Modeling Lifetime Nursing Home Use Under Assumptions of Better Health

Sarah B. Laditka

School of Business and Public Management, State University of New York Institute of Technology at Utica/Rome.

**Objectives.** There is evidence of notable improvement in active life expectancy among older Americans. Little is known, however, about the effect of better health on lifetime nursing home use. The purpose of this study was to address this gap in our knowledge.

**Methods.** Discrete-time hazard models of nursing home admission and discharge were developed using data from the 1982, 1984, and 1989 National Long Term Care Surveys and the 1984–1990 Longitudinal Study of Aging. Microsimulation techniques were used to incorporate monthly functional status information into the models that predict nursing home use and to generate lifetime nursing home histories for a cohort of older men and women under various assumptions of improved morbidity.

**Results.** Improved health increased total life expectancy and the absolute amount of time spent in both the community and in nursing homes. Better health did not change the proportion of life older persons spent in nursing homes or the percentage of the cohort who entered nursing homes.

**Discussion.** If morbidity improves there will be an increase in the use of nursing homes. However, for the majority of older persons, better health will be associated with more independent living throughout the life span.

The substantial increase in the number of older Americans as baby boomers pass age 65 early in the next century is likely to increase the demand for long-term health care services. Financing these services will challenge policy makers. Nursing home services in institutional settings dominate long-term care. Estimated at about $78 billion in 1995, nursing home costs are more than twice the combined costs of home- and community-based services (Levit et al., 1996) and are projected to reach $180 billion by 2005 (Burner & Waldo, 1995), making a better understanding of nursing home use even more important.

Research has shown that health care use and costs depend on both the number of older persons and their health status (Lubitz, Beebe, & Baker, 1995; Weiner, Illston, & Hanley, 1994). Critically related to this phenomenon is active life expectancy, a health measure that integrates mortality and morbidity information and represents the average amount of time people can expect to live free of significant disability. Substantial declines in mortality at older ages over the last several decades have been well documented, but less is known about changes in morbidity among older persons. There is evidence, however, that patterns of morbidity among older persons can change over relatively brief periods. Research using data from the 1970s to early 1980s finds that older Americans were then living longer but in poorer health than previously (Colvez & Blanchet, 1981; Crimmins, Saito, & Ingegneri, 1989). Studies using data from the mid 1980s to the early 1990s indicate improving health among older individuals (Crimmins, Saito, & Ingegneri, 1997; Manton, Corder, & Stallard, 1993; Manton, Stallard, & Corder, 1997).

The medical literature supports the finding that older Americans are now living longer in better health. For example, there has been a significant decrease in the rate of cardiovascular disease (Davis et al., 1985) and mortality and morbidity due to strokes (McGovern et al., 1992). These trends from the active life expectancy and medical literatures, together with substantial education gains in the United States over the past three decades (Preston, 1992)—gains strongly associated with longer life and better health (Guralnik, Land, Blazer, Fillenbaum, & Branch, 1993)—suggest the likelihood that the baby boom cohort will live longer in better health. Given this evidence, it is useful to examine the effects of improved morbidity on older individuals’ use of nursing homes.

This study examines the effect of better health on individuals’ lifetime use of nursing homes using data from two nationally representative samples of older Americans, the Longitudinal Study of Aging (LSOA) and the National Long Term Care Survey (NLTCS), and microsimulation techniques. Microsimulation is a method that uses Monte Carlo simulation (or a random generation process) to produce a data set of individual-level event histories. An important strength of this simulation approach is that, in contrast to time-intensive analytical solutions, microsimulation uses a numerical solution process with relatively modest computational requirements (Wolf, 1986). The simulated data produced by microsimulation (often called micro data) can then be examined using standard statistical methods. In addition to using micro data to compute conventional estimates such as the mean, it is possible to use micro data to tabulate the distribution of event counts and the average length of time spent in any event state. In this study, microsimulation is used to develop individual-level trajecto-
ries of nursing home use and to combine data from different surveys. Due to cost constraints, most longitudinal studies follow older persons for a relatively brief period of time, such as six to eight years. Thus limited data exists upon which to base life cycle estimates of nursing home use. This study uses microsimulation to address this challenge by developing a micro data set of monthly nursing home histories for a cohort of men and women from age 70 until death, based on the parameters of models of nursing home use. In addition, microsimulation is used to augment functional status information in the NLTCs by incorporating monthly functional status information into the models that predict nursing home use. Microsimulation also allows researchers to go beyond the summary indices of nursing home use produced by more conventional methods, for instance, to calculate the number of nursing home spells an individual experiences over his or her older lifetime, as well as the distribution of nursing home use by length of individual spells.

The simulations of nursing home use are repeated under several assumptions of improved morbidity. Results from the baseline simulation and the simulations of better health are compared to study the effects of improving health on lifetime nursing home use. This study examines how improved morbidity (a) influences individuals’ absolute and relative use of nursing homes and (b) affects the proportion of a cohort of men and women who will ever use nursing homes. Information about the absolute amount of time people will spend in nursing homes and the percentage of a cohort who will use nursing homes provides an estimate of resources needed. Estimates of the proportion of life that an older person can expect to live in a nursing home (i.e., relative nursing home use) address an important quality of life issue for older persons: If human longevity is increased, will people spend a larger or smaller percentage of their longer lives living independently? The results of this study allow researchers to gain a better understanding of how improved health influences older persons’ use of nursing homes, thereby enhancing the ability to forecast nursing home use and costs for members of the baby boom generation.

**Background**

Previous studies examining nursing home use can be classified into three areas of research emphasis. The first area seeks to identify factors associated with the risk of nursing home use (Branch & Jette, 1982; Cutler & Sheiner, 1993; Greene & Ondrich, 1990; Wolinsky, Callahan, Fitzgerald, & Johnson, 1993). The second calculates the average length of nursing home stays for individuals with certain characteristics (Freedman, 1993; Garber & MaCurdy, 1990; Liu, Coughlin, & McBride, 1991). Studies in these first two areas are often limited because the health and functional status variables they incorporate are measured at a single point in time. Thus, these studies rely on baseline characteristics to predict the risk of subsequent nursing home use. Although such models do capture, for example, the influence of the initial functional status of an older individual, they often provide little information about how changes in functional status influence the use of nursing homes.

A third research area estimates individuals’ lifetime use of nursing home services (Dick, Garber, & MacCurdy, 1994; Kemper & Murtaugh, 1991; Murtaugh, Kemper, & Spillman, 1990; Murtaugh, Kemper, Spillman, & Carlson, 1997; Palmore, 1976; Vincente, Wiley, & Carrington, 1979). A limitation of prior research in this area is that it has not examined the effects of improved morbidity on nursing home use. Some studies model the effects of increased life expectancy on nursing home use (Kemper & Murtaugh, 1991; Murtaugh et al., 1997); however, they do not consider whether longer life will be spent in better or worse health. All projections of nursing home use are subject to uncertainty, but part of this uncertainty can be attributed to changes in total and active life expectancy. If members of the baby boom generation spend a larger percentage of their longer lives in better health, a lower demand for nursing homes is likely to result than if they live a greater proportion of their longer lives in worse health.

Relatively little is known about the decision processes underlying the use of nursing homes. However, previous research has demonstrated that certain factors are strongly associated with nursing home use, including demographic characteristics, health status, and economic issues. Demographic characteristics consistently found to be significantly associated with nursing home use include increasing age (Greene & Ondrich, 1990), gender (women use substantially more nursing home services than men; Hing, Sekscenski, & Strahan, 1989), and race (Blacks use nursing homes significantly less than Whites; Belgrave, Wykle, & Choi, 1993). Health status is another factor that affects nursing home use; individuals who are in poorer health have notably greater use of nursing homes over the course of their lifetimes (Vincente et al., 1979). Among the most common measures of health status among older people are activities of daily living (ADLs; Katz, Ford, Moskowitz, Jackson, & Jaffee, 1963). Economic issues include socioeconomic status and factors that affect the price of nursing home services. Education is often used to proxy socioeconomic status (Feinstein, 1993): Some studies have found that higher levels of education are significantly associated with reduced use of nursing homes (Branch & Ku, 1989), whereas others have found that education does not significantly influence nursing home use (Kemper & Murtaugh, 1991). There is also evidence that the supply of nursing home beds, the level of Medicaid reimbursement (Cutler & Sheiner, 1993), and price influence the use of nursing home services (Chiswick, 1976; Garber & MacCurdy, 1993; Headen, 1993).

This study examines the effects of improved morbidity on lifetime nursing home use. Thus, this study models the effects of the compression of morbidity scenario (Fries, 1980) on nursing home use. Research has shown that improved morbidity, holding mortality constant, reduces the proportion of life spent in a functionally impaired state (Crimmins, Hayward, & Saito, 1994). Improved morbidity is likely to increase total life expectancy, because people are more likely to remain in or transition to less impaired states, which have lower mortality rates. Based on these empirical findings and observations, this study tests three hypotheses: first, improved morbidity will reduce the proportion of life spent in nursing homes; second, the proportion of a cohort of men and women who will use nursing homes will de-
crease when morbidity is improved; and third, improved morbidity will increase total life expectancy and the absolute number of years of nursing home use.

**METHODS**

**Overview of Methodological Approach**

Several models and data sets are employed in this study. First, a Markov model of functional status is used to generate monthly functional status transition probabilities, using data from the 1984, 1986, 1988, and 1990 waves of the Longitudinal Study of Aging (LSOA). Next, these functional status transition probabilities are used with microsimulation to impute missing monthly functional status information in the 1982, 1984, and 1989 waves of the National Long Term Care Survey (NLTCS). This augmented NLTCS data set is then used to develop discrete-time hazard models of nursing home admission and discharge. Finally, microsimulation is used to generate lifetime nursing home use histories under various assumptions of improved morbidity. The data sets, variables, models, imputation procedure, microsimulation techniques, and improved morbidity modeling methods are described in the sections that follow.

**Data**

Data from the LSOA were used to estimate a Markov model of functional status. The 1984 baseline LSOA survey was administered to a sample of 7,527 individuals aged 70 and older. Follow-up surveys were performed in 1986, 1988, and 1990. The LSOA survey design is described by Kovar, Fitti, and Chyba (1992). The LSOA sampled both functionally impaired and unimpaired individuals; this feature allows researchers to model transitions between fully functional and impaired functional states. Laditka and Wolf (1998) provide details about how the LSOA sample was developed for this analysis.

Data from the NLTCS were used to develop discrete-time hazard models of nursing home admission and discharge. The design of the NLTCS, a longitudinal study of Medicare enrollees, is described in Manton (1988) and Manton et al. (1993). To be included in the sample used for this analysis, NLTCS sample members had to be disabled in at least one of the three survey waves, because detailed information was only collected from persons who were disabled (e.g., this sample includes individuals who were not disabled in the first two survey waves but were disabled when the third survey was conducted). Such individuals were included whether they resided in the community or in a nursing home. Further, to make the NLTCS sample comparable to the LSOA, NLTCS respondents had to be at least 70 years old. For the same reason, nursing home residents who were age 70 in 1982 and community-residing individuals who were aged 68–69 in 1982 and in a nursing home in 1984 were excluded. This resulted in a NLTCS sample of 7,167.

**Variables**

**Demographic variables.**—Demographic variables are age, race, and functional status. Age is measured in months and years. Non-White, a dichotomous variable, captures racial differences in the use of nursing homes. The functional status variables capture information about individuals’ functional status reflected in impairments in the following ADLs: bathing, eating, dressing, transferring, and using the toilet. Individuals were coded as impaired in an ADL if they reported difficulty performing the activity. The imputation procedure (described below) produced three dichotomous functional status variables, which were used in the hazard models of nursing home admission and discharge. Individuals were coded Unimpaired if they exhibited no ADL limitations; individuals limited in one or two ADLs were classified as Moderately Impaired; and individuals with three or more ADL limitations were Severely Impaired. Unimpaired was used as the reference category. Further, separate models were estimated for men and women. Prior research provides strong evidence that men and women have different patterns of morbidity and mortality (Crimmins, Hayward, & Saito, 1996), and that these differing patterns substantially influence the use of health services (Verbrugge, 1989). These notable differences suggest that separate analyses are appropriate.

**Duration variables.**—Duration variables were used in the hazard models of nursing home discharge to control for duration dependence (Norton, 1992). Dichotomous duration variables were constructed based on an analysis of the distribution of the length of time (in months) that individuals in the NLTCS spent in nursing homes before discharge to the community. For men, the duration variables distinguish between persons who were in the first two months (Duration 1) or the third or later month (Duration 2) of a nursing home stay. Duration 2 was used as the omitted category. For women, the duration variables distinguish between individuals who were in the first two months (Duration 1), the third month (Duration 2), the fourth month (Duration 3), or the fifth or later month (Duration 4) of a nursing home stay. For women, Duration 4 was used as the omitted category.

**Economic variables.**—Three economic variables are included in the hazard models. Low Education, a dichotomous variable, indicates respondents who completed less than 12 years of schooling, and is used as a measure of socioeconomic status. Two dichotomous variables are used as measures of the price of nursing home services: Medicaid Generosity. These variables were created using geographic identifiers in the NLTCS that specify each individual’s state of residence. Medicaid need programs allow persons to deduct large medical expenses from their taxable income to become eligible for nursing home coverage. Such programs reduce the effective price of nursing homes by making Medicaid benefits easier to obtain. States were classified as either having medically needy programs or not, based upon a 1987 study (Carpenter, 1988). In the present study, Medically Needy indicates that states provide such programs. A state’s level of nursing home reimbursement is also likely to influence the effective price of services; for example, higher reimbursement rates are likely to be associated with increased bed supply (Cutler & Sheiner, 1993) and, therefore, reduced price. To capture this...
effect, this study uses an index of 1989 state Medicaid payment per recipient developed in a previous study (Little, 1991); the index uses a standardized payment measure that assumes each state had the same mix of Medicaid recipients (e.g., medically needy, categorically needy) but paid state costs and denotes average Medicaid payment per recipient as 1.0. In the present study, Medicaid Generosity indicates states that have more generous reimbursement policies, i.e., which have a ratio above 1.0. Table 1 reports descriptive statistics for the NLTCS sample for the first month that each person appears in the sample.

Markov Model of Functional Status

The Markov model of functional status used here is identical to that presented in Laditka and Wolf (1998). The model assumes that month-to-month transitions within the set of discrete states is described by a first order Markov chain. Three nonabsorbing functional status states are defined: unimpaired (U), or active; moderately impaired (M), or having one or two ADL limitations; and severely impaired (S), or having three to five ADL limitations. Death (D) is included as an absorbing state. Thus, this study models the multichotomous variable STATUS, which takes on values U, M, S, and D. The probability of occupying any functional status state the next month (+1) depends on the status occupied in month t, on age in month t, and on an individual’s race and level of education, where race and level of education are coded as previously described. The monthly transition probabilities are written as a multinomial logistic regression model, and estimates of the unknown parameters are obtained using maximum likelihood techniques. The model generates a series of age-specific matrices of transition probabilities from one state to another in one-month time intervals.

Imputation of Functional Status

To incorporate monthly functional status information into the hazard models of nursing home admission and discharge, the sequences of monthly values of functional status for the months between the NLTCS survey dates are treated as missing data. The monthly transition probabilities developed from the Markov model are used to predict the missing values for each succeeding month between each NLTCS respondent’s actual survey interviews for those participants who share exactly the same limited set of characteristics (e.g., race, education) as individuals in the LSOA. For example, if a woman has ADL code i and covariate values X, in month t, the model generates the four transition probabilities \( p_i(t+1), p_M(t+1), p_S(t+1), \) and \( p_D(t+1) \) corresponding to the possible functional status states occupied the next month. These four probabilities are then mapped onto corresponding subregions of the 0.1 interval: Subregion 1 is the interval from 0 to \( p_i(t+1) \), subregion 2 is the interval from \( p_i(t+1) \) to \( [p_i(t+1) + p_M(t+1)] \), and so on. Next a computer-generated random number from the uniform (0,1) distribution is drawn. Finally, a particular value (1, 2, 3, or 4) for the next month’s functional status is assigned, depending on the subregion into which the random number falls. The preceding steps are repeated until the observed functional status value for the subsequent interview date is reached, with the requirement that the final predicted functional status value be the same as the actual functional status value on the date of the subsequent interview.

Hazard Models of Nursing Home Use

Discrete-time hazard models were estimated to examine the influence of the covariates on the probability that individuals will be admitted into or discharged from a nursing home on a monthly basis. The dependent variables were developed using monthly information about nursing home admissions and discharges from the 1984 and 1989 NLTCS surveys, which collected retrospective information about the months and years of nursing home admissions and discharges for each individual’s three most recent nursing home stays. The dependent variables are dichotomous and represent the probability of transitioning from one state to another on a monthly basis. Two types of transitions were modeled: individuals residing in the community who faced the risk of transitioning into a nursing home during the month and persons residing in a nursing home who faced the risk of transitioning to the community during the month.

A person residing in a nursing home for any portion of a month was assumed to reside in the nursing home for the entire month. These data do not allow researchers to distinguish between live transitions to the community or a hospital, so all persons who were discharged alive from a nursing home were assumed to be discharged to the community. Because no subsequent information about nursing home use is known, nursing home spells in progress at the time of the 1984 interview were right censored at that month for individuals interviewed in 1984 but not 1989. All nursing home spells in progress at the 1989 interview were right censored at that month for the same reason. In the NLTCS sample used in this study, the average length of time spent in a nursing home was 4.3 months for men and 6.8 months for women; 25% of men and 29.9% of women were admitted into nursing homes during the survey period.

Microsimulation of Nursing Home Admission and Discharge

Microsimulation techniques were used to examine the long-range implications of the hazard model coefficients. The simulation consisted of two steps. In the first step,
monthly functional status histories were simulated for synthetic cohorts of 100,000 men and women, beginning at age 70 and ending in death. Laditka and Wolf (1998) describe the starting population and the microsimulation of functional status histories. Next, using the same starting population, the coefficients from the hazard models were used to assign codes representing the probability an individual would be admitted into or discharged from a nursing home, on a monthly basis, beginning at age 70. In the first month of the nursing home microsimulation, for example, for a woman with covariates X, in year t, the model generated two probabilities: the probability that she would remain in the community the next month, \( P_{C(t+1)} \) and the probability that she would transition into a nursing home the next month, \( P_{H(t+1)} \), i.e., \( 1 - P_{C(t+1)} \). These two probabilities were then mapped onto corresponding subregions of the 0,1 interval. Subregion 1 is the interval from 0 to \( P_{C(t+1)} \); subregion 2 is the interval from \( P_{C(t+1)} \) to \( (P_{C(t+1)} + P_{H(t+1)}) \).

Next, a computer-generated random number from the uniform (0,1) distribution was drawn. Finally, the value for the next month’s residence state was assigned, depending on the subregion into which the random number fell. The preceding steps were repeated for each successive month until the individual’s death was simulated.

All individuals began the simulation in the community and were assumed to live in a state that has a medically needy program and generous Medicaid reimbursement policies. The 200,000 simulated life histories for men and women were treated as data to be summarized; total expected residence in a nursing home for women, for example, is simply the average simulated time spent in a nursing home at death among the 100,000 simulated histories of women.

Changes in the Dynamics of Functional Status

The assumptions of improving health reflect two types of improved morbidity: the rate of an individual’s decline in functional status may decrease or a person’s rate of recovery may increase. Table 2 illustrates these changes. A + indicates an increase in the probability, a - denotes a decrease in the probability, and a 0 means there was no change in the probability. The upper panel of Table 2 shows the modifications made in decreasing the rate of functional status decline. For a person who began an interval unimpaired, the probabilities of becoming moderately or severely impaired were reduced, and the probability of remaining unimpaired was increased. If an individual began an interval moderately impaired, the probability of remaining moderately impaired was increased, and the probability of becoming severely impaired was decreased. Finally, because mortality was not changed in this simulation, when a person began an interval severely impaired, no changes were made. The lower panel of Table 2 illustrates the modifications reflecting an increase in recovery. These modifications were incorporated into the simulation of lifetime functional status histories, or the first step in the microsimulation of lifetime nursing home use. In addition to the baseline simulation, 12 simulations were performed, 6 each for men and women, in which the probabilities for a decrease in the rate of decline and an increase in the rate of recovery were altered in steps of 10%, ranging from 10% to 30%.

RESULTS

Hazard Models of Nursing Home Admission and Discharge

The results of the hazard models are reported in Table 3, which displays the coefficients, the standard errors, and (for dichotomous variables that are statistically significant only) the odds ratios. In general, increasing age is significantly associated with an increased risk of nursing home admission and a decreased risk of discharge. Non-White men and women are significantly less likely to be admitted into nursing homes than White men and women. Once admitted, non-White women are significantly less likely to be discharged than White women. Moderately and severely impaired men and women are significantly more likely to be admitted than those who are unimpaired persons; women who are severely impaired are significantly less likely than unimpaired women to be discharged. The duration variables show that the probability of discharge to the community substantially decreases over time for both men and women. Women with less education are less likely to be admitted than women with more education, but once admitted, women with less education are less likely to be discharged. Education is not significantly associated with nursing home use for men. Women who reside in states that have generous Medicaid reimbursement policies are at a significantly higher risk of being admitted into a nursing home and are less likely to be discharged than women who live in states with less generous policies. The presence of a medically needy program in a state is not significantly associated with nursing home use for either men or women.

Microsimulation of Nursing Home Histories

Results of the baseline microsimulation, shown in Table 4, illustrate two types of life table indices of nursing home use. These results are displayed by gender, race, selected ages, and (for Whites only) educational attainment. The first set of results shows the percentage of each cohort living in the community or in nursing homes, given survivorship. For all ages, the proportion of the cohort of women living in a nursing home exceeds that of men; these gender differences are substantial at older ages. At age 95, for example, the
percentage of the cohort of women residing in a nursing home is four times that of men. For both men and women there are substantial differences in the racial subgroups; a smaller proportion of the non-White cohort resides in nursing homes than the Whites. For men, a substantially smaller percentage of the more educated cohort resides in a nursing home than the less educated cohort. For women, there are no appreciable educational differences. Finally, for both men and women, the proportion of the cohort residing in a nursing home increases with increasing age.

The last three columns of Table 4 show total life expectancy (TLE) and a partitioning of this measure into the average number of years individuals can expect to live in the community and in a nursing home. At all ages, women can expect to spend more of their remaining lifetimes in nursing homes than men: At age 85, women can expect to spend about 30% of their remaining lives in nursing homes compared with about 10% for men. The percentage of remaining life spent in nursing homes increases with age for both men and women. Although women’s education levels do not affect the proportion of their remaining lives spent in nursing homes, for men, increased education is associated with a slightly larger proportion of life spent in the community.

Table 5 presents two additional measures of nursing home use. The first is the frequency distribution of the number of distinct nursing home spells, which is displayed as the percentage of a cohort that has 0, 1, 2, and 3 or more spells of nursing home use. The frequency distribution results show that women have a substantially higher percentage of spells of nursing home use than men. There are substantial racial differences in the spells of nursing home use. Racial differences are most pronounced for men: The risk of experiencing one nursing home spell for non-White men is only half of that for White men. Educational differences influence the prevalence of spells of nursing home use. Educational differences influence the prevalence of nursing home spells as follows: For men, more education is associated with fewer spells of nursing home use, but the opposite is true for women, for whom more education is associated with more spells. The second result shown in Table 5 is the average length (in months) of nursing home stays. The average nursing home
Table 4. Life Table Indices of Nursing Home Use: Selected Population Groups and Ages

<table>
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<tr>
<th>Population Group</th>
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<th>Nursing Home</th>
<th>TLE</th>
<th>Community</th>
<th>Nursing Home</th>
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<td>12.1</td>
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<td>80.8</td>
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<td>3.6</td>
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</tr>
</tbody>
</table>

Note: TLE = total life expectancy. Percentage given survivorship.

Table 5. Frequency Distribution and Average Length of Nursing Home Spells: Selected Population Groups

<table>
<thead>
<tr>
<th>Population Group</th>
<th>Distribution by Number of Spells (%)</th>
<th>Average Length (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
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<tr>
<td>Men</td>
<td>82.7</td>
<td>15.8</td>
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<tr>
<td>Non-White</td>
<td>91.2</td>
<td>8.4</td>
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<td>White</td>
<td>81.9</td>
<td>16.4</td>
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<tr>
<td>Low Education</td>
<td>80.0</td>
<td>18.2</td>
</tr>
<tr>
<td>High Education</td>
<td>83.1</td>
<td>15.4</td>
</tr>
<tr>
<td>Women</td>
<td>63.8</td>
<td>31.2</td>
</tr>
<tr>
<td>Non-White</td>
<td>79.6</td>
<td>20.1</td>
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<tr>
<td>White</td>
<td>62.3</td>
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<td>Low Education</td>
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<td>30.6</td>
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<tr>
<td>High Education</td>
<td>60.5</td>
<td>33.1</td>
</tr>
</tbody>
</table>

Note: Rows may not sum to 100% due to rounding.

stay for women exceeds that of men by about 19 months. Differences by gender, race, and education in the average duration of nursing home spells exist, but for the most part are less notable than the differences in the incidence of nursing home episodes. The results displayed in Table 5 do not change appreciably in the simulations assuming better health, although for both men and women, there is a small reduction of the prevalence of nursing home spells with better health.

Table 6 displays selected results from the baseline simulation and the simulations that reflect better health. Table 6 reports the same life table indices shown in Table 4 by gender at age 75 and the percentage of the cohorts of men and women who will use nursing homes during their lifetimes.
The first set of results shows that improved health is associated with a slightly larger percentage of the cohort residing in the community and a slight reduction in the proportion of the cohort in nursing homes. The second set of results shows that improved health increases total life expectancy for both men and women. This is true for decreasing the rate of decline and increasing the rate of recovery; however, the results are more pronounced for decreasing the rate of decline. Each 10% reduction in the rate of decline is associated with an additional 0.3 years of life for men and 0.4 years for women. Longer total life expectancy increases the absolute amount of time that older adults can expect to reside in both the community and in nursing homes. For example, in the simulation of a 30% decrease in decline, the lifetime nursing home use for men is about 17% higher than in the baseline simulation; for women in the same simulation, lifetime nursing home use increases by 10%. Improved health does not change the relative amount of life spent in nursing homes for men or women; for example, in both the baseline simulation and the simulation of a 30% decrease in decline, women at age 75 can expect to spend about 17% of their remaining lives in a nursing home. Although this study focuses on the results of the simulations of improving health by gender only, the age, racial, and education-level differences described in Table 4 are also present in the simulations of improved health.

Information from the frequency distribution results shown in Table 5 was used to tabulate the percentage of the cohort that will use nursing homes over the course of their lifetimes. These results are reported in the final column of Table 6. According to the baseline simulation, 17.3% of men, 36.2% of women, and 30.5% of men and women combined will use nursing home services over the course of their lifetimes. The combined estimate was obtained by weighting the separate estimates for men and women by the proportion of the NLTCS sample members who were male and female. The percentages of lifetime nursing home use obtained in the baseline simulation do not change appreciably under the simulations of better health. In the simulation decreasing the rate of decline by 30%, for example, the proportion of the cohort of men who will ever use nursing homes decreases by 2% compared with the baseline simulation; the analogous figure for women is a 1% increase. In the six simulations of better health for men, the percentage of the cohort that will use nursing homes ranges from 16.9 to 17.1; the corresponding range for women is 36.1–36.7.

**DISCUSSION**

Faced with a dramatic increase in the number of older Americans as members of the baby boom generation age, and the notable improvements in active life expectancy during the 1980s and 1990s, it is useful to examine the consequences of better health on older adults’ use of long-term care services. The methodological techniques used in this analysis allow researchers to address this issue by examining the effect of improved morbidity on lifetime nursing home use. Three hypotheses were tested in this study. In contrast with what was hypothesized, when increased longevity came as a result of better health, the proportion of life spent in a nursing home (i.e., relative nursing home use) did not decrease or change. Second, better health did not appreciably reduce the proportion of the cohorts that used nursing homes. The findings for the first two hypotheses are likely to reflect the degree to which functional status...
influenced nursing home use in this study. Although functional status was significantly associated with nursing home use in this analysis, as other researchers have concluded, many other factors play an important role in lifetime nursing home use (Murtaugh et al., 1997).

There was support for the third hypothesis. Better health did result in an increase in the absolute number of years older persons spent in nursing homes. This result implies that if morbidity improves there will be an increase in the use of long-term care services—an increase above that which researchers should expect from the anticipated larger number of older adults alone. This study also found that better health is associated with increases in total life expectancy and the number of years people lived in the community. Increases in total life expectancy were more pronounced when better health was modeled by a decrease in functional status decline rather than an increase in the rate of recovery; although recovery is possible (e.g., in the case of an injury from an accident), many more older adults experience deteriorating functional status than improving functional status.

Collectively, these findings imply that for the majority of people, better health extends independence; it does not increase the risk of institutionalization during the more advanced years that they will live thanks to their improved health. For individuals and our society as a whole, this finding offers a clear goal and incentive: maintaining or improving health status has a dual payoff, both increased longevity and better health through much of that increased life span. The finding that better health yields an increase in the absolute amount of time spent living in the community implies that improved morbidity is likely to allow a larger percentage of older adults to remain active in the political and economic life of their communities. Thus, there may be greater demands for resources from this group over a longer period of time than previously anticipated.

Consistent with prior lifetime nursing home use studies, this study shows that women use nursing homes substantially more than men; increased age is associated with substantially greater nursing home use; non-Whites use nursing homes notably less than Whites; persons who are more impaired use nursing homes more than less impaired persons (Kemper & Murtaugh, 1991; Murtaugh et al., 1990; Vincente et al., 1979); and a substantial minority of men and women can expect to experience one nursing home stay, although instances of more than two distinct stays are few (Murtaugh et al., 1997). Taken as a whole, these results reinforce the findings of previous studies: There are substantial differences in nursing home use across various subgroups of older persons. The 30.5% lifetime nursing home use estimate for men and women combined, obtained in the baseline simulation in this study, is somewhat lower than estimates obtained in previous studies, which fall in the range of 35% to 39% (Dick et al., 1994; Kemper & Murtaugh, 1991; Murtaugh et al., 1997). Because this study uses a new approach to estimating lifetime nursing home use and a different combination of data sets than those used in prior studies, it is not possible to isolate the reasons for differences in results across studies without further investigation.

Several limitations of this analysis should be recognized. First, relatively few covariates were included in the hazard models. Microsimulation techniques make it computationally complex to incorporate time-varying covariates (e.g., marital status) because variables that are not fixed must be treated as endogenous. The omission of potentially important variables may have biased the results. Second, the use of imputed monthly functional status data introduces an unknown degree of measurement error into the estimates of nursing home use. However, the results of several specification tests of a Markov model similar to the one used in this study offer encouragement: Norton (1992) concludes that a Markov model is a reasonable way to estimate functional status transitions. Third, hospital admissions were considered to be part of community residence. This treatment is consistent with prior research (Dick et al., 1994), and is necessary because of the way in which nursing home and hospital admission and discharge information was collected in the NLTCs survey; the survey does not allow nursing home spells broken by a brief period of hospitalization to be linked into an episode of nursing home use. Thus, the lengths of stay in this study tend to be underestimated. In addition, although the frequency distributions of nursing home spells reported in Table 5 suggest differences among subgroups, it should be noted that a percentage of these spells reflect discharge to a hospital instead of discharge to the community.

Another limitation of this study is that, because of computational considerations, functional status histories were determined outside of the nursing home models. As there is evidence that an individual’s functional status depends, in part, on whether he or she resides in a nursing home (Wolinsky, Callahan, Fitzgerald, & Johnston, 1992), it would have been more realistic to develop monthly functional status estimates within the models. The fact that the functional status histories were determined outside of the models of nursing home use, rather than simultaneously, is most likely the cause of an inconsistency between the educational differences in the microsimulation results of lifetime nursing home use and the models developed to predict nursing home use. In the microsimulation results, men with less education used more nursing home services than did men with more education. Yet in the models of nursing home use there were no significant education effects for men. For women, in the simulations of lifetime nursing home use there were no notable education-level differences; however, there were significant educational effects in the models of nursing home use. The functional status histories used in this study were based on estimates developed by Laditka and Wolf (1998), who derived functional status estimates from the LSOA. Laditka and Wolf found strong education-level differences for men in total and active life expectancy; for women, the education differences were less pronounced. The education-level differences found in Laditka and Wolf were incorporated into the micro data set used in the present study through the simulations of functional status histories; it is likely that these education-level differences account for differences in lifetime nursing home use found here. The models of nursing home use in this study were based primarily on the NTLCS, which may have had different education effects than the LSOA.

The most important limitation of this study is that better
health was modeled by improving morbidity rates; mortality changes were modeled only as affected by morbidity improvements. This modeling feature tends to reduce lifetime nursing home use to the extent it is directly influenced by functional status. How might lifetime nursing home use change if the effects of both improved morbidity and mortality were modeled simultaneously? Previous research has shown that improving mortality and morbidity rates simultaneously by exactly the same percentage results in an unchanged percentage of life spent in an impaired state (Crimmins et al., 1994). This finding suggests that modeling both improved morbidity and mortality might be associated with greater relative use of nursing homes and a higher proportion of the cohort of older adults using nursing homes than this study found. The final result would depend on the relative changes in mortality and morbidity rates. As researchers have stressed, if mortality rates are reduced by major medical advances that reduce fatal diseases, without associated reductions in chronic conditions there could be substantially more people living more impaired years, which could dramatically increase the need for long-term care and other services (Branch et al., 1991; Gruenberg, 1977). Longitudinal studies that examine functional status changes of older adults in the baby boom generation will shed additional light on these issues. In the meantime, this analysis provides information that can inform further research.

Finally, these results have implications for future research. Useful next steps would be to apply the methods presented here to an examination of the patterns of functional status and nursing home use of a more recent cohort of older adults, and to refine the models. In the first of these areas, the methods used here could be applied to the Survey of Asset and Income Dynamics of the Oldest Old (AHEAD), a longitudinal survey of older persons currently underway. The AHEAD survey collects detailed information about functional status, nursing home use, individual wealth, and family living arrangements. These data allow researchers to incorporate important additional information into the models estimating functional status and predicting nursing home use. In the second area, the model used to estimate monthly values of functional status could be enhanced to reflect trends in patterns of morbidity and mortality. This enhancement is important given the evidence of notable decreases in the prevalence of disability in recent longitudinal studies (Manton et al., 1997). Further research in areas such as these would improve estimates of lifetime nursing home use and enhance researchers’ understanding of the interaction between changes in active life expectancy and the use of long-term care services.

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Address correspondence to Dr. Sarah B. Laditka, School of Business and Public Management, State University of New York Institute of Technology at Utica/Rome, PO Box 3050, Utica, NY 13504-3050. E-mail: laditks@sunyit.edu

REFERENCES


LIFETIME NURSING HOME USE


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Accepted February 25, 1998

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