimate the lifetime risk of nursing home residency in the USA. His computation method involved three steps.

A. Establishing the 1976 age-specific net incidence rates of nursing home admission.

B. Estimating the expected occurrences of nursing home admission by applying the estimated age-specific incidence rates (from A) to the stationary population.

C. Calculating the probability (risk) of nursing home admission at an exact age by dividing the total expected occurrences at and beyond the age of the cohort (from B) with the number of survivors at the exact age in the population life table.

From this study, McConnel found that the lifetime risk of institutionalisation at age 65 was about 63%, the highest estimate ever produced. This figure is generally held to be an overestimation (Liang & Tu 1986).

McConnel's study has three major limitations stemming from data problems. Firstly, he estimated the age-specific prevalence rates for 1976 by using data from two separate surveys in different years. Secondly, the age-specific prevalence rates for residents who had resided in a nursing home for less than one year were used to allocate the total admissions among the age groups due to a lack of information on age at admission. Thirdly, not all re-admissions were excluded due to an absence of historical data, which led to an overestimation of the risk of nursing home use (McConnel 1986).

McConnel also had some computational and interpretation problems. He did not distinguish the institutionalised and non-institutionalised populations, and failed to identify the actual population at risk. To correct McConnel's computational errors, Liang and Tu (1986) estimated the population at risk of the 'event' and the non-institutionalised survivors. These adjustments led to a downward revision of the lifetime risk at age 65 from 63% (McConnel 1984) to 36%, a finding much closer to those reported by previous researchers (Vicente et al. 1979).

Liang and Tu (1986) had, however, inherited the data limitations from McConnel's study. In addition, their analysis had a number of implausible assumptions. One of them was the assumption that death rates would be equal between those who had been a resident in a nursing home and those who had not. This assumption is intuitively unsound because people who have used a nursing home would be expected to have a higher death rate. The impact of this bias on the estimate increases with age due to the increased proportion of people who enter a nursing home. This is particularly true in Australia where all nursing home admissions are subject to rigorous assessment by Aged Care Assessment Teams to ensure that only frail persons requiring nursing care are eligible for nursing home admission. It is therefore reasonable to suggest that people who have used nursing home care in Australia would have higher death rate than those who have not.

There were two groups of people who, in these data, were not at risk of first admission to a nursing home among the 1976 population. One group consisted of those who were currently in a nursing home and the other consisted of those who were currently not in a nursing home but had had at least one previous stay in a nursing home. Liang and Tu captured the first group in their analysis, but overlooked the second. Such a bias would lead to the underestimation of age-specific institutionalisation rates, and this, in turn, would result in an underestimation of the lifetime risk of nursing home residency.

Liang and Tu (1986) suggested that an increment-decrement life table technique would be a preferable option if age-specific distributions of institutional status in two consecutive years, and age-specific death rates by institutional status, were both available. But multiple admissions of an individual within a year remain a problem for such an approach.

Another methodological approach worthy of note was recently developed by Carlson and her associates (Carlson et al. 1995) in the USA. This methodology represents a development on both the death certificate and the longitudinal study methods discussed earlier. It enables the derivation of a sample of decedents who used nursing homes at some time during their lives by selecting and reweighing a sample of discharge data. This methodology is particularly useful when nursing home data other than discharges are not available. The methodology does rely, however, on the assumption that most people who use nursing homes die at the end of their stay or shortly thereafter. Such an assumption is not supported by Australian experience (Liu 1995:76). In addition, this method involves a very complex process and requires additional mortality information.

Conceptual development

The task of determining how to measure the probability of nursing home use requires some decisions as to how key elements are defined; these decisions will influence the results obtained. There are two fundamental elements in the concept of lifetime risk (probability) of nursing home use. One is the target population or population at risk (denominator). The other is the 'events' of nursing home use (numerator).

The population potentially 'at risk' can be divided into three exclusive groups as shown in Figure 1. The first group consists of people who are not in a nursing home now and have not used a nursing home before. The second comprises people who are not in a nursing home now but have used a nursing home before. The last group is made up of all current nursing home residents. Any combination of the three groups can produce a conceptually different result.

The definition of 'event' is also complicated, as indicated earlier, by the fact that an individual may make multiple uses of nursing home care over his or her lifetime.

The previous studies all claimed to be measuring the lifetime risk (probability) of nursing home use and yet they measured somewhat different things depending on the choice of methodology and/or types of data. This point can be clarified by a few examples. The death certificate method effectively used the total population (i.e. Group 1 plus Group 2 plus Group 3 in Figure 1) as the target population represented by decedents and the last episode of nursing home stay as the event (Kastenbaum & Candy 1973). The follow-up studies generally used the first two groups of people

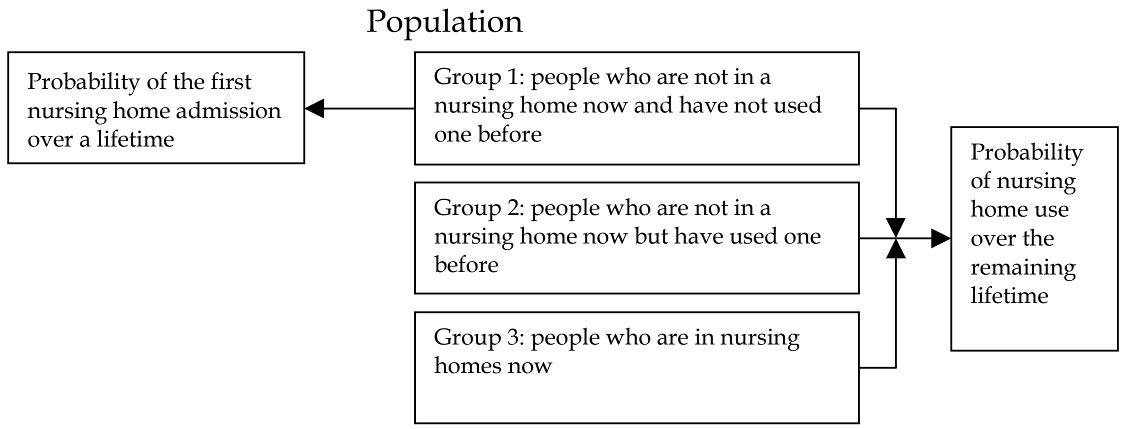

Figure 1: Population grouping and probability of nursing home use

(non-residents) as the target population and the last episode of nursing home stay as the event (Palmore 1976; Cohen et al. 1986).

The life table methods employed in previous studies have used the first nursing home admission over a lifetime as the event but employed varying target populations. McConnel (1984) used all three groups as the target population while Liang and Tu (1986) attempted to use the first group only.

This definitional inconsistency contributed to the great variation in the findings emerging from different studies and inevitably led to confusion and incompatibility when researchers attempted to reconcile the results. Precise definitions are an essential step in overcoming these problems. McConnel (1986:195) is the only person to date who has paid special attention to issues of definition. He defined 'the lifetime risk of nursing home residency' as 'the risk of the event of institutionalisation which confronts a cohort of individuals as that cohort ages'. Unfortunately this definition does not clearly spell out the 'event'. As mentioned in the introduction, this paper employs two definitions of the lifetime risk of nursing home use and accordingly calculates two sets of probabilities.

The first definitional construct is the probability of a person at a given age entering a nursing home at least once at and beyond the given age if this person has never used a nursing home before. It is a modification or refinement of McConnel's definition. The target population is those who have never entered a nursing home (the first group). The ‘event’ is the first nursing home admission over a lifetime. It can be interpreted as the probability of an average person entering a nursing home at least once sometime after turning a given age if this person has never been to a nursing home before.

This paper also initiates a new definitional construct—the probability of a person at a given age residing in a nursing home at least once at and beyond the given age regardless of this person’s previous use of nursing home care. Its target population is the total of the three groups. The ‘event’ is defined as the first episode of stay in a nursing home after turning a given age. The episode may begin before the given age. For example, the current residents who are at the given age and beyond, and entered the nursing home at a younger age are treated as ‘events’ in this new construct.

The new construct may not be so different from the old one (i.e. *the probability of a person at a given age entering a nursing home at least once at and beyond the given age if this person has never used a nursing home before*) at age 65 but the difference will increase with age. If all residents were to eventually die in a nursing home, this measurement strategy would yield the same probability estimate as that derived from the death certificate method. It would also be equivalent to the estimate based on the longitudinal study method if all people who had resided in a nursing home at some time before death were captured during the follow-up interview. This new measurement construct is particularly useful for service provision and budgetary planning.

Life table models

To estimate these two sets of probabilities, this paper uses life tables to model the lifetime experience of nursing home residence for a population cohort. The life table models in this paper combine the strengths of the models used by McConnel (1986) and Liang and Tu (1986). Adjustments are also made to overcome the deficiencies in their models, in part aided by the nature of the Australian national nursing home database, discussed in more detail in the following section. There are thus some distinct features and developments in this paper compared with earlier studies. Firstly, this paper uses single years of age for people at age 65 and older rather than 5-year age groups. Secondly, life tables are constructed for males and females separately to reflect the very different use patterns by sex. Thirdly, nursing home admissions by age for each sex are directly derived from nursing home data in contrast to the indirect estimations used by McConnel (1986) and Liang and Tu (1986) due to the unavailability of age-specific admissions data in the US data. Finally, for the first time, the first admissions are directly derived from historical data in this paper. All these features combine to improve the accuracy of the estimates reported here.

There are four basic steps in computing the lifetime risk of nursing home admission. The general life table notations are followed.

A. Calculate the age-specific admission rates based on cross-sectional data.

$$r_x = Adm_x / (Pop_x \bullet \lambda_x) \quad (1)$$

Adm_x represents the number of people admitted to a nursing home in 1994–95 for the first time over their lifetime between age x and x+1 for each sex. These figures are directly derived from national nursing home data.
Population data (Pop_x) are obtained by averaging the ABS (1996) estimated resident populations by age and sex at 30 June 1994 and 1995. If the sex–age-specific proportion of the population who had never resided in a nursing home before 1 July 1994 is denoted as λ_x then the population at risk is $Pop_x \bullet \lambda_x$.
The subscript x represents age throughout the paper.

B. Apply the cross-sectional admission rates to a life table stationary population (L_x) to estimate the number of admissions (events) between age *x* and *x+1* (Est_adm_x) for each sex in a population cohort. The Australian life table for 1993–95 is used here (ABS 1997). It is plausible to assume that the proportion of the stationary population in the life table who had never used nursing home care before age *x* is the same as the proportion of the population in 1994–95 (λ_x). The expected admissions can be estimated as:

$$Est\_adm_x = (L_x \bullet \lambda_x) \bullet r_x = (L_x \bullet \lambda_x) \bullet Adm_x / (Pop_x \bullet \lambda_x)$$

$$Est\_adm_x = L_x \bullet Adm_x / Pop_x \quad (2)$$

λ_x is cancelled out and therefore it can be ignored for computational purpose. The total number of admissions at and beyond an age x is:

$$T\_adm_x = \sum_{i=x}^{\infty} Est\_adm_i \quad (3)$$

C. Estimate the cohort population at risk of the admission (rl_x), or survivors at age *x* who have never used a nursing home before.

$$rl_{x+1} = rl_x - Est\_adm_x - cd_x \quad (4)$$

where cd_x is the number of deaths among those who have never entered a nursing home before.
All members of the cohort are at risk of future nursing home use at birth. That is: $rl_o = l_o$

The value of cd_x is estimated differently for persons aged under 65 compared with those 65 and older. There is only a minimal proportion of people entering a nursing home before age 65. It is reasonable to assume that the death rates are equal between those who have had at least one nursing home admission and those who have not by age 65. The number of people who died under age

65 without experiencing a nursing home residence is thus:

$$cd_o = (l_o - Est\_adm_o / 2) \bullet q_o \qquad \text{(aged between 0 and 64 years)} \qquad (5)$$

where q_o (the mortality rate between birth and age 64) and l_o are from the population life table.

It is assumed that the number of admissions are evenly distributed in the age interval. That is, those people who enter a nursing home in an age interval are at risk for a half of the interval of death without entering a nursing home and for the other half of the interval they face the risk of death after having at least one admission.

From age 65, the deaths (nd_x) among those who have had at least one admission are computed first.

$$nd_x = (nl_x + Est\_adm_x / 2) \bullet nq_x \qquad (x>64) \qquad (6)$$

$$nl_x = l_x - rl_x, \quad (nl_o = 0) \qquad (7)$$

$$cd_x = (l_x - l_{x+1}) - nd_x \qquad (8)$$

where nl_x represents those persons who have been in a nursing home before and survive to age x, l_x and l_{x+1} are taken from the relevant Australian life table and nq_x is the estimated mortality rate for those who have had at least one stay in a nursing home or are currently in a nursing home (i.e. Group 2 and 3 in Figure 1). The estimate was derived from the nursing home database, employing the assumption that the probability of dying among those who had been admitted to a nursing home but had since left (Group 2 in Figure 1) is the same as the probability of dying among those who are currently resident in a nursing home. Deaths in nursing homes are, however, often under-reported and this may lead to an overestimate of the lifetime risk (Liu 1996).

D. Estimate the lifetime risk (LR_x) of at least one nursing home admission from age x among those who have never been admitted to a nursing home

$$LR_x = T\_adm_x / rl_x \qquad (9)$$

The above computational procedure is further illustrated in the appendix.

The computation of the *probability of nursing home use in the remaining lifetime* (irrespective of whether have already been in a nursing home) for each age x is much simpler.

$$\hat{r}_y = \hat{A}dm_y / Pop_y \qquad (y \geq x) \qquad (10)$$

$$\hat{E}st\_adm_y = L_y \bullet \hat{r}_y \qquad (11)$$

$$\hat{T}\_adm_x = \sum_{y=x}^{\infty} \hat{E}st\_adm_y \qquad (12)$$

$$\hat{L}R_x = \hat{T}\_adm_x / l_x \qquad (13)$$

where the symbol '^' indicates that the current measurement is different from that used in formula (1) to (9).

It is important to point out that the observed admissions ($\hat{A}dm_y$) in formula (10) include two groups. One includes the existing residents at the beginning of the study year who have turned age y and who entered a nursing home before age x. The other comprises those who entered a nursing home at age y during the study year (1994–95) and these are their first time admissions after turning age x. This group can not have had previous admission at age x and over while they may have previous nursing home admissions prior to age x. The value of $\hat{A}dm_y$ depends on the age x for which the calculation is being made. Each $\hat{L}R_x$ is based on a unique life table. For each age x, a unique set of $\hat{A}dm_y$ s are generated to produce the other parameters in the life table.

Data and scope

A successful application of the above life table models requires comprehensive information on nursing home admissions. The USA studies discussed earlier were generally disadvantaged by the lack of availability of these data. This paper uses Australian data from a national Nursing Home Payment System (NHPS) which contains historical unit records for all residents.[1] Each individual resident carries a unique identification number over his or her lifetime. Date of birth and sex are recorded for each resident. An individual can have multiple admissions over a period of time; date of admission and date of separation for each stay are reported. Therefore, age at any given time (for example, at admission and separation) can be established. The number of admissions in a year can be derived for each sex–age group. More importantly, the admissions of an individual resident can be put in a sequence according to the date of admission so that the first admission can be selected and re-admissions can be eliminated.[2] These aspects of the Australian nursing home database have significant advantages for life table.

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1 The current nursing home database was established at the beginning of 1988. The completeness of coverage for residents admitted and discharged prior to that date is uncertain.

2 It is also possible for a resident to transfer from one home to another without leaving the nursing home system. The nursing home database records such a transfer as a new admission for some administrative purposes. In this paper, however, such episodes are treated as one admission. In instances where the gap between the discharge date of one episode and the admission date of the next is less than two days, these two episodes are conjoined to form one admission, the second episode being regarded as a continuation of the first one.

Australian nursing homes provide respite care as well as permanent care (or long-term care). Respite care provides short-term accommodation and care for people who need a 'break' away from their usual care arrangements in order to maintain such people in the community for as long as possible. A person is entitled to a total of nine weeks of respite care in the same nursing home in any 12-month period following his or her first respite admission. Respite residents represented less than 1% of the total residents at any point in time in 1994–95, although respite admissions accounted for about 20% of total admissions (including multiple admissions) during the year. The utilisation patterns are quite different for respite and permanent care (Liu & Choi 1996). The number of respite admissions is, however, too small to be analysed separately with life table models here. The text of this paper focuses on permanent care, presenting information on permanent care alone, but the tables present data both on permanent care alone, and on permanent and respite care in combination.

The population data for this paper are from ABS (1996) estimated resident population at 30 June 1994 and 1995. ABS (1997) population life tables for 1993–1995 are also used here.

In terms of nursing home use, the population is a heterogeneous group (Howe 1982; Kemper et al. 1991; Liu 1996). It is unfortunate that, due to data absence, this paper is unable to provide a further refinement of the current methodology by incorporating those factors (such as marital status, housing status, or living arrangement prior to admission to a nursing home) that are known to influence nursing home use patterns.

Results

1. Probability of the first nursing home admission over a lifetime

Based on the assumption that the nursing home utilisation pattern prevailing in 1994–95 and the age-specific survival rates between 1993 and 1995 will continue indefinitely, the life table reveals that a newborn baby girl faces a 34% chance of entering a nursing home for permanent care at least once over her lifetime (Table 1). In other words, over one-third of the members of a female birth cohort will eventually enter nursing homes for long-term care at least once if the admission probabilities and mortality rates continue at the levels applying at birth. The corresponding probability for males is one in five.

It is both more interesting and more pertinent to look at older ages given that people aged under 65 are relatively unlikely to enter a nursing home for the aged. For a woman at age 65, who has not previously been to a nursing home for permanent care, the probability of entering a nursing home for permanent care at some time prior to death is 37% (only marginally higher than that at birth). For men at age 65, the probability is 24%. These figures can usefully be compared with the 20% to 33% range (for both sexes together) produced by the death certificate method (Lesnoff-

Caravaglia 1978); the 22% to 46% range generated by those studies based on longitudinal data (Palmore 1976; Vicente et al. 1979; Zappolo 1981; Kemper & Murtaugh 1991); and the 34% to 63% range yielded by previous life table methodologies (McConnel 1984; Cohen et al. 1986; Liang & Tu 1986).

Table 1: Probability of first nursing home admission over a lifetime, age by sex, Australia 1994–95

	Age (years)							
Type of care by sex	**0**	**65**	**70**	**75**	**80**	**85**	**90**	**95**
Permanent care								
Males	0.20	0.24	0.26	0.29	0.32	0.36	0.38	0.37
Females	0.34	0.37	0.39	0.41	0.44	0.46	0.46	0.37
Permanent and respite care combined								
Males	0.21	0.25	0.27	0.30	0.34	0.37	0.40	0.39
Females	0.35	0.39	0.41	0.43	0.46	0.48	0.48	0.40

Notes

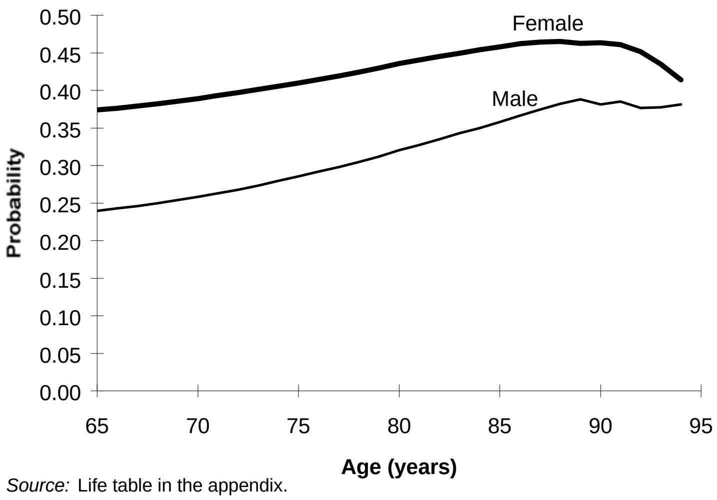
1. The databases used in this analysis were the DHFS ACCSIS system 1997; ABS 1996:15; ABS 1997:73–74.
2. The data in this table are estimated using life table models based on 1994–95 hostel and nursing home use patterns. These life tables are not all included in this report but are available on request.

Caution must be exercised, however, in attempting to draw firm conclusions from what are essentially indicative comparisons. The earlier studies were undertaken in the USA where the aged care system, and thus patterns of service use, is considerably different from that in Australia. Moreover, many of those studies did not distinguish nursing homes and other long-term aged care facilities (McConnel 1984; Cohen et al. 1986; Liang & Tu 1986; Palmore 1976). The Australian data reported here relate to nursing homes only and do not include other types of institutional aged care facilities such as hostels, or 'nursing home type patients' in acute hospitals. There are also, as discussed earlier in the paper, definitional and measurement differences among the studies, which influence the results obtained.

The estimated lifetime probabilities in this paper are higher than those from the only other known Australian study undertaken by Anna Howe (1982). For example, she reported the lifetime risk of entering a nursing home in Victoria as 32% at age 85 for both men and women compared with 36% for men and 46% for women in this paper.

The probability of the first nursing home admission over a lifetime displays a striking sex pattern that is consistent with the finding from the study of Murtaugh et al. (1990). It shows that women are much more likely to enter a nursing home than men (Table 1 and Figure 2). It is widely recognised that men are more likely to have the care and support of a spouse and hence are less likely to use a nursing home even if disabled (Murtaugh et al. 1990). The other common explanation for the sex difference is that women live longer and thus have a longer period of exposure to nursing home admission. The life expectancy at birth for women was 5.89 years longer than that for men in 1994–95. This difference reduced at older ages. By age 65, the gap dropped to 3.8 years. After age 91, the difference diminished to less than half a year (ABS 1997:73–74). This trend is consistent with the trend that emerged in this analysis of a narrowing gap between men and women at older ages in the probability of the first nursing home admission over a lifetime (Figure 2).

The lifetime probability of a first nursing home admission increases with age until about age 90 for both men and women. These age patterns are consistent with the findings which emerged from a number of earlier studies (Vicente et al. 1979; Howe 1982; Cohen et al. 1986; Liang & Tu 1986; Murtaugh et al. 1990). Palmore's (1976) study was, however, an exception. It showed no increase in the lifetime risk with increasing age. In general, the need for nursing homes increases with age as a result of greater likelihood of chronic illnesses and deteriorating mental status, and the lower likelihood that support will be available from close relatives.



Source: Life table in the appendix.

Figure 2: The probability of first nursing home admission at various ages and beyond by sex, Australia, 1994–95

The sudden decline in probabilities at the oldest ages (shown in Table 1 and Figure 2 for women in particular) may be affected by a higher mortality rate so that death comes before nursing home admission (Liang & Tu 1986). It has also been suggested that people who survive to a very old age without previous nursing home admissions are less likely to suffer from chronic conditions and hence are less likely to need nursing home care (Cohen et al. 1986).

The age distributions of first admissions for the cohort are also of some interest (Table 2). The vast majority of first nursing home admissions occurred at very old ages for both men and women. For men, over two-thirds of permanent admissions happened after age 80 while less than 3% occurred before age 65. This finding is even stronger among women. Permanent admissions between the ages of 65 and 80 account for about 20% of total admissions, while over 70% of the admissions occur in the next 15 years between the ages of 80 and 95.

Table 2: Cumulative percentage of first nursing home admission over a lifetime, age at admission by sex, Australia 1994–95

	Age (years)							
Type of care by sex	**0**	**65**	**70**	**75**	**80**	**85**	**90**	**95**
Permanent care								
Males	0	2.9	7.4	16.4	32.9	57.3	81.7	95.4
Females	0	1.5	3.8	9.7	22.0	44.9	72.5	93.2
Permanent and respite care combined								
Males	0	3.2	7.8	17.1	33.8	58.0	82.1	95.5
Females	0	1.6	4.0	10.1	22.7	45.7	73.2	93.5

Notes

1. The databases used in this analysis were the DHFS ACCSIS system 1997; ABS 1996:15; ABS 1997:73–74.
2. The data in this table are estimated using life table models based on 1994–95 hostel and nursing home use patterns. These life tables are not all included in this report but are available on request.

Men are likely to enter a nursing home for permanent care at a younger age than are women. The median ages of the first permanent nursing home admission are about 84 years for men and 86 years for women. Admissions before age 80 comprise 33% of the total admissions for men compared with only 22% for women. This sex pattern partly reflects the sex structure of the general population. It has also been suggested that the chronic conditions which are the most common reason for nursing home use become more frequent during the last few years of life. As men die earlier, they are likely to develop these conditions earlier, and hence require earlier admission to nursing home care (Murtaugh et al. 1990).

2. Probability of nursing home use in the remaining lifetime

At birth, there are no differences between the probability of the first nursing home admission over a lifetime and the probability of nursing home use in the remaining lifetime (Table 3). For the other ages, the latter estimates, as would be expected, are much higher.

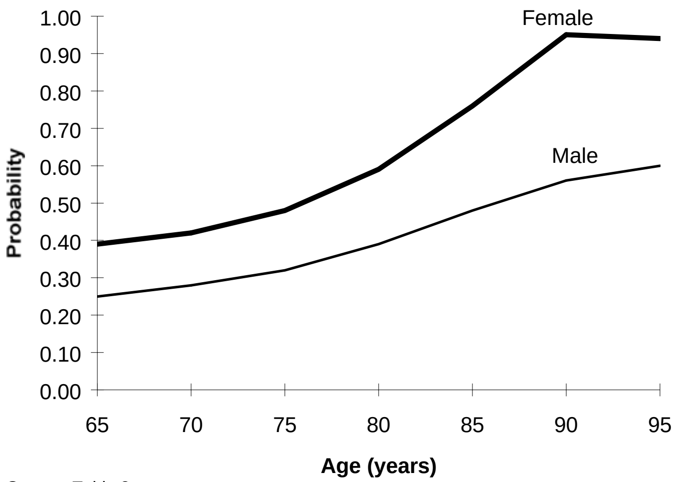
A woman at age 65 faces a probability as high as 39% of using a nursing home for permanent care before her death. The corresponding figure for a man is 25%. As was found to be the case for the probability of the first nursing home admission, the probability of nursing home use in the remaining lifetime is higher for women than that for men at all ages (Table 3 and Figure 3). Unlike the lifetime risk of first nursing home admission, however, the sex difference increases substantially with age (the highest age group being an exception). The remaining lifetime probability increases with age for both sexes, but the rate of increase is greater for women. By age 90, women reach the highest level of 95%. That is, almost all women at age 90 will use a nursing home for permanent care some time before their death. For men, the highest probability is 60% at age 95. These statistics suggests that nursing home use is almost unavoidable for women at very advanced ages, and quite likely for men at very old ages.

Table 3: Probability of nursing home use over the remaining lifetime, age by sex, Australia 1994–95

	Age (years)							
Type of care by sex	**0**	**65**	**70**	**75**	**80**	**85**	**90**	**95**
Permanent care								
Males	0.20	0.25	0.28	0.32	0.39	0.48	0.56	0.60
Females	0.34	0.39	0.42	0.48	0.59	0.76	0.95	0.94
Permanent and respite care combined								
Males	0.21	0.27	0.30	0.34	0.40	0.49	0.57	0.61
Females	0.35	0.41	0.44	0.50	0.61	0.78	0.97	0.95

Notes

1. The databases used in this analysis were the DHFS ACCSIS system 1997; ABS 1996a:15; ABS 1997a:73–74.
2. The data in this table are estimated using life table models based on 1994–95 hostel and nursing home use patterns. These life tables are not included in this report but are available on request.



Source: Table 3.

Figure 3: The probability of using a nursing home for permanent care at various ages and beyond by sex, Australia, 1994-95

Discussion

This paper fills a gap in Australian knowledge of nursing home use patterns from a lifetime perspective, and contributes to the methodological development of life table models of nursing home use. It employs life table models to estimate the probability of the first nursing home admission over a lifetime and the probability of nursing home use in the remaining lifetime. For the first time, historical nursing home data that contains all admissions for all residents have been used in the life table models. This refinement undoubtedly raises the accuracy of the estimates above earlier efforts, providing a useful technical contribution to the relevant literature.

The new definitional construct of the probability of nursing home use over the remaining lifetime provides a significant methodological advance over that employed in the existing literature. It is more comprehensive than previous measures, incorporating both existing residents and new entrants. Because it takes the total population as the target population, its computation process is straightforward and the results are more accurate. This construct thus provides more useful information for service provision planning and budgetary forecasting. Such information can be obtained neither from cross-sectional data nor from the first construct, the probability of the first nursing home admission over a lifetime. The estimates of the probability of nursing home use in the remaining lifetime once again demonstrate that the death certificate method significantly underestimates the lifetime risk of admission to a nursing home.

Apart from technical and methodological advancements, the paper also yields an important substantive finding. The probability of nursing home admission over a lifetime is considerably greater than that commonly perceived based on a point-in-time prevalence rate. For example, the analysis revealed that the chance of entering a nursing home after turning age 65 is actually one in three, despite the fact that only 3% of people aged 65 and over were resident in a nursing home on any one day in 1994–95. In other words, a much larger number of older people than has often been recognised are at risk of nursing home admission at some point in their lives. This argument is strengthened by the estimates of the probability of nursing home use in the remaining lifetime. This new measurement reveals that over 95% of women will spend some time in a nursing home after turning age 90. Over a lifetime, women are much more likely to use nursing home care than are men. Age is a good predictor of the probability of nursing home admission. In general, the older a person is, the higher probability of nursing home admission he or she faces (extreme old age—95 and over—is excepted).

Such findings are of considerable significance in terms of planning for the availability and financing of residential aged care. This is the case not only for Australia, but also internationally, where the financing of aged care has emerged as a critical question for many countries, with a range of policy responses (particularly around various forms of long-term care insurance) being put into place. This finding also has implications for individuals in terms of retirement planning. It becomes of particular relevance to individuals in Australia with the recent introduction of an income-tested resident contribution to nursing home care (SCRCSSP 1997).

It is important to reiterate that there are important assumptions underlying these calculations, and that any interpretation and extrapolation of the findings must keep these assumptions in mind. Firstly, the life tables are based on the nursing home use patterns prevailing in 1994–95; a forward projection based on these estimates is valid only if the patterns of nursing home supply and use are statistically comparable to that of 1994–95. In particular, nursing home use patterns in Australia appear to be basically supply driven. The estimated probabilities do not represent 'need' or 'demand' but the patterns of utilisation only, a pattern which is constrained by levels of nursing home provision. A relatively small change in the supply of nursing home care could significantly change the levels of the probabilities; thus for example a reduced level of provision would necessarily reduce the likelihood of lifetime nursing home use.

Secondly, those people who have been in a nursing home are treated equally in terms of mortality rates regardless of whether they remained in the nursing home. This assumption may not be accurate because many people return to the community after a very short stay and they may have quite a different mortality pattern (Liu 1996). Fortunately, this potential source of error affects only the estimates of the probability of the first admission beyond age 65. The estimates of the probability at birth and at age 65 remain unaffected. Thirdly, owing to the likelihood that a proportion of residents who die shortly after leaving the nursing home (in particular those transferred to acute care hospitals) are recorded as live discharges, the death rates among nursing home residents may be underestimated.

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Appendix A

Life table for estimating lifetime risk of permanent nursing home admission, males, Australia,1994–95

Age	Observed admissions	Population	Admission rates	Life table stationary population	Estimated admissions	Total estimated admissions	Mortality rates of those have had at least one admission	Survivors in population life table	Survivors without a nursing home admission	Deaths after having at least one admission	Deaths without an admission	Lifetime risk
x	Adm_x	Pop_x	Adm_x/Pop_x	L_x	Est_Adm_x	T_Adm_x	nq_x	l_x	rl_x	nd_x	cd_x	LR_x
0	754	8,012,500	0.0001	6,213,039	585	20,055	na	100,000	100,000	53	18,205	0.20
65	103	70,114	0.0015	80,968	119	19,470	0.2762	81,742	81,211	173	1,397	0.24
66	141	69,123	0.0020	79,330	162	19,351	0.2586	80,172	79,695	149	1,559	0.24
67	149	67,346	0.0022	77,552	172	19,190	0.2672	78,464	77,974	153	1,696	0.25
68	180	65,973	0.0027	75,631	206	19,018	0.3042	76,615	76,107	189	1,804	0.25
69	202	62,871	0.0032	73,564	236	18,812	0.3003	74,622	74,097	200	1,940	0.25
70	242	59,470	0.0041	71,352	290	18,575	0.2567	72,482	71,920	188	2,096	0.26
71	278	56,365	0.0049	68,995	340	18,285	0.2888	70,198	69,534	248	2,180	0.26
72	284	53,085	0.0053	66,498	356	17,945	0.2879	67,770	67,013	274	2,292	0.27
73	293	50,755	0.0058	63,865	369	17,589	0.3271	65,204	64,366	340	2,359	0.27
74	347	46,531	0.0075	61,100	456	17,220	0.3402	62,505	61,638	381	2,451	0.28
75	362	40,031	0.0090	58,200	526	16,765	0.3313	59,673	58,732	411	2,558	0.29
76	396	34,919	0.0113	55,160	626	16,238	0.3645	56,704	55,647	519	2,593	0.29
77	418	32,808	0.0127	51,978	662	15,613	0.3666	53,592	52,429	562	2,690	0.30
78	464	31,146	0.0149	48,660	725	14,950	0.3800	50,340	49,077	626	2,755	0.30
79	489	29,042	0.0168	45,222	761	14,226	0.3890	46,959	45,598	698	2,791	0.31
80	585	26,267	0.0223	41,690	928	13,464	0.4035	43,470	42,045	782	2,788	0.32
81	560	22,964	0.0244	38,096	929	12,536	0.4096	39,900	38,328	851	2,761	0.33
82	556	19,640	0.0283	34,479	976	11,607	0.4314	36,288	34,638	949	2,665	0.34
83	569	16,788	0.0339	30,883	1,047	10,631	0.4504	32,674	30,997	1005	2,565	0.34
84	532	14,282	0.0373	27,355	1,019	9,584	0.4584	29,104	27,386	1042	2,436	0.35
85	518	11,910	0.0435	23,943	1,041	8,565	0.4349	25,626	23,931	979	2,360	0.36
86	465	9,720	0.0478	20,691	990	7,523	0.4693	22,287	20,530	1074	2,083	0.37
87	442	7,909	0.0559	17,641	986	6,534	0.4469	19,130	17,457	981	1,956	0.37
88	395	6,421	0.0615	14,827	912	5,548	0.4686	16,193	14,515	1023	1,664	0.38
89	399	5,025	0.0794	12,276	975	4,635	0.5068	13,506	11,939	1052	1,362	0.39
90	266	3,820	0.0696	10,003	697	3,661	0.4905	11,092	9,601	922	1,208	0.38
91	257	2,882	0.0892	8,017	715	2,964	0.5048	8,962	7,697	837	1,007	0.39
92	181	2,236	0.0809	6,313	511	2,249	0.4937	7,118	5,975	705	860	0.38
93	140	1,632	0.0858	4,882	419	1,738	0.4899	5,553	4,603	575	726	0.38
94	114	1,059	0.1077	3,704	399	1,319	0.5207	4,252	3,459	517	542	0.38
95	242	2,077	0.1165	7,898	920	920	0.5254	3,193	2,518	1595	1,598	0.37

na Not applicable.

Note: Columns nq_x , l_x , rl_x and LR_x are measurements for an exact age such as 0, 65 … 95 and the other columns for an age interval such as 0–<65, 65–<66 … 94–<95 and 95+.

Sources: ABS 1996, 1997; HFS 1997 unpublished data.

Formula:

$$Est\_adm_x = L_x \bullet Adm_x / Pop_x \qquad T\_adm_x = \sum_{i=x}^{\infty} Est\_adm_i$$

$$rl_{x+1} = rl_x - Est\_adm_x - cd_x \quad (rl_o = l_o) \qquad nl_x = l_x - rl_x \quad (nl_o = 0)$$

$$nd_x = (nl_x + Est\_adm_x / 2) \bullet nq_x \qquad cd_x = (l_x - l_{x+1}) - nd_x \quad (x>=65) \qquad cd_o = (l_o - Est\_adm_o / 2) \bullet q_o$$

$$LR_x = T\_adm_x / rl_x$$

Appendix B

Life table for estimating lifetime risk of permanent nursing home admission, females, Australia, 1994–95

Age	Observed admissions	Population	Admission rates	Life table stationary population	Estimated admissions	Total estimated admissions	Mortality rates of those have had at least one admission	Survivors in population on life table	Survivors without a nursing home admission	Deaths after having at least one admission	Deaths without an admission	Lifetime risk
x	Adm_x	Pop_x	Adm_x/Pop_x	L_x	Est_Adm_x	T_Adm_x	nq_x	l_x	rl_x	nd_x	cd_x	LR_x
0	617	7,800,757	0.0001	6,338,726	501	33,803	na	100,000	100,000	26	10,393	0.34
65	85	71,217	0.0012	89,143	106	33,301	0.1947	89,581	89,080	126	764	0.37
66	119	72,039	0.0017	88,210	146	33,195	0.2211	88,691	88,209	118	858	0.38
67	120	71,288	0.0017	87,188	147	33,049	0.2082	87,715	87,206	144	926	0.38
68	145	71,380	0.0020	86,068	175	32,902	0.2450	86,645	86,133	130	1,041	0.38
69	178	70,158	0.0025	84,843	215	32,728	0.2111	85,474	84,918	149	1,132	0.39
70	201	67,437	0.0030	83,504	249	32,512	0.2185	84,193	83,570	161	1,237	0.39
71	259	65,408	0.0040	82,044	325	32,263	0.2145	82,795	82,084	188	1,335	0.39
72	319	63,489	0.0050	80,455	404	31,939	0.2097	81,272	80,425	259	1,398	0.40
73	363	63,291	0.0057	78,725	452	31,534	0.2423	79,615	78,622	264	1,541	0.40
74	437	59,234	0.0074	76,842	567	31,083	0.2107	77,810	76,630	349	1,616	0.41
75	462	51,723	0.0089	74,790	668	30,516	0.2331	75,845	74,447	409	1,731	0.41
76	460	47,420	0.0097	72,557	704	29,848	0.2314	73,705	72,048	500	1,830	0.41
77	573	45,920	0.0125	70,127	875	29,144	0.2435	71,375	69,515	545	1,987	0.42
78	618	45,015	0.0137	67,489	927	28,269	0.2344	68,843	66,652	628	2,117	0.42
79	656	43,511	0.0151	64,635	974	27,342	0.2329	66,098	63,609	841	2,123	0.43
80	866	40,982	0.0211	61,560	1,301	26,368	0.2746	63,134	60,511	876	2,308	0.44
81	936	37,182	0.0252	58,268	1,467	25,067	0.2621	59,950	56,903	996	2,403	0.44
82	942	33,005	0.0285	54,766	1,563	23,600	0.2607	56,551	53,033	1163	2,438	0.45
83	947	30,011	0.0316	51,074	1,612	22,037	0.2660	52,950	49,032	1332	2,447	0.45
84	1022	26,884	0.0380	47,218	1,795	20,426	0.2778	49,171	44,973	1442	2,485	0.45
85	977	23,230	0.0421	43,233	1,818	18,631	0.2793	45,244	40,693	1555	2,480	0.46
86	955	20,176	0.0473	39,164	1,854	16,812	0.2808	41,209	36,395	1775	2,320	0.46
87	958	17,444	0.0549	35,063	1,926	14,958	0.3039	37,114	32,221	1831	2,268	0.46
88	923	14,633	0.0631	30,987	1,955	13,033	0.3086	33,015	28,028	1921	2,121	0.46
89	808	12,152	0.0665	26,999	1,795	11,078	0.3176	28,973	23,952	1806	2,117	0.46
90	698	9,933	0.0703	23,163	1,628	9,283	0.3023	25,050	20,040	1938	1,802	0.46
91	657	7,887	0.0833	19,539	1,628	7,655	0.3289	21,310	16,611	1861	1,637	0.46

92	580	6,332	0.0916	16,182	1,482	6,028	0.3340	17,812	13,346	1795	1,412	0.45
93	454	4,956	0.0916	13,138	1,204	4,545	0.3423	14,605	10,452	1699	1,176	0.43
94	384	3,815	0.1007	10,441	1,051	3,342	0.3533	11,730	8,073	1626	892	0.41
95	859	9,104	0.0944	24,277	2,291	2,291	0.3848	9,212	6,130	5373	3,839	0.37

na Not applicable.

Note: Columns nq_x, l_x, rl_x and LR_x are measurements for an exact age such as 0, 65 … 95 and the other columns for an age interval such as 0–<65, 65–<66 … 94–<95 and 95+.

Sources: ABS 1996, 1997; DHFS 1997 unpublished data.