# The probability of using an aged care home over a lifetime (1999–00)

**WELFARE DIVISION**
**WORKING PAPER NUMBER 36**

# The probability of using an aged care home over a lifetime (1999–00)

**Frieda Mason, Zhibin Liu and Peter Braun**

**September 2001**

Australian Institute of Health and Welfare
Canberra

A complete list of the Institute's publications is available from the Publications Unit, Australian Institute of Health and Welfare, GPO Box 570, Canberra ACT 2601, or via the Institute's web site at http://www.aihw.gov.au.

**Suggested citation**

Mason, Lui & Braun 2001. The probability of using an aged care home over a lifetime (1999–00). Welfare Division Working Paper No. 36. AIHW Cat. no. AGE 21. Canberra: AIHW.



Any enquiries about or comments on this publication should be directed to:

Diane Gibson
Australian Institute of Health and Welfare
GPO Box 570
Canberra ACT 2601

Phone: (02) 6244 1190

# Contents

# Acknowledgements

This paper builds on the methodology developed by Zhibin Liu in his earlier paper entitled *The Probability of Nursing Home Use Over a Lifetime* published by the Australian Institute of Health and Welfare in 1998. The authors would like to acknowledge the useful advise and suggestions provided by Dr Diane Gibson, Dr Ching Choi and Dr Richard Madden at the Australian Institute of Health and Welfare, Dr Don Rowland at the Australian National University, and Mr John Walsh at Pricewaterhouse Coopers Actuarial Services Pty Ltd

# Abstract

This paper applies life table models (Liu 1998) to 1999–00 residential aged care data and estimates the probabilities of using an aged care home over a lifetime for Australian men and women at various ages. The results show that, on current patterns of use, there is 0.42 probability that members of a female birth cohort will enter an aged care home for permanent care at least once over their lifetime. The corresponding probability for males is 0.24. A woman at age 65 faces a probability as high as 0.46 of using an aged care home for permanent care before her death compared with 0.28 for a man at the same age.


# Introduction

What is the probability of a person entering residential aged care over their lifetime? This question is of 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 the 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 remained largely neglected by Australian demographers, gerontologists and health services researchers until 1998 when Liu (1998) developed life table models and estimated the probabilities of nursing home use over a lifetime using 1994–95 data. The life table models were also used to estimate the probabilities of hostel use over a lifetime based on 1994–95 data (AIHW 1997:251).

An update of this earlier work is now timely, given the many changes to the aged care service system in Australia since 1994–95. In particular, under a series of reforms to the structure of residential aged care, nursing homes and hostels were amalgamated into one system from 1 October 1997. The new system requires and enables an estimate of the probabilities of using the amalgamated service system as a whole.

Another important change has occurred in the level of supply of residential aged care relative to the size of the older population. There were 3,004 occupied aged care homes in Australia providing a total of 141,162 places as at 30 June 2000. This level of provision equates to 84 places per 1,000 people aged 70 and over, compared with over 93 places per 1,000 people aged 70 and over in 1994 (AIHW 2001:1).

While this paper draws heavily on the methodology and techniques developed in earlier work, some additional refinements and additions have been undertaken. In this paper three conceptually different constructs are presented:

1. The probability of a person at a given age who has never entered an aged care

home entering during their remaining lifetime.

2. The probability of a person at a given age who has never entered an aged care home entering before a specified age.
3. The probability of a person at a given age being in an aged care home at a given age or entering an aged care home during their remaining lifetime.

In this paper, results are presented separately for permanent care only and for permanent and respite care together.

# Method

The task of determining how to measure the probability of using an aged care home requires some decisions as to how key elements are defined; these decisions influence the results obtained. There are two fundamental elements in the concept of lifetime risk (probability) of using an aged care home. One is the 'population at risk' (denominator in the calculation), the other is the 'event' of using an aged care home (numerator in the calculation).

The population at risk can be divided into three exclusive groups as shown in Figure 1. The first group consists of people who are not currently in an aged care home and have not used one before. The second comprises people who are not currently in an aged care home but have used one before. The last group is made up of all the current residents in aged care homes. Different combinations of the three groups in the denominator for the calculations produce conceptually different results.

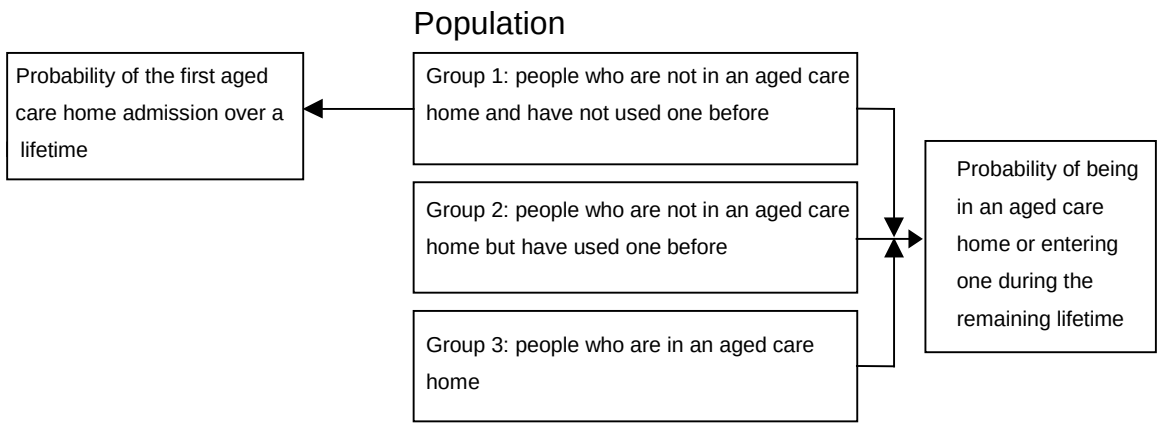



**Figure 1: Population grouping and probability of aged care home use**

The definition of 'event' is also complicated by the fact that an individual may use an aged care home more than once over their lifetime.

It should be pointed out here that many earlier studies did not clearly define the concepts of 'population at risk' and 'event'. They all claimed to be measuring the lifetime risk (probability) of aged care home use and yet measured somewhat different things depending on the choice of methodology and data. The definitional inconsistency contributed to the great variation in findings emerging from different studies and inevitably led to confusion and incompatibility when researchers attempted to reconcile their results. A more detailed account of the problems is provided in Liu's (1998) paper. This paper employs three definitions of the risk of using an aged care home and accordingly calculates three sets of probabilities, which are described below. For more technical aspects of the calculations, see the Technical Appendix.

## Construct 1: The probability of someone in the community[1] entering an aged care home

The first definitional construct is the probability of a person at a given age entering an aged care home at least once during their remaining lifetime if the person has never entered an aged care home. The population at risk consists of those who have never entered an aged care home (the first group in Figure 1). The 'event' is the first admission to an aged care home in the remaining lifetime at a given age. This is calculated directly as the event over the population at risk. It can be interpreted as the probability of an average person entering an aged care home at least once after

[1] The term type of type of 'someone in the community' is used throughout this report to refer to a person who is not in an aged care home and has not used one before.

turning a given age, if this person has not previously been admitted to an aged care home.

### Construct 2: The probability of someone in the community entering an aged care home between two ages

The second definitional construct is a refinement of the first. That is, the probability of a person who has never entered an aged care home at a specified age entering a home for the first time before a subsequent specified age. For example, what is the probability that a man aged 65, will enter an aged care home by age 75. The population at risk remains the same as in construct 1, i.e. people who are not in an aged care home now and have not used one before. The probability is calculated indirectly by excluding those who do not experience the event. Three groups are excluded: people who are in an aged care home at a specified base age, people who die before the specified final age without entering an aged care home and people who are alive at a specified final age but have not entered an aged care home.

### Construct 3: Probability of being in or entering an aged care home

The third definitional construct is the probability of a person at a specified age residing in an aged care home at least once at and beyond that age regardless of the person's previous or current use of an aged care home. The population at risk is the total population alive at the base age, that is the total of the three population groups specified in Figure 1. Again, as in the second construct, the indirect approach is used. However, this method only excludes from the event calculation of those people who die without entering an aged care home. It is not necessary to exclude people who are in an aged care home at the specified base age as they are considered to be part of the event. Nor is it necessary to exclude people who survive to the final age without entering an aged care home, as this construct is a lifetime probability and everyone eventually dies.

The third construct is similar to the first construct at age 65 but the difference increases with age. This measurement construct is particularly useful for service provision and budgetary planning as it can be applied to the whole population at the base age.

## Assumptions and limitations

There are important assumptions underlying these calculations, and any interpretation or extrapolation of these findings must keep these underlying assumptions in mind. Firstly, the life tables are based on the use patterns of aged care homes prevailing in 1999–00; a forward projection based on these estimates is valid only if the patterns of aged care home supply and use are the same as those of 1999–00. The use patterns of aged care homes 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 aged care

home provision. A relatively small change in the supply of residential aged care in the future could significantly change the levels of the probabilities; thus for example a reduced level of provision would necessarily reduce the probability of using an aged care home over a lifetime.

Secondly, those people who have been in an aged care home are treated equally in terms of mortality rates regardless of whether they remained in the aged care home. This assumption may not be accurate because those who return to the community after a very short stay may have quite different mortality patterns to those who remain (Liu 1996). 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 aged care home (in particular those transferred to acute care hospitals) are recorded as live discharges, the death rates among the residents of aged care homes may be underestimated.

Fourthly, the national aged care data system has changed since 1997 and some data held in the old system may have been lost. This is assumed to have only a limited impact on the analysis, although the exact extent is hard to measure.

# Results

## Construct 1: Probability of someone in the community ever entering an aged care home

Based on the assumption that the 1999–00 pattern of usage and the continuation of the 1997–99 age-specific survival rates between 1997 and 1999 will continue indefinitely, the life table reveals that a female at birth faces a 0.42 chance of entering an aged care home for permanent care at least once over her lifetime (Table 1). In other words, over two in five of the members of a female birth cohort will enter an aged care home at least once over their lifetime if the admission probabilities and mortality rates continue at the current levels. The corresponding probability for males is about one in four (0.24).

**Table 1: Probability of someone in the community entering an aged care home, age by sex, Australia 1999–00**

| | Age (years) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Type of care by sex** | **0** | **65** | **70** | **75** | **80** | **85** | **90** | **95** |
| **Permanent care** | | | | | | | | |
| Males | 0.24 | 0.28 | 0.30 | 0.33 | 0.36 | 0.40 | 0.42 | 0.33 |
| Females | 0.42 | 0.46 | 0.47 | 0.50 | 0.52 | 0.54 | 0.54 | 0.48 |
| **Permanent and respite care combined** | | | | | | | | |
| Males | 0.33 | 0.39 | 0.41 | 0.45 | 0.49 | 0.55 | 0.61 | 0.50 |
| Females | 0.59 | 0.64 | 0.67 | 0.70 | 0.74 | 0.79 | 0.87 | 1.00 |

*Notes:*

1. The databases used in this analysis were the DHAC SPARC system 2000; ABS 1999:93–94; ABS 2000:16–33.
2. The data in this table are estimated using life table models based on 1999–00 aged care home use patterns. These life tables are not all included in this report.

It is both more interesting and more pertinent to look at older ages given that people aged under 65 are relatively unlikely to enter an aged care home. For a woman at age 65, who is not in and has not previously been in an aged care home for permanent care, the probability of entering an aged care home for permanent care prior to death is 0.46 (only marginally higher than that at birth). For men at age 65, the probability is 0.28.

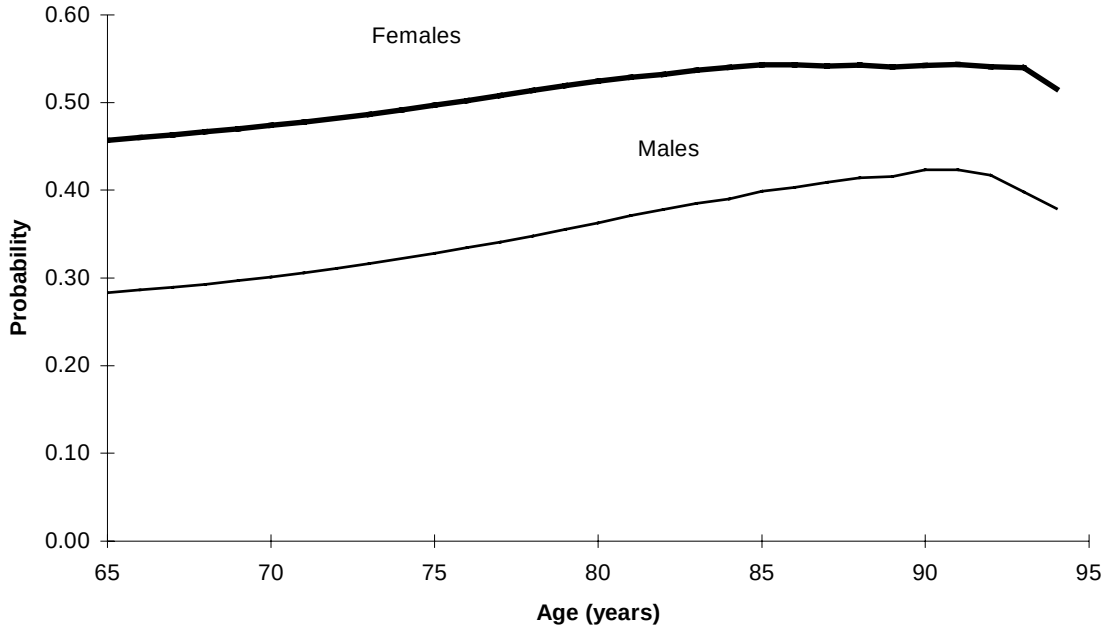
The probability of someone in the community entering an aged care home displays a striking sex pattern that is consistent with the earlier study of nursing homes (Liu 1998). It shows that women are much more likely to enter an aged care home than men (Table 1 and Figure 2). This is consistent with the higher representation of women than men in cross-sectional data. There were 98,248 female residents in aged care homes compared to 37,743 male residents, on the 30 June 2000 (AIHW 2001).

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 an aged care 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 the likelihood of an aged care home admission. The life expectancy at birth for women was 5.55 years longer than that for men in 1997–99. This difference was reduced at older ages. By age 65, the gap decreased to 3.62 years. After age 90, the difference diminished to less than half a year (ABS 1999:93–94). This trend is consistent with the trend that emerged in the present analysis of a narrowing gap between men and women at older ages (the highest age group being an exception) in the probability of someone in the community entering an aged care home (Figure 2).

The lifetime probability of a first admission to an aged care home increases with age until after age 90, for both men and women. These age patterns are consistent with the findings that emerged from the earlier studies of nursing homes (Liu 1998). In general, the use of residential care services 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.

The decline in probabilities at the oldest ages (shown in Table 1 and Figure 2) may be affected by a higher mortality rate so that death comes before admission to an aged

care home (Liang & Tu 1986). It has also been suggested that people who survive to a very old age without previous admissions to an aged care home are less likely to suffer from chronic conditions and hence are less likely to need residential aged care (Cohen et al. 1986).




*Source:* Life table in the Technical Appendix.

**Figure 2: The probability of someone in the community entering an aged care home, age by sex, Australia, 1999–00**

## Construct 2: Probability of someone in the community entering an aged care home between two ages

The probability that a man in the community aged 65 will be admitted to an aged care home for permanent care before age 80 is 0.08. This is considerably lower than the life time probability of 0.28. The difference between a 65-year-old woman entering over the next 15 years compared with over their lifetime is even more striking — 0.09 compared with 0.42.

The probability of entering permanent care in an aged care home for the first time is, not surprisingly, higher for 70 year olds than 65 year olds over the same number of years. A woman aged 70 has a 0.20 chance of entering before age 85, considerably higher than the 0.15 probability for men. In fact, the probability of a woman entering aged care between two ages is always higher than for men, with the exception of between ages 65 and 75 where the probabilities are very similar and quite low for both sexes. The probability of a 65-year-old entering aged care before age 70 is less than 0.01, and that of entering before 75 is also very low at 0.03 for both males and females.

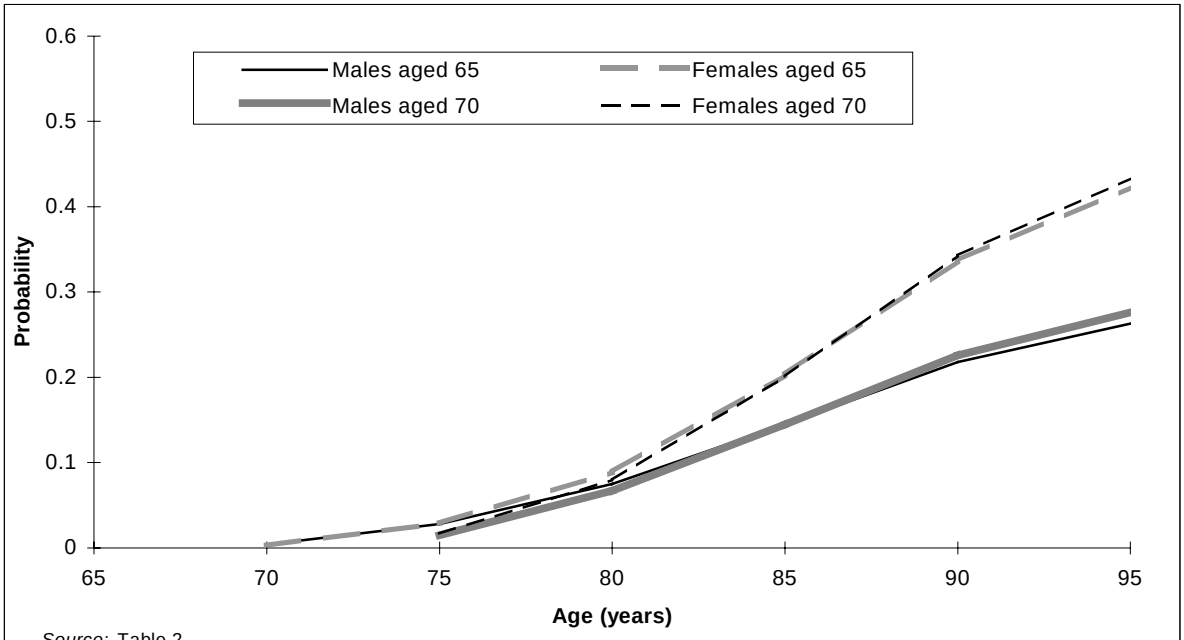
**Table 2: Probability of someone in the community entering an aged care home for permanent care between two ages, age by sex, Australia 1999–00**

| | Age y (years) | | | | | |
|---|---|---|---|---|---|---|
| **Age x (years)** | **70** | **75** | **80** | **85** | **90** | **95** |
| **65** | | | | | | |
| Males | 0.004 | 0.03 | 0.08 | 0.15 | 0.22 | 0.26 |
| Females | 0.003 | 0.03 | 0.09 | 0.20 | 0.34 | 0.42 |
| **70** | | | | | | |
| Males | | 0.02 | 0.07 | 0.15 | 0.23 | 0.28 |
| Females | | 0.02 | 0.08 | 0.20 | 0.34 | 0.43 |

*Notes:*

1. The databases used in this analysis were the DHAC SPARC system 2000; ABS 1999:93–94; ABS 2000:16–33.
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.

The difference between the probabilities for men and women is highlighted in Figure 3. While the probability of entering an aged care home for the first time before a specified age is higher for women than for men, the difference increases markedly with age.




*Source:* Table 2.

**Figure 3: Probability of someone in the community entering an aged care home for permanent care between two ages, age by sex, Australia 1999–00**

## Construct 3: Probability of being in order entering an aged care home

At birth, there is no difference between the probability of someone living in the community entering an aged care home and the probability of anyone entering an aged care home (Table 3). For the other ages, the latter estimates, as would be expected, are much higher because they include people who have been or are currently in aged care homes.

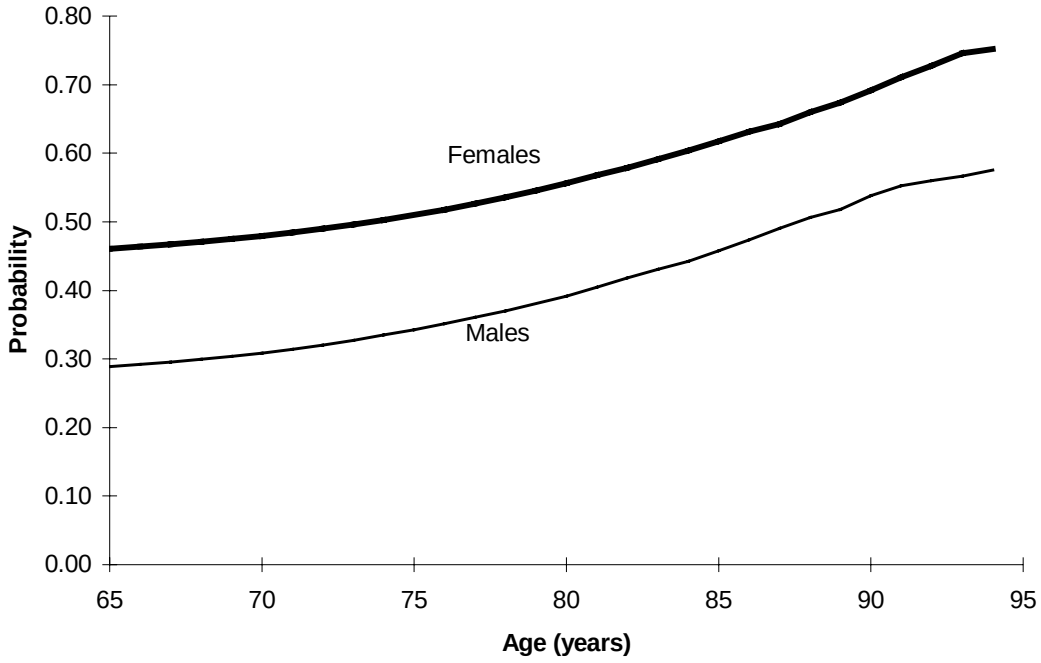
**Table 3: Probability of ever entering an aged care home, age by sex, Australia 1999–00**

| | Age (years) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Type of care by sex** | **0** | **65** | **70** | **75** | **80** | **85** | **90** | **95** |
| **Permanent care** | | | | | | | | |
| Males | 0.24 | 0.29 | 0.31 | 0.34 | 0.39 | 0.46 | 0.54 | 0.54 |
| Females | 0.42 | 0.46 | 0.48 | 0.51 | 0.56 | 0.62 | 0.69 | 0.75 |
| **Permanent and respite care combined** | | | | | | | | |
| Males | 0.33 | 0.40 | 0.42 | 0.47 | 0.53 | 0.62 | 0.73 | 0.73 |
| Females | 0.59 | 0.65 | 0.67 | 0.71 | 0.77 | 0.85 | 0.93 | 1.00 |

*Notes*

1. The databases used in this analysis were the DHAC SPARC system 2000; ABS 1999:93–94; ABS 2000:16–33.
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.

A woman at age 65 faces a 0.42 probability of entering an aged care home for permanent care during her remaining lifetime. The corresponding figure for a man is lower, only 0.24 (Table 3 and Figure 4). As was found to be the case for the probability of someone in the community entering an aged care home, the probability of using an aged care home in the remaining lifetime is higher for women than for men at all ages. Similarly, the sex difference decreases with age (the highest age group being an exception), particularly after age 80. By age 85, women have a 0.62 probability of using an aged care home for permanent care over their remaining lifetime. For those surviving at age 95, 3 in 4 women will use an aged care home for permanent care before they die. For men, the highest probability is 0.54 at age 90. These statistics suggest that admission to an aged care home becomes highly likely for women and men, if they survive to very old ages.




*Source:* Life table in the Technical Appendix.

**Figure 4: The probability of being in or entering an aged care home, age by sex, Australia, 1999–00**

# Conclusion

This paper analyses the patterns of use of aged care homes in Australia. It employs life table models to estimate the probability of someone in the community entering an aged care home, the probability of someone in the community entering and aged care home between two ages and the probability of anyone entering an aged care home.

It would be desirable to compare this study with the previous ones; however, the changes which occurred in the residential aged care system and the corresponding data systems in 1997 make such a comparison impossible for all practical purposes. A single individual can be admitted to a hostel as well as to a nursing home, thus the probabilities calculated in the previous studies are not additive.

The probability of aged care 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 probability of entering an aged care home after turning age 65 is actually 0.42 for women and 0.24 for men, despite the fact that only 7% of women and 3% of men aged 65 and over were residents in an aged care home on any one day in 1999–00. In other words, a much larger proportion of older people than has often been recognised are likely to be admitted to an aged care home at some point in their lives. This argument is strengthened by the estimates of the probability of using an aged care home in the remaining lifetime. This measurement reveals that women have a 0.62 probability of spending some time in an aged care home for permanent care after turning age 85. Over a lifetime, women are much

more likely than men are to use an aged care home. Age is a good predictor of the probability of aged care home admission. In general, the older a person is, the higher the probability of an aged care home admission he or she faces.

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 (including long-term care insurance) being put into place. These findings also have implications for individuals in terms of retirement planning. It has become of particular relevance to individuals in Australia with the introduction of income-tested resident contributions, accommodation fees and accommodation bonds.

# Technical appendix

## Appendix table A1: Life table for estimating lifetime risk of permanent admission to residential aged care facilities, males, Australia, 1999–00

| 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 an aged care home admission | Deaths after having at least one admission | Deaths without an admission | Lifetime risk | Lifetime probability |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $x$ | $adm_x$ | $pop_x$ | $adm_x / pop$ | $L_x$ | $est\_adm$ | $T\_Adm_x$ | $aq_x$ | $l_x$ | $cl_x$ | $ad_x$ | $cd_x$ | $LR_x$ | $LP_x$ |
| 0 | 1,021 | 8,452,75 | 0.0001 | 6,232,906 | 753 | 24,229 | 0.1637 | 100,0 | 100,000 | 62 | 16,308 | 0.24 | 0.24 |
| 65 | 118 | 67.776 | 0.0017 | 82,961 | 144 | 23,477 | 0.1724 | 83,63 | 82,939 | 132 | 1,226 | 0.28 | 0.29 |
| 66 | 131 | 66.590 | 0.0020 | 81,542 | 160 | 23,332 | 0.2151 | 82,27 | 81,568 | 169 | 1,314 | 0.29 | 0.29 |
| 67 | 180 | 65,422 | 0.0028 | 79,992 | 220 | 23,172 | 0.2009 | 80,78 | 80,093 | 162 | 1,454 | 0.29 | 0.30 |
| 68 | 174 | 66,170 | 0.0026 | 78,306 | 206 | 22,952 | 0.2207 | 79,17 | 78,419 | 189 | 1,569 | 0.29 | 0.30 |
| 69 | 258 | 65,421 | 0.0039 | 76,475 | 302 | 22,746 | 0.2099 | 77,41 | 76,644 | 193 | 1,712 | 0.30 | 0.30 |
| 70 | 237 | 62.930 | 0.0038 | 74,494 | 281 | 22,444 | 0.2297 | 75,51 | 74,631 | 234 | 1,824 | 0.30 | 0.31 |
| 71 | 295 | 61,121 | 0.0048 | 72,358 | 349 | 22,164 | 0.2503 | 73,45 | 72,527 | 275 | 1,940 | 0.31 | 0.31 |
| 72 | 334 | 58,745 | 0.0057 | 70,064 | 398 | 21,814 | 0.2341 | 71,23 | 70,238 | 281 | 2,092 | 0.31 | 0.32 |
| 73 | 377 | 56,465 | 0.0067 | 67,612 | 451 | 21,416 | 0.2329 | 68,86 | 67,747 | 313 | 2,218 | 0.32 | 0.33 |
| 74 | 439 | 52,742 | 0.0083 | 65,002 | 541 | 20,965 | 0.2677 | 66,33 | 65,077 | 409 | 2,280 | 0.32 | 0.33 |
| 75 | 474 | 49,106 | 0.0097 | 62,234 | 601 | 20,424 | 0.2618 | 63,64 | 62,256 | 442 | 2,403 | 0.33 | 0.34 |
| 76 | 563 | 46,389 | 0.0121 | 59,312 | 720 | 19,823 | 0.2683 | 60,79 | 59,252 | 512 | 2,487 | 0.33 | 0.35 |
| 77 | 584 | 43,310 | 0.0135 | 56,239 | 758 | 19,103 | 0.2991 | 57,80 | 56,045 | 638 | 2,508 | 0.34 | 0.36 |
| 78 | 634 | 40,406 | 0.0157 | 53,023 | 832 | 18,345 | 0.2834 | 54,65 | 52,779 | 649 | 2,635 | 0.35 | 0.37 |
| 79 | 679 | 36,202 | 0.0188 | 49,676 | 932 | 17,513 | 0.3110 | 51,37 | 49,312 | 785 | 2,623 | 0.36 | 0.38 |
| 80 | 616 | 29,524 | 0.0209 | 46,213 | 964 | 16,581 | 0.2979 | 47,96 | 45,757 | 801 | 2,712 | 0.36 | 0.39 |
| 81 | 667 | 24,464 | 0.0273 | 42,659 | 1,163 | 15,617 | 0.3102 | 44,44 | 42,081 | 915 | 2,676 | 0.37 | 0.40 |
| 82 | 701 | 22,537 | 0.0311 | 39,041 | 1,214 | 14,454 | 0.3185 | 40,85 | 38,242 | 1,027 | 2,613 | 0.38 | 0.42 |
| 83 | 720 | 20,235 | 0.0356 | 35,392 | 1,259 | 13,239 | 0.3485 | 37,21 | 34,414 | 1,197 | 2,455 | 0.38 | 0.43 |
| 84 | 676 | 17664 | 0.0383 | 31,751 | 1,215 | 11,980 | 0.3278 | 33,56 | 30,699 | 1,139 | 2,483 | 0.39 | 0.44 |
| 85 | 757 | 15,568 | 0.0486 | 28,161 | 1,369 | 10,765 | 0.3351 | 29,94 | 27,001 | 1,216 | 2,333 | 0.40 | 0.46 |
| 86 | 706 | 13,381 | 0.0528 | 24,668 | 1,302 | 9,395 | 0.3265 | 26,39 | 23,298 | 1,224 | 2,206 | 0.40 | 0.47 |
| 87 | 625 | 10,861 | 0.0575 | 21,316 | 1,227 | 8,094 | 0.3417 | 22,96 | 19,790 | 1,295 | 1,971 | 0.41 | 0.49 |
| 88 | 564 | 8,719 | 0.0647 | 18,150 | 1,174 | 6,867 | 0.3647 | 19,69 | 16,592 | 1,347 | 1,713 | 0.41 | 0.51 |
| 89 | 464 | 6,997 | 0.0663 | 15,210 | 1,009 | 5,693 | 0.3456 | 16,63 | 13,705 | 1,188 | 1,627 | 0.42 | 0.52 |
| 90 | 421 | 5,375 | 0.0783 | 12,533 | 982 | 4,685 | 0.3686 | 13,82 | 11,070 | 1,196 | 1,337 | 0.42 | 0.54 |
| 91 | 331 | 3,939 | 0.0840 | 10,153 | 853 | 3,703 | 0.3909 | 11,29 | 8,751 | 1,160 | 1,063 | 0.42 | 0.55 |
| 92 | 290 | 2,956 | 0.0981 | 8,090 | 794 | 2,850 | 0.3886 | 9,068 | 6,835 | 1,022 | 880 | 0.42 | 0.56 |
| 93 | 209 | 2,178 | 0.0960 | 6,350 | 609 | 2,056 | 0.3662 | 7,166 | 5,161 | 846 | 734 | 0.40 | 0.57 |
| 94 | 144 | 1,537 | 0.0937 | 4,925 | 462 | 1,447 | 0.4341 | 5,586 | 3,817 | 868 | 406 | 0.38 | 0.58 |
| 95 | 287 | 4,137 | 0.0857 | 143,867 | 985 | 985 | 0.4485 | 4,312 | 2,950 | 2,347 | 1,965 | 0.33 | 0.54 |

*Note:* Columns $aq_x$, $l_x$, $al_x$ 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:* AIHW analysis of ABS 1999, 2000; DHAC 2000 unpublished data.

## Appendix table A2: Life table for estimating lifetime risk of permanent admission to residential aged care facilities, females, Australia, 1999–00

| 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 an aged care home admission | Deaths after having at least one admission | Deaths without an admission | Lifetime risk | Lifetime probability |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $x$ | $Adm_x$ | $Pop_x$ | $Adm_x/Pop_x$ | $L_x$ | $Est\_Adm_x$ | $T\_Adm_x$ | $nq_x$ | $l_x$ | $rl_x$ | $nd_x$ | $cd_x$ | $LR_x$ | $LP_x$ |
| 0 | 810 | 8.253.782 | 0.0001 | 6.348.066 | 623 | 41.657 | 0.0959 | 100.000 | 100.000 | 30 | 9.563 | 0.42 | 0.42 |
| 65 | 87 | 69,772 | 0.0012 | 90,020 | 112 | 41,034 | 0.1440 | 90,407 | 89,784 | 98 | 688 | 0.46 | 0.46 |
| 66 | 102 | 68,927 | 0.0015 | 89,199 | 132 | 40,921 | 0.1239 | 89,621 | 88,984 | 87 | 769 | 0.46 | 0.46 |
| 67 | 146 | 67,947 | 0.0021 | 88,304 | 190 | 40,789 | 0.1225 | 88,765 | 88,083 | 95 | 840 | 0.46 | 0.47 |
| 68 | 145 | 69,314 | 0.0021 | 87,326 | 183 | 40,600 | 0.1629 | 87,830 | 87,053 | 141 | 883 | 0.47 | 0.47 |
| 69 | 225 | 69,865 | 0.0032 | 86,254 | 278 | 40,417 | 0.1727 | 86,806 | 85,988 | 165 | 957 | 0.47 | 0.47 |
| 70 | 291 | 67,768 | 0.0043 | 85,077 | 365 | 40,139 | 0.1343 | 85,684 | 84,753 | 150 | 1,084 | 0.47 | 0.48 |
| 71 | 307 | 67,214 | 0.0046 | 83,782 | 383 | 39,774 | 0.1534 | 84,450 | 83,304 | 205 | 1,153 | 0.48 | 0.48 |
| 72 | 353 | 66,248 | 0.0053 | 82,357 | 439 | 39,391 | 0.1618 | 83,092 | 81,768 | 250 | 1,245 | 0.48 | 0.49 |
| 73 | 413 | 65,414 | 0.0063 | 80,788 | 510 | 38,952 | 0.1559 | 81,597 | 80,084 | 276 | 1,368 | 0.49 | 0.50 |
| 74 | 498 | 63,360 | 0.0079 | 79,063 | 621 | 38,442 | 0.1641 | 79,953 | 78,206 | 338 | 1,469 | 0.49 | 0.50 |
| 75 | 612 | 61,204 | 0.0100 | 77,171 | 772 | 37,821 | 0.1766 | 78,146 | 76,115 | 427 | 1,553 | 0.50 | 0.51 |
| 76 | 704 | 59,853 | 0.0118 | 75,099 | 883 | 37,049 | 0.1707 | 76,166 | 73,790 | 481 | 1,683 | 0.50 | 0.52 |
| 77 | 837 | 57,374 | 0.0146 | 72,839 | 1,063 | 36,166 | 0.1648 | 74,002 | 71,224 | 546 | 1,814 | 0.51 | 0.53 |
| 78 | 984 | 54,977 | 0.0179 | 70,376 | 1,260 | 35,103 | 0.1762 | 71,642 | 68,347 | 692 | 1,876 | 0.51 | 0.54 |
| 79 | 1082 | 50,870 | 0.0213 | 67,699 | 1,440 | 33,844 | 0.1769 | 69,074 | 65,211 | 811 | 1,977 | 0.52 | 0.55 |
| 80 | 1138 | 43,124 | 0.0264 | 64,797 | 1,710 | 32,404 | 0.1830 | 66,286 | 61,793 | 979 | 2,038 | 0.52 | 0.56 |
| 81 | 1182 | 37,728 | 0.0313 | 61,664 | 1,932 | 30,694 | 0.1916 | 63,269 | 58,045 | 1,186 | 2,064 | 0.53 | 0.57 |
| 82 | 1243 | 36,086 | 0.0344 | 58,297 | 2,008 | 28,762 | 0.1857 | 60,019 | 54,049 | 1,295 | 2,187 | 0.53 | 0.58 |
| 83 | 1354 | 33,970 | 0.0399 | 54,702 | 2,180 | 26,754 | 0.1974 | 56,537 | 49,855 | 1,535 | 2,169 | 0.54 | 0.59 |
| 84 | 1452 | 31,376 | 0.0463 | 50,896 | 2,355 | 24,573 | 0.1986 | 52,833 | 45,505 | 1,689 | 2,216 | 0.54 | 0.60 |
| 85 | 1593 | 29,099 | 0.0547 | 46,904 | 2,568 | 22,218 | 0.2048 | 48,928 | 40,934 | 1,900 | 2,174 | 0.54 | 0.62 |
| 86 | 1539 | 26,228 | 0.0587 | 42,763 | 2,509 | 19,650 | 0.2207 | 44,854 | 36,192 | 2,189 | 2,010 | 0.54 | 0.63 |
| 87 | 1455 | 22,574 | 0.0645 | 38,523 | 2,483 | 17,141 | 0.2060 | 40,655 | 31,673 | 2,106 | 2,165 | 0.54 | 0.64 |
| 88 | 1323 | 19,366 | 0.0683 | 34,243 | 2,339 | 14,658 | 0.2256 | 36,384 | 27,025 | 2,376 | 1,901 | 0.54 | 0.66 |
| 89 | 1177 | 16,464 | 0.0715 | 29,993 | 2,144 | 12,319 | 0.2250 | 32,107 | 22,784 | 2,339 | 1,871 | 0.54 | 0.67 |
| 90 | 1009 | 13,137 | 0.0768 | 25,852 | 1,986 | 10,174 | 0.2316 | 27,897 | 18,769 | 2,344 | 1,713 | 0.54 | 0.69 |
| 91 | 809 | 10,016 | 0.0808 | 21,909 | 1,770 | 8,189 | 0.2471 | 23,840 | 15,070 | 2,385 | 1,430 | 0.54 | 0.71 |
| 92 | 667 | 8,088 | 0.0825 | 18,245 | 1,505 | 6,419 | 0.2516 | 20,025 | 11,871 | 2,241 | 1,261 | 0.54 | 0.73 |
| 93 | 588 | 6,357 | 0.0925 | 14,927 | 1,381 | 4,914 | 0.2778 | 16,523 | 9,105 | 2,253 | 872 | 0.54 | 0.75 |
| 94 | 423 | 4,877 | 0.0867 | 12,008 | 1,042 | 3,534 | 0.2890 | 13,398 | 6,852 | 2,043 | 666 | 0.52 | 0.75 |
| 95 | 924 | 13,168 | 0.0788 | 245,406 | 2,492 | 2,492 | 0.2938 | 10,689 | 5,144 | 8,037 | 2,652 | 0.48 | 0.75 |

*Note:* Columns $aq_x$, $l_x$, $cl_x$ 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:* AIHW analysis of ABS 1999, 2000; DHAC 2000 unpublished data.

## Life table models

To estimate these three sets of probabilities, this paper uses life tables to model the lifetime experience of residence in an aged care home for a population cohort. There are six steps in computing these probabilities. The general life table notations are followed. In addition *a* is used to represent people who are in or have been in aged care homes, *c* represents people who are in the community, that is, people who have never used an aged care home. The subscript *x* represents age throughout the paper and when there is a range of ages *x* is used as the initial age and *y* is used as the final age.

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 an aged care home in 1999–00 for the first time over their lifetime between age *x* and *x*+1 for each sex. These figures are directly derived from the national aged care home data set (the System of Payment for Aged Residential Care).
Population data ( $pop_x$ ) are obtained by averaging the ABS (2000:16–33) estimated resident populations by age and sex at 30 June 1999 and 2000. If the sex–age-specific proportion of the population who had never resided in an aged care home before 1 July 1999 is denoted as $\lambda_X$ then the population at risk is $pop_x \bullet \lambda_x$.

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 1997–99 is used here (ABS 1999:93–4). It is plausible to assume that the proportion of the stationary population in the life table who had never resided in an aged care home before age *x* is the same as the proportion of the population in 1999–00 ( $\lambda_X$ ). The expected admissions can be estimated as:

$$est\_adm_x = (L_x \bullet \lambda_x) \bullet r_X = (L_X \bullet \lambda_X) \bullet adm_X/(pop_x \bullet \lambda_x)$$

$$est\_adm_x = L_X \bullet adm_X / pop_x \quad (2)$$

$\lambda_X$ is cancelled out and therefore it can be ignored for computational purposes.
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 ($cl_x$), or survivors at age *x* who have never used an aged care home before.

$$cl_{x+1} = cl_x - est\_adm_x - cd_x \quad (4)$$

where $cd_x$ is the number of deaths among those who have never used an aged care home before**.**

All members of the cohort are at risk of future use of an aged care home at birth. That is: $cl_o = l_o$

The value of $cd_x$ is estimated di with fferently for persons aged under 65 compared with those 65 and older. There is only a minimal proportion of people entering an aged care home before age 65. It is reasonable to assume that the death rates are equal between those who have had at least one admission to an aged care home and those who have not by age 65. The number of people who died under age 65 without experiencing a period of residence in an aged care home is thus:

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

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.

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

$$ad_x = (al_x + est\_adm_x/2) \bullet aq_x \quad (x>64) \quad (6)$$

$$al_x = l_x - cl_x \; (al_o = 0) \quad (7)$$

$$cd_x = (l_x - l_{x+1}) - ad_x \quad (8)$$

where $al_x$ represents those persons who have been in an aged care home before and survive to age *x*, $l_X$ and $l_{X+1}$ are taken from the relevant Australian life table and $aq_x$ is the estimated mortality rate for those who have had at least one stay in an aged care home or are currently in an aged care home (i.e. Group 2 and 3 in Figure 1). The estimate was derived from the System of Payment for Aged Residential Care (SPARC), employing the assumption that the probability of dying among those who had been admitted to an aged care home but had since left (Group 2 in Figure 1), was the same as the probability of dying among those who are currently residing in an aged care home. Deaths in aged care 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 admission to an aged care home from age *x* among those who have never been admitted to an aged care home

$$LR_x = T\_adm_x / cl_x \quad (9)$$

E. The computation of the probability of at least one admission to an aged care home between and *x* and *y* ($R_x^y$) by those who have never been admitted to and aged care home ($cl_x$) is as follows

$$al_x = l_x - cl_x \quad (10)$$

$$R_x^y = 1 - \left( \sum_{i=x}^{y} cd_x + al_x + cl_y \right) / cl_x \quad (11)$$

where $al_x$ is the number of people in an aged care home at age $x$.

F. The computation of the probability of using an aged care home in the remaining lifetime ($LP_x$) (irrespective of whether they have already been in an aged care home) for each age *x* is much simpler.

$$LP_x = 1 - \left( \sum_{i=x}^{\infty} cd_x \right) / l_x \quad (12)$$

## Data and scope

A successful application of the above life table models requires comprehensive information on admissions to aged care homes. This paper uses Australian data from SPARC, which contains national historical unit records for all residents in all aged care homes. The SPARC was developed by combining two previous systems, which were the Nursing Home Payment System (NHPS) and the Commonwealth Hostel Information Payment System (CHIPS) on 1 October 1997. The new system inherited all existing records on the NHPS at 1 October 1997. For the data on the CHIPS, only those records that related to the following two groups of people were carried over:

1. Those who were in a hostel at 1 October 1997; and
2. Those who had a valid Aged Care Assessment Team (ACAT) assessment covering 1 October; these people were regarded as potential residents.

In other words, the records for residents discharged from hostels before 1 October 1997 are not available on SPARC. This may lead to an overestimate of the first admissions in 1999–00. The estimate of the first admissions may also be affected (though minimally) by the completeness of coverage of residents admitted and discharged before the dates when the NHPS and CHIPS were established. The NHPS was established at the beginning of 1988 and the CHIPS was established in the middle of 1990.

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 numbers of admissions and deaths in a year can be derived for each age–sex 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 database have significant advantages for life table construction.

Australian aged care homes provide respite care as well as permanent care. Respite care provides short-term accommodation and care for people who need a 'break' away from their usual care arrangements. A person is entitled to a total of nine weeks of respite care in any financial year. Respite residents represented less than 2% of the total residents at any point in time in 1999–00, although respite admissions accounted for about 48% of total admissions (including multiple admissions) during the year. The utilisation patterns are quite different for respite and permanent care (Liu & Choi 1996). The text of this paper focuses on permanent care, presenting information on permanent care alone, but the tables present data both on permanent care and on permanent and respite care in combination.

The population data for this paper are taken from the ABS (2000:16–33) estimated resident population at 30 June 1999 and 2000. The most recent available life tables for the Australian population are ABS (1999:93–4) population life tables for 1997–99 which are used in this paper.

The population using aged care homes is a heterogeneous group (Howe 1982; Kemper et al. 1991; Liu 1996). It is unfortunate that, due to data limitations, 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 an aged care home) that are known to influence aged care home use patterns.

[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.

# References

Australian Bureau of Statistics (ABS) 1999. Deaths (Australia). Catalogue No. 3302.0. Canberra: ABS.

Australian Bureau of Statistics (ABS) 2000. Population by Age and Sex: Australian State and Territories, June quarter 2000. Catalogue No. 3201.0. Canberra: ABS.

Australian Institute of Health and Welfare (AIHW) 1997. Australia's welfare 1997: services and assistance. Canberra: AGPS:239–88.

Australian Institute of Health and Welfare (AIHW) 2000. Residential aged care in Australia 1998–99: a statistical overview. AIHW Cat. No. AGE 16. Canberra: Australian Institute of Health and Welfare.

Australian Institute of Health and Welfare (AIHW) 2001. Aged care homes in Australia 1999–00: a statistical overview. AIHW Cat. No. AGE 19. Canberra: Australian Institute of Health and Welfare.

Cohen M, Tell E & Wallack S 1986. The lifetime risks and costs of nursing home use among the elderly. Med Care 24(12):1161–72.

Howe A L 1982. Beginning at the end; patterns of death among the aged. Community Health Studies 6(3):253–62.

Kemper P & Murtaugh C M 1991. Lifetime use of nursing home care. The New England Journal of Medicine 324(9):595–600.

Liang J & Tu E J-C 1986. Estimating lifetime risk of nursing home residency: a further note. Gerontologist 26(5):560–3.

Liu Z 1996. Length of stay in Australian nursing homes. Aged Care Series no. 1. Canberra: Australian Institute of Health and Welfare.

Liu Z 1998. The probability of nursing home use over a lifetime. Aged Care Series no. 16. Canberra: Australian Institute of Health and Welfare.

Liu Z & Choi C 1996. The use of respite care in Australian nursing homes and hostels. Welfare Division Working Paper No. 12. Canberra: Australian Institute of Health and Welfare.

Murtaugh C M, Kemper P & Spilliman B C 1990. The risk of nursing home use in later life. Medical Care 28(10):952–62.

Steering Committee for the Review of Commonwealth / State Service Provision (SCRCSSP) 1997. Report on Government Service Provision, Volume 2. Canberra: AGPS:340–79.