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INDIVIDUALS' LIFETIME USE OF NURSING HOME SERVICES: A DYNAMIC MICROSIMULATION APPROACH

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Abstract

Despite the projected growth in the number of older Americans who will use nursing home services as the baby boom generation ages, there is little information about the total amount of time we can expect people to reside in nursing homes. I estimate individuals' lifetime use of nursing home services using data from the 1984-1990 Longitudinal Study of Aging and the 1982, 1984, and 1989 National Long-Term Care Survey. A Markov model of functional status was used to estimate monthly functional status transition probabilities. Discrete-time hazard models were estimated to determine characteristics that were associated with nursing home use. Microsimulation techniques were employed to impute monthly values of functional status, incorporate monthly information about individuals' functional status into the models that predict nursing home use, and examine the life-cycle implications of the nursing home use estimates. I find that substantially more women use nursing home services during their lifetimes than men (36 percent versus 18 percent). Nonwhite males use nursing homes significantly less than white males. Women who reside in states that have generous nursing home supply and demand factors use substantially more nursing home services than women living in states without these policies. With the projected large increase in the older population, these findings have important fiscal planning implications for the delivery of long-term care services.

Introduction

The huge anticipated increase in the number of older Americans as baby boomers pass age 65 early in the next century raises significant challenges for policy makers. High on the list of these challenges is financing the long-term care services this cohort will need. An equal challenge is anticipating the specific types of long-term care services required, to ensure that these services are available when needed.

Traditionally, the emphasis in long-term care has been on providing older people with services in institutional settings, in nursing homes. This emphasis is reflected in the fact that the cost of nursing home services dominates the long-term care market (American Academy of Actuaries 1994). Over 70 percent of all dollars spent on long-term care are spent for nursing home services (Wiener, Illston, and Hanley 1994). Estimated at about $70 billion in 1993, nursing home costs are more than twice the combined costs of home and community-based services (Levit et al. 1994). Nursing homes are also the most expensive component of long-term care services in terms of per patient cost. Average nursing home costs per person are about $35,000 annually, and these costs can be substantially higher in urban areas (Wiener, Illston, and Hanley 1994). Thus nursing home costs place an enormous financial burden on older individuals, who most often pay for these services with out-of-pocket dollars (Friedland 1990). Currently, the only national program that covers the costs of extended nursing home services is Medicaid, which requires individuals to “spend down” their resources to become eligible for coverage (Adams, Meiners, and Burwell 1993). Further, researchers largely agree that the number of people who will use nursing home services will increase dramatically over the next several decades as the older population grows—especially since the number of persons aged 85 and older, the heaviest users of nursing home services, is projected to increase substantially (American Academy of Actuaries 1994; Wiener, Illston, and Hanley 1994). Thus an improved understanding of how older people use nursing home services over the course of their lifetimes is important from fiscal and planning perspectives.

How do various factors affect how older persons use nursing home services over the course of their lifetimes? How does the use of nursing home services vary across different subgroups of the population of older persons? These questions are relevant to researchers, public policy makers, and private insurers alike. To make sound decisions about policies that would cover nursing home services, to develop plans that will address nursing home use by persons in the baby boom generation, policy makers need prospective information about the use of nursing home services. This need remains critical whether nursing home services are financed publicly, privately, or with some combination of public and private financing.

This paper provides three contributions to the research on the use of nursing home services, contributions that help us to address the sorts of questions just raised. First, I incorporate monthly information about individuals' functional status into equations that predict nursing home use. The fact that researchers often utilize information about individuals' functional status that was collected years prior to actual nursing home use is a significant limitation of previous research. After all, the functional status of an older person is likely to change over the course of several years. To address this limitation of much previous research, I specify the likelihood of an observed sequence of functional statuses in terms of *monthly* transition matrices. The model I use represents the probabilities that an older person of a given functional status and age will, in the next month, experience an improvement or decline in functional status, remain in the same functional status, or die.

Second, I use microsimulation techniques together with monthly estimates of functional status to combine information from two large surveys of older Americans, the 1984-1990

Longitudinal Study of Aging (LSOA) and the 1982, 1984, and 1989 National Long-Term Care Survey (NLTCS). The resulting data set contains actual and imputed monthly information about functional status, together with actual information about place of residence and other factors for a sample of older persons.

Finally, in order to better understand the nursing home use patterns of older persons, I employ microsimulation techniques to calculate the average amount of time individuals can expect to spend in the community or in a nursing home. Microsimulation allows me to develop individual-level projections about residence in the community and in nursing homes for a cohort of older persons, extending available data beyond its observed temporal limits. Specifically, the microsimulation approach allows me to examine the life-cycle implications of my hazard model estimates of nursing home admission and discharge. We can use this information to better understand the consequences of patterns of changes in functional status on nursing home use. In addition, policy makers can use this information to inform their planning for future services and financing of long-term care.

This paper proceeds as follows: I first consider previous research that is relevant for my study. Then, I describe the data and the methodology. Next, my results are presented. The paper concludes with a discussion of my major findings and their policy implications.

Background

A number of studies of lifetime use of nursing home services have been conducted. Researchers use various methodological approaches to estimate how people will use nursing home services over the course of their lifetimes.[1] These studies provide evidence that persons who live to older ages spend notably longer periods of time in nursing homes compared with people who die at younger ages (Cohen, Tell, and Wallack 1986; Dick, Garber, and MaCurdy 1992; Kemper and Murtaugh 1991; Liang and Tu 1986; Murtaugh, Kemper, and Spillman 1990; Vincente, Wiley, and Carrington 1979).[2] In addition, these studies find that women can expect to reside in a nursing home substantially longer than men (Kemper and Murtaugh 1991; Palmore 1976; Wiener, Illston, and Hanley 1994). Further, this research consistently finds that blacks spend notably less time in nursing homes compared with whites (Ellwood and Kane 1990; Palmore 1976; Kemper and Murtaugh 1991; Vincente, Wiley, and Carrington 1979).

Several studies of lifetime use of nursing home services examine the effect of socioeconomic status on lifetime nursing home use. Researchers most commonly use education or income as proxies of socioeconomic status. Studies using education as a proxy of socioeconomic status generally do not find evidence that use of nursing home services differs substantially among groups with differing levels of education (Kemper and Murtaugh 1991; Palmore 1976). In contrast, studies find that income is significantly associated with individuals' lifetime use of nursing home services. Ellwood and Kane (1990) find that a substantially higher percentage of individuals who are classified as poor at age 65 are likely to be in a nursing home compared with those having greater affluence. Vincente, Wiley, and Carrington (1979) also find that individuals with fewer financial resources have a greater lifetime risk of using nursing home services than persons with more financial resources. Palmore (1976), on the other hand, finds more affluent individuals have a higher lifetime risk of nursing home use than less affluent individuals. Palmore suggests that people with low income have difficulty gaining access to nursing home services.

There has been relatively little work done to incorporate variables that reflect community-level resources into models that estimate lifetime nursing home use. Murtaugh, Kemper, and Spillman (1990) find that the region of the country in which an individual resides has a significant effect on lifetime nursing home use. They speculate that state policies may influence nursing home use; however, they do not investigate this possibility further.

Finally, studies find that reduced functional status is associated with notably greater lifetime use of nursing home services (Ellwood and Kane 1990; Vincente, Wiley and Carrington 1979; Wiener, Illston, and Hanley 1994). An important limitation in this area of research is that many previous studies use only baseline information about individuals' functional status to predict nursing home use, information that can be years out of date by the time of a nursing home admission. The work of Wiener, Illston, and Hanley (1994) addresses this limitation in part. These researchers use the Brookings-ICF Long-Term Care Financing Model (the Brookings Model) and microsimulation techniques to project nursing home use. They use matrices representing annual transition probabilities among several disabled states as a factor in their nursing home simulation. One notable limitation of their model of functional status is that the transition probability matrices are constant over broad age intervals (i.e., 65 to 74, 75 to 84, and 85 and older). In light of these broad age intervals, it is likely that research that relies on this approach does a less satisfactory job of reflecting the dynamics of functional status in the model than year-of-age-specific matrices. Further, the Brookings Model permits only annual transitions in functional status.

As Wolinski et al. (1992) point out, we could improve the quality of information about nursing home use "by shifting from *static* to *dynamic* models" (Wolinski et al. 1992: S180;

emphasis in original). This study attempts such an improvement by using a dynamic model of functional status to examine the use of nursing home services. I examine the consequences of improving or deteriorating health in monthly time intervals on individuals' use of nursing home services; thus, my model is dynamic in its functional status dimension.

Another limitation of previous studies is that they do not include factors that reflect community-level resources in the model in a rigorous way. This is a serious omission in the literature, because better information about community-level resources would likely be useful from a policy perspective, as these factors can be more readily addressed by policy makers than characteristics such as race.

This study addresses this shortcoming by incorporating measures of nursing home supply and demand into the hazard models of nursing home admission and discharge. I build on research conducted by Cutler and Sheiner (1993). Cutler and Sheiner use data from the 1982 and 1984 NLTCS, and identify variables that they contend reflect exogenous nursing home care supply and demand factors. They call these variables state policy factors. These supply and demand variables reflect differences in Medicaid programs and Medicaid payment levels across states. Cutler and Sheiner use the presence of a medically needy program in a state as a nursing home demand factor. A medically needy program allows persons to deduct large medical expenses (e.g., nursing home expenses) from their income in order to qualify for Medicaid benefits (see Carpenter 1988 for a detailed review of medically needy program criteria). So states having medically needy programs allow individuals to qualify for Medicaid benefits with higher incomes than would be allowed in states without medically needy programs. An appropriate measure of nursing home supply, in Cutler and Sheiner's view, is the difference between a state's Medicaid per diem and a state's average private market per diem, which they call the underpayment amount. The underpayment amount is a proxy of a state's Medicaid payment generosity. For example, fewer nursing home beds may be built in states having larger underpayment amounts. Examining the consequences of nursing home supply and demand factors on lifetime use of nursing home services is likely to help policy makers better understand the effects of those factors involved in nursing home use that can be influenced by state policy.

Methodology

Data: The Longitudinal Study of Aging and the National Long-Term Care Survey

This research uses data from the 1984-1990 Longitudinal Study of Aging (LSOA) and the 1982, 1984, and 1989 National Long-Term Care Survey. Data from the LSOA are used to develop functional status transition estimates.[3] The LSOA is a six year follow-up study to the 1984 Supplement on Aging to the National Health Interview Survey.[4] The goal of the LSOA was to evaluate changes in functional ability and living arrangements in a cohort of older persons in the United States over time. The 1984 survey consisted of 7,527 individuals aged 70 and over who were living in the community. One of the strengths of the LSOA is that it sampled both functionally impaired and unimpaired individuals. As a result, I am able to model the transition between full and reduced functional status.

Data from the NLTCS are used to develop discrete-time hazard models of nursing home admission and discharge. There are several reasons why the NLTCS is preferable to the LSOA for this component of my study. First, the NLTCS provides information about the timing (i.e., month) of nursing home admission and discharge. While the LSOA did collect information about the timing of nursing home admission and discharge, it was unfortunately not coded into the LSOA public access files. A second advantage of the NLTCS is that it provides geographic identifiers, which enable us to determine the state in which each survey participant resides; this feature allows me to include state policy factors in my analysis.

The 1982 NLTCS provides nationally representative data on unimpaired and chronically impaired individuals aged 65 and older who lived in the community.[5] The 1984 NLTCS was designed to trace changes in individuals' functional status, and to track individuals who returned to a community residence from a nursing home. The 1989 wave of the NLTCS selected for re-interview those persons who survived to 1989, and who either received a detailed community residence survey or were in a nursing home in 1982 or 1984.

To be included in my sample, I required individuals to be at least 70 years old. Individuals who were 68 or 69 years old in 1982 were eligible to be included in my sample by 1984. This age criterion is required because I impute (or predict) missing values for functional status using information from functional status transition probability matrices, developed using data from the LSOA—which sampled only those individuals aged 70 and over. The imputation procedure is described below. In addition, to be included in my sample, individuals were required to be disabled in at least one of the three survey waves. This criterion is necessary because of the survey design of the NLTCS: information about functional status and other characteristics (e.g., educational attainment) was only obtained from individuals who had a documented disability in at least one of the survey waves. Further, I exclude individuals who were aged 70 in 1982 and were in a nursing home, and individuals who were aged 68 and 69 in 1982 and were in a nursing home in 1984. This sample selection criterion is required to make my sample comparable with that of the LSOA, since all LSOA sample members were aged 70 or over and living in the community during the first survey wave (i.e., 1984). The sampling criteria just described resulted in a total sample of 7,167 persons.

The covariates that predict nursing home admission and discharge can be usefully classified into three major categories, which were suggested by Andersen (1968) in his behavioral model of health care use. These categories are: (1) predisposing factors, or characteristics that exist prior to an individual's use of health care services; (2) enabling characteristics, those that influence an individual's access to health care services; and (3) need factors, which reflect an individual's health status.

The covariates in the predisposing category are age, race, level of education, and duration (which are only included in the hazard models of nursing home discharge). Age is measured in months. The race variable is coded as 1 if the individual is nonwhite, 0 otherwise. Education is based on completed years of schooling, and is coded 1 if a person had less than twelve years of schooling, 0 otherwise. Dichotomous "duration" variables are used in the hazard models of nursing home discharge to capture information about how the length of time that an individual spends in a nursing home influences the probability that he or she will be discharged from the nursing home. Previous research finds that factors reflecting individuals' past health are likely to influence the length of time, or duration, of their nursing home stay (Freedman 1993). The duration categories were selected based on an analysis of the distribution of the length of time (in months) that males and females spent in a nursing home before being discharged to the community. For males, two dichotomous duration variables were constructed. Duration 1 equals 1 while a male is in the first two months of his nursing home stay, 0 otherwise. Duration 2 is coded 1 while a male is in the third or later month of a nursing home spell, 0 otherwise. Duration 2 is used as the reference category. For females, four dichotomous duration variables were created. Duration 1 is coded 1 while a female is in the first two months of her nursing home stay, 0 otherwise. Duration 2 is coded 1 while a female is in the third month of her nursing home stay, 0 otherwise. Duration 3 is coded 1 while a female is in the fourth month of her nursing home stay, 0 otherwise. Duration 4 is coded 1 while a female is in the fifth or later month of a nursing home spell, 0 otherwise. Duration 4 is used as the reference or omitted category for females. Separate estimations were performed for males and females.

In the enabling factor category, I use two covariates as measures of nursing home supply and demand factors. I use the presence of a medically needy program in a state as a proxy of nursing home demand. Table 1 shows whether or not each state in the United States had a medically needy program in 1987. The medically needy variable is coded 1 if the state has a medically needy program, 0 otherwise.

I use a measure reflecting states' Medicaid payment generosity as a proxy for nursing home supply. The Medicaid payment generosity variable used in this research is based on an index of Medicaid payments per standardized recipient in fiscal year 1989 in relation to the United States average.[6] To standardize payments it is assumed that each state had the same mix of Medicaid recipients but paid state costs. In this index, the United States average Medicaid payment per recipient is denoted as 1.0. States having a ratio below 1.0 have less generous Medicaid payment policies; states with a ratio above 1.0 have more generous Medicaid payment policies. The Medicaid payment variable is coded as follows: States for which the ratio of Medicaid payments per standardized recipient is greater than 1.0 are coded as 1, states for which this ratio is less than 1.0 are coded as 0. Table 2 displays a breakdown of the generosity of states' Medicaid payment policies.[7]

Finally, in the need category, I use variables that reflect individuals' ability to perform activities of daily living (ADLs). The criteria for impairment for NLTCS sample members includes having difficulty performing ADLs, and requiring help with these activities (Verbrugge 1990). I focus on five ADLs in common use: bathing, eating, dressing, transferring, and using the toilet (Katz et al. 1963, 1983). The functional status categories are: unimpaired (no ADL limitations), moderately impaired (1 to 2 ADL limitations), and severely impaired (3 to 5 ADL limitations). Using these functional status categories, I develop two dichotomous functional status variables to incorporate into the hazard models of nursing home admission and discharge. Moderate impairment is coded 1 if an individual is moderately impaired, 0 otherwise. Severe impairment is coded 1 if an individual is severely impaired, 0 otherwise. Unimpairment is the reference category.

Table 3 shows descriptive statistics, except of the duration variables, in percent distributions for the predisposing and enabling factors. Table 4 displays the percentage of the NLTCS that is unimpaired, moderately impaired, severely impaired, and dead in each wave of the survey. Also shown are the percentages with missing information in one or more of the covariates (e.g., ADL status), the percentage of the sample that was not interviewed, and the percentage of cases lost to follow-up. As Table 4 shows, there are no substantial racial differences in functional status in the proportion of the sample lost to follow-up, or in the percent of the sample that had missing covariate values during each survey wave.

A Model of Functional Status Transitions

I adopt a simple stochastic process model of the evolution of functional status.[8] I define three discrete, nonabsorbing functional status states: unimpaired (or active), moderately impaired (1 or 2 ADL limitations), and severely impaired (3-5 ADL limitations). Death is included as an absorbing state. Thus I model the multichotomous variable $STATUS_t$ which takes on values 1, 2, 3, and 4 (corresponding to the states unimpaired, moderately impaired, severely impaired and dead).

The LSOA provides a series of up to four measures of functional status, each of which corresponds to an interview taken in an identified calendar month. Therefore, the natural time unit for my model is a month. It is important to note that a transition in functional status can occur in any month. Further, over a finite period (e.g., two years) several transitions in functional status can occur. Both of the features just described are captured by this model specification. Thus I model the path of functional status as a discrete-time first-order Markov chain with monthly transition matrix $P(t)$, a 4x4 matrix with typical element. Note that $p_{41}(t) = p_{42}(t) = p_{43}(t) = 0$ while $p_{44}(t) = 1$ due to the absorbing nature of death:

$$p_{ij}(t) = pr(STATUS_{t+1} = j \mid STATUS_t = i) \qquad (1)$$

(state 4). The assumed probabilistic structure of this model, while rather restrictive, is consistent with virtually all past research.

To parameterize the model just described, I use three multinomial logit expressions, one each for rows 1, 2 and 3 of $P(t)$. Each is of the form

$$p_{ij}(t) = \frac{e^{B_{if} X_t}}{\sum_{j=1}^{4} e^{B_{if} X_t}} \qquad (2)$$

for i = 1, 2, 3 and j = 1, 2, 3, 4. In (2) B_{ij} is a vector of coefficients to be estimated, and X_t is a vector of covariates measured in month t. For identification all elements of B_{i1} (for i = 1, 2, 3) are set to zero.

To illustrate my basic approach to estimation in this situation, suppose that $P(t)$ does not depend on age or time. Then the monthly transition matrix becomes P with elements p_{ij}. For observation n, let t_{1n} and t_{2n} be two months in which functional status is recorded, with $t_{2n} - t_{1n} = W$. Functional status at time t_{kn} is denoted $STATUS_n(t_{kn})$. Then the probability of occurrence of the observed event $\{STATUS_n(t_{1n}) = i_n \cap STATUS_n(t_{2n}) = j_n\}$ is given by the i,j^{th} element of the matrix P^W (i.e., the W^{th} power of the monthly transition matrix), denoted $P^{(W)}_{if}$. Then the log-likelihood of the data is

$$\sum_{n=1}^{N} \ln p^{(W)}_{i_n j_n}. \tag{3}$$

with each observation contributing one term per observed interview-to-interview interval. The advantages of this approach are apparent: it will accommodate arbitrarily long intervals between recorded functional statuses, permitting use of all observed between-interview intervals in the LSOA, while allowing for any pattern of (unrecorded) intervening transitions of functional status, thereby permitting relaxation of the assumption that no more than one functional status transition occurs between interviews.

In my implementation of this approach P is a step function of age, and in addition depends on the fixed covariates race and education. Thus P must be indexed by observation (n) and month (t), and each interview-to-interview observation contributes to the log-likelihood a term

$$\ln[P_n(t_{1n})P_n(t_{1n}+1) \ldots P_n(t_{2n}-1)]_{i_n j_n} \tag{4}$$

where $[\;\;]_{ij}$ represents the i,j^{th} element of the matrix found inside the brackets. Equation (4) represents the probability of reaching state j_n from state i_n in t_{2n} - t_{1n} months, when nothing is known about the intervening sequence of states. When an individual is known to have *died* in month t_{2n} this expression can be refined; in this case the contribution to the log-likelihood becomes

$$\ln \sum_{k=1}^{3} [P_n(t_{1n}) P_n(t_{1n}+1) \ldots P_n(t_{2n}-1)]_{i_n k}\, p_{k j_n}(t_{2n}). \tag{5}$$

Expression (5) represents the sum (over k) of the probabilities of following an arbitrary path from state i_n in month t_{in} to some status k (which must equal 1, 2, or 3), reached the month *before* death; then, in the final month, making a transition from status k to death.

The log-likelihood shown in equation (3) was maximized using the Gauss "maxmum" search algorithm, and using numerical calculations of the derivatives.[9] Separate estimations were performed for males and females.

Imputation of Functional Status

A significant shortcoming of the NLTCS, the LSOA, and other existing large surveys of older individuals is that functional status information is collected only as it exists at the time of the survey interview. In the NLTCS, this static snapshot information about individuals' functional status was collected on a maximum of three dates over an eight-year period. In order to incorporate *monthly* information for functional status into the hazard models of nursing home admission and discharge, I treat the sequences of monthly values of functional status for the months between NLTCS survey dates as missing data. I use the functional status transition probabilities estimated by the Markov model to predict the values of the missing functional status variables. Specifically, the Markov model of functional status transitions was used to develop a series of matrices of transition probabilities, identifying the probability of each transition from one functional status to another. These monthly matrices are single-year-of-age-specific and therefore enable me to predict the missing values of the monthly functional status variables for each succeeding month in the interval between each individual's actual survey interviews. Moreover, separate functional status transition matrices were developed from the LSOA for persons with each differing set of characteristics (e.g., age, gender, race), so the imputed monthly functional status values for each individual in the NLTCS evolve from probabilities associated with persons sharing exactly the same limited set of characteristics.

For each individual, I impute the values for functional status for each month between his or her interview dates. That is, individuals' functional status is known in their first interview date and their subsequent interview date. For example, if a male or female has ADL code i and covariate values X_t in month t, the model generates the four transition probabilities $p_{i1}(t+1)$, $p_{i2}(t+1)$, $p_{i3}(t+1)$, and $p_{i4}(t+1)$, corresponding to possible states occupied in the next month. These four probabilities are then mapped into corresponding subregions of the 0,1 interval: subregion 1 is the interval from 0 to $p_{i1}(t+1)$, while subregion 2 is the interval from $p_{i1}(t+1)$ to $[p_{i1}(t+1) + p_{i2}(t+1)]$, 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. My procedure requires that the final predicted functional status value be the same as the actual functional status value on the date of the subsequent interview. If the predicted functional status value does not match the actual functional status value, the simulation is repeated for the entire sequence of missing value, until agreement between predicted and actual functional status is obtained.

Using this imputation procedure to predict the missing values of functional status for NLTCS respondents introduces an unknown degree of measurement error into the estimates of nursing home use. However, the imputation procedure allows me to incorporate *monthly* measures of individuals' functional status into the models of nursing home admission and discharge.

Hazard Models of Nursing Home Admission and Discharge

Discrete-time hazard models were estimated to examine the influence of the covariates just described on the probability that individuals will be admitted into or discharged from a nursing home. The dependent variables in these hazard models are dichotomous and represent the probability that a person who resides in a given "state" at the beginning of an interval (i.e., one month) will transition to another "state" during the interval. I separately model two states: individuals can either reside in a nursing home or in the community. Thus I focus on the risk, or hazard, of two types of transitions: (1) individuals residing in the community at the beginning of the month face the risk of transitioning into a nursing home; and (2) persons residing in a nursing home at the beginning of the month face the risk of transitioning to the community during the month.

Instead of individual sample members, a "person-month" is the fundamental unit of analysis in the hazard models of nursing home admission and discharge. That is, each person in my NLTCS sample is at risk of making a transition during each month. Thus the number of person-months is the number of persons in the sample multiplied by the number of months that they are in the survey (up to a maximum of about 96 months). But since the hazard models used for this research condition on survival, this figure is adjusted by subtracting from the sample those people who die during the study period.

In the hazard model of nursing home admission, I assume that individuals' risk of transitioning from the community to a nursing home is constant over time, given their current age. I relax the assumption that there is no duration dependence in the hazard model of nursing home discharge. As researchers have demonstrated, the risk of discharge decreases with length of stay (e.g., Freedman 1993). Here I use the dichotomous duration variables to reflect how individuals' risk of discharge to the community changes over time. For males, 84 percent of the person-months were lived in a duration of three months or more in a nursing home, and 16 percent were lived in the first two months of a nursing home spell. For females, about 79 percent of the person-months were lived in a duration of five months or more in a nursing home, and about 21 percent were lived in the first four months of a nursing home episode.

In the hazard model for nursing home admission, the relevant sample for the nursing home admission hazard model is individuals who are in the community and face the risk of a nursing home admission. For each person-month in this sample, the dependent variable is coded 1 if a transition to a nursing home occurs during that month; and 0 otherwise. In the hazard model of nursing home discharge, the relevant sample is individuals who are in a nursing home and face the risk of discharge to the community. In this sample, for each person-month the dependent variable is coded 1 if a transition to the community occurs during that month and 0 otherwise. I assume that a person who resides in a nursing home for any portion of a month resides in the nursing home for the whole month.[10]

Thus, there are a total of four different hazard models, two each for males and females. For males, there were 71,038 person-months in the total set of persons at risk of making a transition (i.e., at risk of transitioning from the community to a nursing home or vice versa. For males in the nursing home admission model there were 70,860 person-months spent in the community, and 178 transitions into a nursing home. For males in the nursing home discharge model, there were 2,114 person-months spent in a nursing home, and 48 transitions to the community. For females, there were 195,144 person-months in the total set of persons at risk of making a transition. In the nursing home admission model there were 184,619 person-months spent in the community, and 633 transitions to a nursing home. In the nursing home discharge model, there were 9,741 person-months spent in a nursing home, and 151 transitions to the community.

The hazard model of transitioning from the community to a nursing home, $P_{C,N}$, is given by expression (6).

$$P_{C,N} = \frac{1}{1+e^{-B_1 Z_t}} \tag{6}$$

The hazard model of transitioning from a nursing home to the community, $P_{N,C}$ is given by expression (7).

$$P_{N,C} = \frac{1}{1+e^{-B_2 Z_t}} \tag{7}$$

B_1 represents the hazard coefficients, and Z_t represents the vector of covariates (e.g., age, race, and education) for $P_{C,N}$; and B_2 represents the hazard coefficients, and Z_t represents the vector of covariates (e.g., age, race, and education) for $P_{N,C}$.

Microsimulation of Nursing Home Use. The microsimulation of nursing home use consists of two steps. In the first step, or the functional status microsimulation, the functional status transition matrices developed by the Markov model were used to simulate a large sample of prospective monthly functional status histories ending in death. Synthetic cohorts of 100,000 males and females exactly 70 years old were created for use as the starting population for the microsimulation procedure. The gender, racial, and functional status composition of these cohorts was based on the characteristics of individuals aged 65 to 74 in the 1989 wave of the NLTCS. Additional information for creating the initial distribution of characteristics for the cohorts to be simulated was taken from census information on educational attainment (U.S. Bureau of the Census 1991), since educational attainment of the *nondisabled* NLTCS respondents cannot be determined. Table 5 shows the distribution by race, education, and functional status of the two radix populations used in the microsimulation of active life. As indicated in Table 5, several of the groups (in particular, disabled nonwhites in the "high education" category) were quite rare in the underlying NLTCS data.

In the functional status microsimulation procedure, the functional status transition matrices were used to assign (or predict) an individual's survivorship and functional status, month by month, from exact age 70 onward until death. This procedure is analogous to that described in the imputation of functional status approach. However, in contrast with the imputation approach, in which I require the final imputed functional status value to match the actual functional status value, in the functional status microsimulation I simulate functional status histories beginning at age 70 on a month by month basis until each individual is predicted to die.

In the second step of the nursing home microsimulation procedure, the monthly values of functional status that were obtained in the functional status simulation are used as the values of functional status in the nursing home admission and discharge hazard models. The estimated coefficients in the hazard models generate the probability that an individual will be admitted into or discharged from a nursing home in one-month time intervals. In this second step, these hazard models were used to simulate a large sample of prospective monthly nursing home histories.

The microsimulation of nursing home use procedure is similar to that of the imputation of functional status. In the first month of the nursing home microsimulation, for example, for a male or female with covariate values X_t in month t, the model generates two probabilities, the probability that he or she will remain in the community in the next month, $P_c(t+1)$, and the probability that he or she will transition into a nursing home the next month, $P_n(t+1)$ (i.e., $1-P_c(t+1)$). These two probabilities are then mapped into corresponding subregions of the 0,1 interval: Subregion 1 is the interval from 0 to $P_c(t+1)$, while subregion 2 is the interval from $P_c(t+1)$ to $[P_c(t+1) + P_n(t+1)]$. Next, a computer-generated random number from the uniform (0,1) distribution is drawn. Finally, a particular value (1 or 2) for the next month's residence state is assigned, depending on the subregion into which the random number falls. The preceding steps are repeated for each successive month until the individual has been simulated to die.

In the nursing home microsimulation procedure, the probabilities that an individual will be admitted into or discharged from a nursing home were used to assign (or predict) an individual's residence state (i.e., the community or a nursing home), month by month, from exactly age 70 onward, up to the month immediately preceding the age (in months) at which the functional status simulation predicted and assigned the individual's death. I assume that the entire cohort of males and females resides in the community in the first month of the simulation. Further, in each run of the simulation, I assume that the entire cohort lives in a state which has more generous nursing home supply and demand policies or, alternatively, lives in a state which has less generous policies for the entire simulation.

It is important to acknowledge a limitation of this research: functional status histories are determined independently of the nursing home admission and discharge models. That is, individuals' functional status histories are developed exogenously to the nursing home admission and discharge models. Because nursing home use is likely to have an effect on an individual's functional status (e.g., Wolinski et al. 1993), it would have been preferable to develop monthly functional status estimates endogenously, or within the models of nursing home admission and discharge. The most significant limitation in the approach employed in this research is that an individual's death does not depend on whether he or she was in a nursing home. In addition, the functional status at the start of each month *t* determines, in part, whether an individual is admitted to or discharged from a nursing home during month *t*. That is, information about an individual's functional status in previous months, e.g., *t-1*, *t-2,* does not play a role in whether a person will be admitted into or discharged from a nursing home during month *t*.

I use the large samples of simulated nursing home histories just described to calculate various summary indices: the 100,000 nursing home histories for males and females are treated as data to be summarized. Total expected residence in a nursing home for females, for example, is simply the average simulated time spent in a nursing home at death among the 100,000 simulated histories of women. Using this approach, it is easy to create summary measures of nursing home use for different subgroups of older men and women, as defined by age, race, and educational attainment. It also becomes possible to calculate nonstandard summary descriptive indicators, such as the frequency distribution of distinct episodes of residence in the community and in a nursing home, and average length of time spent in any given residence state. Summary indicators of this sort indicate the analytic power and flexibility of the microsimulation approach.

Results

Hazard Models of Nursing Home Admission and Discharge

The estimated logistic regression coefficients for the hazard models of nursing home admission and discharge are displayed in Table 6.

Hazard Models: Males. In the hazard model of nursing home admission, two of the three predisposing factors are statistically significant, age and race. I find that older males are significantly more likely to enter a nursing home than younger males, and that nonwhite males are significantly less likely to enter a nursing home than white males. The odds of a nursing home admission for nonwhite males are only 37 percent that of white males.[11] The coefficient for education was not statistically significant in the hazard model of nursing home admission.

In the hazard model of nursing home discharge, the only predisposing variable to emerge as statistically significant is duration 1. The odds of a male who is in the first two months of his nursing home stay being discharged to the community were 10.2 times that of a male who is in the third or later month of a nursing home spell. In the enabling category, none of the state policy variables was statistically significant in the hazard model of nursing home admission and discharge.

Finally, in the need category, the results show that males who are moderately or severely impaired were at significantly higher risk of being admitted to a nursing home compared with those who are unimpaired. The odds of entering a nursing home for males who were moderately impaired and severely impaired were, respectively, about 2.1 and 4.6 times those of males who were unimpaired. The coefficient for moderate impairment was not significant in the discharge hazard model. The coefficient for severe impairment was statistically significant in the nursing home discharge model. However, the sign of this coefficient indicates that men who are severely impaired are more likely to be discharged to the community. Since we would expect males who are more severely functionally impaired to be less likely to be discharged to the community, this result is counter-intuitive. A factor that may have contributed to this result is that very few (i.e., 48) males were discharged from a nursing home to the community. In addition, some men may have been discharged from a nursing home to a hospital. Unfortunately, these data do not allow me to distinguish between a discharge to a hospital and to the community. Thus both small sample size and the fact that several of these males may have been discharged to hospitals, and thus are likely to be in poor functional status, may have accounted for this result.

Hazard Models: Females. With the exception of education, all of the coefficients for the predisposing factors were statistically significant in the hazard models of nursing home admission and discharge. In the hazard of nursing home admission, increasing age was positively associated with nursing home admission. In addition, white females were at significantly higher risk of entering a nursing home than nonwhite females. The odds of a nursing home admission for nonwhite females were only about 50 percent that of white females. Further, I find that women with a lower level of education were significantly less likely to enter a nursing home than more highly educated women. The odds of entering a nursing home for females with low education are only about 82 percent that of females with high education.

In the hazard of nursing home discharge, increasing age was significantly associated with a reduced probability of discharge to the community. Once admitted into a nursing home, nonwhite females were significantly less likely to be discharged to the community. The coefficient on education was not statistically significant. The findings for the duration variables show that a female who is in the first four months of her nursing home stay was significantly more likely to be discharged from a nursing home than a female who is in the fifth or later month of a nursing home spell. The odds of being discharged to the community for a female in the first or second, third, and fourth months of her nursing home spell were, respectively, 21.9, 21.8, and 14.2 times those of a female who is in the fifth or later month of her nursing home spell.

The main finding for the enabling factors is that the coefficient for Medicaid generosity was statistically significant in the hazard models of nursing home admission and discharge. The odds of being admitted into a nursing home for females who live in a state with generous Medicaid payment policies are about 1.2 times those of females who live in a state without these policies. In the nursing home discharge model, the odds of being discharged to the community for females who live in a state with generous Medicaid payment policies are only 67 percent of those for females who live in states without these policies. The medically needy coefficient was not statistically significant in the nursing home admission or discharge hazard model.

For the need factors, I find that females who are moderately or severely impaired were significantly more likely to enter a nursing home compared with unimpaired females. The odds of being admitted into a nursing home for females who are moderately impaired and severely impaired are, respectively, about 2 and 4.4 times those of females who are unimpaired. In the nursing home discharge model the odds of being discharged to the community for females who are severely impaired are only 49 percent of those for females who are unimpaired. The coefficient for moderate impairment was not statistically significant in the nursing home discharge hazard model.

Microsimulation of Nursing Home Use

The next set of tables illustrates the results of my microsimulation analysis. To examine the effect of the state policy factors, I performed two simulations for males and females. In the first simulation, I assume that the entire cohort lives in a state which has a medically needy program and a generous Medicaid payment policy. In the second simulation, I assume that the entire cohort lives in a state which does not have generous nursing home supply and demand policies. I first describe the findings for the simulation that assumes the entire cohort of males and females lives in a state which has generous nursing home supply and demand policies. Next, for selected tables, and only for women, I present the percent difference in nursing home residence between the simulations with and without generous supply and demand policies.

Expected Residence Status. Table 7 shows average remaining total life expectancy (TLE), expected residence in the community (COM), and expected residence in a nursing home (NH) at selected ages by gender, race, and educational status. At all ages, females spend notably more time in nursing homes than males. At age 80 for instance, females can expect to spend about 21 percent of their lives in nursing homes, compared with about 10 percent for men. For both males and females, the percentage of remaining life spent in a nursing home increases with increasing age. For example, at age 95, females can expect to spend about 49 percent of their remaining lives in a nursing home; the comparable figure for females at age 75 is 16 percent.

Table 7 also shows that educational attainment does not have a significant effect on the percentage of remaining lifetimes that females can expect to spend in a nursing home. Females with more education can expect to live longer than females with less education. However, females with more education can expect to live a greater number of years in both the community and in a nursing home; the percentage of life spent in both the community and in a nursing home is similar for females of both education categories.

Educational attainment does affect the percentage of life that white males spend in a nursing home. White males with more education can expect to spend a smaller proportion of their remaining lifetime in a nursing home, compared with those having less education. At age 75, for instance, white males with more education can expect to spend about 6 percent of their remaining lifetimes in a nursing home, compared with 11 percent for those with less education.

Nonwhite females can expect to spend a lower proportion of their remaining lives in a nursing home compared with white females. At all ages, nonwhite males spend substantially less time in a nursing home (about half the time) compared with white males.

The percent differences between years spent in a nursing home between females who live in a state with generous supply and demand policies and females living in a state without these policies are shown in Table 8. For both race and educational attainment subgroups, females who live in states having generous nursing home supply and demand policies can expect to spend a notably higher percentage of their remaining lives in a nursing home compared with women who live in a state without these policies. At age 75, for instance there is a 27 percent difference between females who live in a state with generous supply and demand policies compared with those who live in a state without these policies.

Residence Status Distributions by Age. Table 9 displays the percentage of each cohort who were in the community, in a nursing home, or dead at selected five-year age intervals for older people living in a state that has generous supply and demand policies. For all ages, the percentage of the female cohort that is in a nursing home exceeds that for males. At age 85, for instance, the percentage of the female cohort in a nursing home peaks at about 9 percent. In contrast, the percentage of the male cohort in a nursing home peaks at about 4 percent, at age 80. At all ages, the percentage of the nonwhite male cohort that is in a nursing home is about half that of the white male cohort.

Table 10 shows the percent differences in the female cohort living in a nursing home between women who live in a state with generous supply and demand policies and women who live in a state without these policies, at selected ages. For both nonwhite and white females and for both educational attainment subgroups for the female cohort that lives in a state with generous supply and demand policies, a larger percentage of the cohort are residing in a nursing home compared with the female cohort living in a state without these generous policies. For example, at age 80, there is a 27 percent difference between females who live in a state with generous supply and demand policies compared with those who live in a state without these policies.

Frequency and Duration of Residence Status Episodes. The indicators presented in Tables 11 and 12 illustrate the types of information about episodes (or "spells") of residence status that are uniquely obtainable using microsimulation techniques. Information about the average number of consecutive months spent in each residence (i.e., community and nursing home) episode by gender, race, and educational attainment for persons who live in a state with generous supply and demand policies is shown in Table 11. The mean lengths of spells for females in both community and nursing home residence exceed that of males. For instance, the average nursing home stay for females exceeds that of males by about 11 months; the average spell of residence in the community for women exceeds that for males by about 1.8 years. The mean community and nursing home residence also differs by race. Nonwhite females can expect to experience notably longer spells in both the community and a nursing home compared with white females. Nonwhite males can expect to have substantially longer spells in the community and notably shorter spells in a nursing home than white males.

When females reside in states without generous supply and demand policies (results not shown), the mean length of time in the community is about five months longer, than that of females who live in a state with these policies. In addition, females who live in a state without generous supply and demand policies can expect to experience shorter mean lengths of stay in a nursing home, by 3 months, compared with females who live in more generous policy states.

Table 12 displays the frequency distribution of the number of episodes spent in the community and in nursing homes by gender, race, and educational attainment for persons who live in a state with generous supply and demand policies.[12] Females have a notably higher percentage of spells of nursing home use than males. For all females, 30.9 percent experience one nursing home episode and 5.0 percent experience two nursing home episodes. In contrast, only 16.5 percent of males experience one nursing home episode and 1.4 percent of males have two spells of nursing home use.

Nonwhite females experience substantially fewer episodes of nursing home use compared with white females. Only 21.3 percent of nonwhite females experience one nursing home episode and .3 percent experience two nursing home episodes; the corresponding percentages for white females are 31.8 and 5.4. Nonwhite males have substantially fewer episodes of nursing home use compared with white males.

A smaller percentage of females living in a state without generous supply and demand policies experience nursing home episodes compared with their counterparts who live in a state with more generous policies. For example, 67.6 percent of females who live in a state without generous policies experience zero episodes of nursing home use, compared with 63.62 percent of women who live in a state with these policies.

Percentage of the Cohort Ever, Currently, and New Users of Nursing Home Services. To further illustrate the advantages of the microsimulation approach, I use the simulated residence histories to determine the percentages of the male and female cohorts that would be in a nursing home at each year from age 70 until death. I calculate the percentage of the cohort that has "ever" used nursing home services as the cumulative percentage of those individuals who were new users of nursing home services. For women, I find that between 32.3 percent (in a state without generous nursing home supply and demand policies) and 36.4 percent (in a state with generous nursing home supply and demand policies) use nursing home services from age 70 to death. For men, I find that 16.7 percent (in a state with without generous nursing home supply and demand policies) to 18.1 percent (in a state with generous nursing home supply and demand policies) use nursing home services from age 70 to death.

Discussion and Policy Implications

The simulation of nursing home use described in this paper used a methodological feature not previously found in the research on nursing home use. Specifically, I used a dynamic model of functional status to develop lifetime estimates of functional status for a cohort of older persons. Information produced by this model was incorporated into discrete-time hazard models of nursing home admission and discharge. To examine the long-run implications of these models, I then employed microsimulation techniques to produce a data file to obtain summary indicators of residence status. An important question, then, is how my results compare with estimates previously obtained with more conventional methodological techniques.

Overall, my findings are in agreement with those obtained by previous research in three major areas. First, I find that women use nursing home services substantially more than men (e.g., Murtaugh, Kemper, and Spillman 1990; Palmore 1976). Second, I find that nonwhites use nursing home services less than whites, although this difference is substantial only for nonwhite males (e.g., Kemper and Murtaugh 1991). Finally, persons who are functionally impaired are significantly more likely to use nursing home services than individuals who are unimpaired (Wiener, Illston, and Hanley 1994).

My finding that women with less education are significantly less likely to enter a nursing home than women with more education may reflect the fact that women with less education in the NLTCS may have had more children than women with more education. With fewer children, more highly educated women may have less kin support, thereby incurring greater risk of nursing home use. Some support for this theory is provided in a preliminary descriptive analysis of data from the LSOA. The results of a cross-tabulation (not shown) between level of educational attainment and the number of living children indicated that a higher percentage of women with less education had living children than women with more education.

The findings that more generous Medicaid payments are associated with an increased probability that women will enter a nursing home and a decreased probability that women will be discharged to the community are consistent with those obtained by Cutler and Sheiner (1993). The medically needy variable in the hazards of nursing home admission and discharge for women was borderline statistically significant (at the 20 to 30 percent level) when it was included in hazard models without the generous Medicaid payment variable. Further, chi-square results (not shown) indicate that the medically needy and generous Medicaid payment variables are relatively strongly associated. Thus multicollinearity may be a factor in the fact that the medically needy variable was not significant in the final model. It is unclear why neither of the policy factors was statistically significant in the hazard models of nursing home admission and discharge for men. Several factors may have contributed to this result. First, men use nursing home services substantially less than women. Second, the sample size of men who were discharged from a nursing home to the community was small; this is likely to be the reason that only two coefficients were estimated with precision in the nursing home discharge hazard model.

When comparing the lifetime estimates of nursing home use obtained by my study with those obtained in previous studies, It is important to keep in mind that most previous studies estimate individuals' risk of nursing home services over a greater length of life. For example, some researchers have estimated individuals' lifetime risk of nursing home services from age 25 to death (Kemper and Murtaugh 1991) or from age 65 to death (e.g., Dick, Garber, and MaCurdy

1992; Murtaugh, Kemper, and Spillman 1990). The fact that I estimate individuals' lifetime use of nursing home services beginning at age 70 suggests that my estimates are likely to be lower than those of previous researchers. This is particularly likely in the case for men. Men die at younger ages than women (Kitagawa and Hauser 1973), so we can expect that a larger portion of any nursing home use they incur (vis-à-vis women) would arise before age 70.

Estimates of lifetime nursing home use obtained in this research and several recent studies are shown in Table 13. The estimates obtained in this research are in fact lower than those in previous research. However, the differences are notable only for males; for example, Kemper and Murtaugh (1991) estimate that 32 percent of men will use nursing home services between age 25 and death. In contrast with the results for men, the results obtained for women in this study are quite similar to those of previous studies. Overall, my results fall reasonably within the range of estimates obtained in earlier studies, despite the notable differences in methodology and data sets employed.[13]

My results suggest several important policy implications. First, nursing home supply policies significantly influence the use of nursing home services for women. Women who live in states having generous nursing home supply policies spend notably longer periods of time in nursing homes compared with women who live in states without these policies. This is the case for women at all ages (over 70) and racial groups, regardless of educational level. One practical implication of this finding is that states having more generous nursing home supply policies may be at risk of having a larger proportion of their female residents use nursing home services, and of spending more for nursing home care than states that do not have these kinds of policies. The importance of this finding is underscored by the trend toward devolution of the Medicaid program. If states substantially reduce their spending for Medicaid, this might reduce access to nursing home services.

In addition to its implications for nursing home utilization and cost, this finding has important consequences for individuals. Whether these consequences are perceived as harmful or beneficial will in part depend on the divergence between individuals' demand for nursing home services and the specific policies enacted by state legislators. If people get what they want from their state's nursing home policy, they will consider the policy to be beneficial. If the nursing home policy does not correspond to an individual's demand for services, he or she may feel harmed.

This begs the question of individuals' ability to accurately assess their own long-term care needs, that is, which level of nursing home use is appropriate. Are women who live in states with generous nursing home supply policies well served by spending longer periods of time in nursing homes? Are women who live in states without generous nursing home supply side policies necessarily less well off because they spend less time in nursing homes? These questions are extremely important for policy makers, older individuals and their families, and our society as a whole. However, they cannot be addressed using either the data available for this study or its results. But in light of these findings and those of previous studies, and in view of the dramatic increases in the population of older persons in our nation, they are important normative questions to raise.

My research highlights many important unanswered questions about the effects of race on the use of nursing home services. Overall, nonwhites use nursing home services less than whites; this difference is substantial for nonwhite males. These findings are consistent with those of previous research. Do nonwhites use nursing home services less because they tend to have stronger informal support systems? Or are nonwhites subject to widespread discrimination that restricts their access to nursing home services? A better understanding of the reasons for the substantial variation in nursing home use rates between whites and nonwhites will increase in importance as the nonwhite percentage of the population grows—and it is projected to grow rapidly by the beginning of the next century (Ahlburg and DeVita 1992).

Findings from this study are also likely to be useful from an actuarial perspective. Decision makers in both the public and private sector can use results from research such as this to improve their pricing of policies for nursing home coverage. If women use substantially more long-term care services than men, policies that cover nursing home services will cover women in a disproportionate share. One can readily imagine the impact of this gender difference on private insurance rates for nursing home services, and governmentally sponsored programs will necessarily consider these differences in their estimates of costs and need. Beyond this simple reaction to the observed risks of nursing home use for women, researchers would do well to further explore the causes of their increased risk. Is the risk primarily a result of increased age, women’s greater longevity? Or are other factors at work, factors that might be influenced by public policy? Causative factors for nursing home admission among older women include hip fractures, for example, and public policy could help promote scientific advances and public health campaigns to prevent and treat the osteoporosis that makes falls among older women more likely to result in fractures. Even if the primary cause of women’s increased risk is their greater longevity, their risk might nonetheless be reduced if public policy were to successfully target those diseases and conditions that yield declining functional status in older ages—arthritis, for example.

There are numerous ways in which the research presented here might be extended. One would be to investigate the effects of various trends in the dynamic model of functional status on nursing home use. Another would be to examine the consequences of various assumptions about functional status on the estimates of individuals' lifetime use of nursing home services. This is particularly important in light of recent evidence of a reduction in the prevalence of disability among older people during the 1980s (Manton, Stallard and Corder 1995). Finally, with new data collection efforts underway, such as the Survey of Asset and Health Dynamics of the Oldest Old (AHEAD), it will be possible to incorporate a richer array of variables into equations that predict functional status change and nursing home use.

TABLE 1

PRESENCE OF A MEDICALLY NEEDY PROGRAM, 1987

State	Program	State	Program
Alabama	No	Montana	Yes
Alaska	No	Nebraska	Yes
Arizona	No[a]	Nevada	No
California	Yes	New Hampshire	No
Colorado	No	New Jersey	No
Connecticut	Yes	New Mexico	No
Delaware	No	New York	Yes
Washington, D.C.	Yes	North Carolina	Yes
Florida	No	North Dakota	Yes
Georgia	No	Ohio	Yes
Hawaii	Yes	Oklahoma	No
Idaho	No	Oregon	Yes
Illinois	Yes	Pennsylvania	Yes
Indiana	Yes	Rhode Island	Yes
Iowa	No	South Carolina	No
Kansas	Yes	South Dakota	No
Kentucky	Yes	Tennessee	Yes
Louisiana	No	Texas	No
Maine	Yes	Utah	Yes
Maryland	Yes	Vermont	Yes
Massachusetts	Yes	Virginia	Yes
Michigan	Yes	Washington	Yes
Minnesota	Yes	West Virginia	Yes
Mississippi	No	Wisconsin	Yes
Missouri	Yes	Wyoming	No

[a]Arizona did not participate in Medicaid in 1987; this state did not cover long-term care services for residents in 1987.
Sources: Carpenter (1988); Cutler and Sheiner (1993).

TABLE 2

MEDICAID PAYMENTS PER RECIPIENT IN RELATION TO U.S. AVERAGE (1989)

State	Index Above (Below) 1.0	State	Index Above (Below) 1.0
Alabama	(Below)	Montana	Above
Alaska	Above	Nebraska	Above
Arizona	(Below)[a]	Nevada	Above
California	(Below)	New Hampshire	Above
Colorado	Above	New Jersey	Above
Connecticut	Above	New Mexico	(Below)
Delaware	Above	New York	Above
Washington, D.C.	Above[b]	North Carolina	Above
Florida	(Below)	North Dakota	Above
Georgia	(Below)	Ohio	Above
Hawaii	(Below)	Oklahoma	Above
Idaho	Above	Oregon	(Below)
Illinois	(Below)	Pennsylvania	Above
Indiana	Above	Rhode Island	Above
Iowa	Above	South Carolina	(Below)
Kansas	Above	South Dakota	(Below)
Kentucky	(Below)	Tennessee	(Below)
Louisiana	(Below)	Texas	(Below)
Maine	Above	Utah	Above
Maryland	Above	Vermont	Above
Massachusetts	Above	Virginia	(Below)
Michigan	(Below)	Washington	Above
Minnesota	Above	West Virginia	(Below)
Mississippi	(Below)	Wisconsin	Above
Missouri	(Below)	Wyoming	(Below)

[a]Arizona did not participate in Medicaid in 1989; this state did not cover long-term care services for residents in 1989.

[b]Washington, D.C., was not included in this component of Little's (1991) analysis.

Source: Little (1991).

TABLE 3

PERCENT DISTRIBUTION OF NLTCS SAMPLE PREDISPOSING AND ENABLING VARIABLES[a]

Independent Variables	Percent Distribution
Predisposing Factors	
Gender	
Males	30.2 (29.5)
Females	69.8 (70.5)
Race	
White	89.1 (89.2)
Nonwhite	10.9 (10.8)
Age[b]	
68-69	5.9
70-74	22.3
75-79	24.8
80-84	23.1
85+	24.8
Educational Attainment[c]	
High	29.6 (29.6)
Low	70.4 (70.4)
Enabling Factors	
Generous Medicaid Payment State	
Yes	43.6 (44.2)
No	56.4 (55.8)
Medically Needy Program	
Yes	61.9 (62.3)
No	38.1 (37.7)

[a]Percentage distribution of the usable sample shown in parentheses.
[b]Based on 1982 age distribution.
[c]High education = 12 or more years; low education = less than 12 years.
Total *n* = 7,167.

TABLE 4

PERCENTAGE OF NLTCS SAMPLE UNIMPAIRED, MODERATELY IMPAIRED, SEVERELY IMPAIRED, DEAD, VARIABLE MISSING, INTERVIEW NOT ATTEMPTED, AND CASE LOST TO FOLLOW-UP, AT EACH SURVEY YEAR BY GENDER AND RACE[a]

Gender/Race	Survey Date	Unimpaired	Moderately Impaired	Severely Impaired	Dead	Variable Missing	Interview Not Attempted	Lost ToFollow-Up
Males,	1982	24.7	24.3	20.5	N/A	1.7	28.9	N/A
Nonwhite[b]		(34.1)	(37.0)	(28.9)				
	1984	26.8	25.9	20.9	17.1	7.1	1.3	.8
		(30.8)	(27.4)	(26.6)	(18.1)			
	1989	7.5	18.4	16.3	54.4	2.1	.8	.4
		(10.0)	(23.2)	(20.2)	(50.5)			
Males,	1982	22.0	25.2	14.5	N/A	1.7	36.6	N/A
White[c]		(34.9)	(41.1)	(24.0)				
	1984	29.5	25.0	19.0	16.5	6.8	1.5	1.8
		(33.0)	(26.3)	(22.5)	(18.2)			
	1990	6.9	15.7	15.1	59.1	1.4	1.3	.5
		(9.3)	(20.0)	(20.2)	(50.5)			
Females,	1982	25.1	23.6	15.4	N/A	3.7	32.2	N/A
Nonwhite[d]		(36.9)	(36.0)	(27.1)				
	1984	33.3	23.4	18.2	11.2	8.8	4.5	.6
		(35.9)	(25.0)	(23.9)	(15.2)			
	1989	9.9	17.8	18.9	48.3	1.7	3.0	.4
		(12.9)	(22.3)	(24.6)	(42.2)			
Females,	1982	18.0	25.4	11.9	N/A	1.1	43.6	N/A
White[e]		(31.9)	(46.1)	(22.0)				
	1984	27.0	28.6	21.5	8.5	9.6	2.5	2.3
		(31.4)	(30.6)	(28.1)	(10.0)			
	1989	6.0	20.3	20.1	46.5	2.3	3.7	1.0
		(8.2)	(24.3)	(25.4)	(42.1)			

[a]Rows may not sum to 100 percent due to rounding; percentages of the usable sample appear in parentheses.
[b]Total sample size = 239.
[c]Total sample size = 1876.
[d]Total sample size = 534.
[e]Total sample size = 4518.

TABLE 5

DISTRIBUTION OF STARTING POPULATION USED FOR MICROSIMULATION OF LIFE EXPECTANCY[a]

Subgroup	Unimpaired	Moderately Impaired	Severely Impaired
Males			
Nonwhites, High Education[b]	2,549	45[c]	83[c]
Whites, High Education[b]	54,631	805	1,378
Nonwhites, Low Education[b]	5,042	470	382
Whites, Low Education[b]	31,462	1,409	1,744
Females			
Nonwhite, High Education[b]	2,583	52[c]	124[c]
White, High Education[b]	56,215	1,572	1,784
Nonwhite, Low Education[b]	5,167	363	470
White, Low Education[b]	27,662	2,021	1,987

[a]Source: 1989 National Long-Term Care Survey; persons aged 65-74; sample weighted by 1989 prevalence weight.

[b]High education = 12 or more years; low education = less than 12 years.

[c]Based on fewer than 10 observations.

TABLE 6

LOGISTIC REGRESSION COEFFICIENTS[a]

Independent Variables	Panel A: Males — Community To Nursing Home	Panel A: Males — Nursing Home To Community	Panel B: Females — Community To Nursing Home	Panel B: Females — Nursing Home To Community
Constant	-7.2815**** (.2742)	-5.14**** (.5049)	-6.9445**** (.1467)	-4.4822**** (.3661)
Predisposing Factors				
Age	.0310*** (.0117)	.0187 (.0217)	.0450**** (.00596)	-.0437*** (.0136)
Race	-.9949*** (.3389)	.2772 (.5629)	-.6865**** (.1758)	-2.2036** (1.009)
Education	.2613 (.1783)	-.2985 (.3133)	-.1985** (.0845)	-.2754 (.1721)
Duration 1	N/A	2.3178**** (.3085)	N/A	3.0858**** (.2450)
Duration 2			N/A	3.0816**** (.2851)
Duration 3			N/A	2.6534**** (.3235)
Enabling Factors				
Medicaid Payment Generosity	-.0186 (.1698)	.5807 (.3667)	.1639* (.0897)	-.4068** (.1865)
Medically Needy Program	.0973 (.1731)	-.4293 (.3758)	.0184 (.0933)	.2947 (.1939)
Need Factors				
Moderate Impairment	.7632**** (.2074)	.5227 (.3732)	.6921**** (.1125)	-.2460 (.2181)
Severe Impairment	1.5345*** (.2071)	.7593* (.4151)	1.4924**** (.1119)	-.7213*** (.2303)

[a]Standard errors in parentheses.
*p < .10; **p < .05; ***p < .01; ****p < .0001

TABLE 7

REMAINING TOTAL LIFE EXPECTANCY (TLE), EXPECTED RESIDENCE IN COMMUNITY (COM), AND EXPECTED RESIDENCE IN NURSING HOME (NM) IN YEARS AT SELECTED AGES, BY GENDER, RACE, AND EDUCATIONAL STATUS IN STATES WITH GENEROUS SUPPLY AND DEMAND POLICIES

	Age 70			Age 75			Age 80		
Subgroup	**TLE**	**COM**	**NH**	**TLE**	**COM**	**NH**	**TLE**	**COM**	**NH**
					Males				
All	11.3	10.7	0.6	8.9	8.2	0.7	6.8	6.1	0.7
Nonwhite	11.8	11.5	0.3	9.4	9.1	0.3	7.3	7.0	0.3
White	11.3	10.6	0.7	8.9	8.1	0.8	6.8	6.1	0.7
High Education[a]									
Nonwhite	13.2	13.0	0.2	10.1	9.9	0.2	7.7	7.5	0.2
White	12.1	11.5	0.6	9.3	8.6	0.6	7.0	6.4	0.6
Low Education[a]									
Nonwhite	11.2	10.9	0.3	9.1	8.7	0.4	7.1	6.7	0.4
White	10.0	9.2	0.8	8.1	7.2	0.9	6.3	5.4	0.9
					Females				
All	15.3	13.5	1.8	11.9	10.0	1.9	9.1	7.1	1.9
Nonwhite	13.9	12.4	1.5	10.6	9.0	1.6	8.1	6.4	1.7
White	15.4	13.6	1.8	12.0	10.1	1.9	9.1	7.2	1.9
High Education[a]									
Nonwhite	15.2	13.3	1.9	11.8	9.8	2.0	9.2	7.1	2.1
White	15.7	13.8	1.9	12.3	10.3	2.0	9.3	7.3	2.0
Low Education[a]									
Nonwhite	13.3	12.0	1.3	10.0	8.6	1.4	7.6	6.1	1.5
White	14.8	13.1	1.7	11.6	9.7	1.9	8.8	6.9	1.9

TABLE 7 (CONTINUED)

Subgroup	Age 85			Age 90			Age 95		
	TLE	COM	NH	TLE	COM	NH	TLE	COM	NH
					Males				
All	5.1	4.5	0.6	3.8	3.3	0.5	2.8	2.4	0.4
Nonwhite	5.5	5.2	0.3	4.3	4.0	0.3	3.3	3.1	0.2
White	5.0	4.3	0.6	3.7	3.2	0.5	2.8	2.3	0.5
High Education[a]									
Nonwhite	5.8	5.6	0.2	4.4	4.2	0.2	3.1	2.9	0.2
White	5.1	4.6	0.5	3.7	3.3	0.4	2.8	2.4	0.4
Low Education[a]									
Nonwhite	5.4	5.1	0.3	4.3	4.0	0.3	3.4	3.2	0.2
White	4.7	3.9	0.8	3.5	2.8	0.7	2.7	2.1	0.6
					Females				
All	6.7	4.8	1.9	4.9	3.0	1.9	3.5	1.8	1.7
Nonwhite	6.1	4.4	1.7	4.6	2.9	1.7	3.5	1.8	1.7
White	6.8	4.8	2.0	4.9	3.0	1.9	3.5	1.8	1.7
High Education[a]									
Nonwhite	6.8	4.8	2.0	5.1	3.1	2.0	3.9	2.0	1.9
White	6.9	5.0	1.9	5.0	3.1	1.9	3.6	1.8	1.8
Low Education[a]									
Nonwhite	5.7	4.1	1.5	4.2	2.7	1.5	3.2	1.7	1.5
White	6.4	4.6	1.8	4.6	2.9	1.7	3.3	1.7	1.6

[a]High education = 12 or more years; low education = less than 12 years.

TABLE 8

PERCENT DIFFERENCE IN EXPECTED RESIDENCE IN NURSING HOME FOR FEMALES: LIVING IN A STATE WITH GENEROUS SUPPLY AND DEMAND POLICIES COMPARED WITH LIVING IN A STATE WITHOUT THESE POLICIES

Subgroup	Age 75	Age 80	Age 85
All	27	19	19
Nonwhite	23	21	21
White	19	19	25
High Education[a]			
Nonwhite	25	31	25
White	25	18	12
Low Education[a]			
Nonwhite	17	15	15
White	7	7	20

[a]High education = 12 or more years; low education = less than 12 years.

TABLE 9

MEAN PERCENTAGE OF COHORT IN COMMUNITY (COM), IN NURSING HOME (NH), AND DEAD AT 5 YEAR INTERVALS BY GENDER, RACE, AND EDUCATION STATUS IN STATES WITH GENEROUS SUPPLY AND DEMAND POLICIES

	Age 75			Age 80		
Subgroup	**COM**	**NH**	**DEAD**	**COM**	**NH**	**DEAD**
			Males			
All	73.04	3.50	23.40	48.57	4.01	47.43
Nonwhite	76.30	1.40	22.30	53.05	1.53	45.42
White	72.74	3.69	23.57	48.14	4.24	47.62
High Education[a]						
Nonwhite	83.26	1.23	15.50	61.34	1.12	37.54
White	77.45	3.14	19.41	53.46	3.86	42.68
Low Education[a]						
Nonwhite	73.14	1.48	25.38	49.29	1.71	49.00
White	65.00	4.61	30.39	39.42	4.86	55.72
			Females			
All	83.93	4.21	11.86	63.93	7.39	28.68
Nonwhite	82.34	3.74	13.92	58.60	6.86	34.54
White	84.08	4.25	11.67	64.44	7.45	28.12
High Education[a]						
Nonwhite	84.02	3.81	12.18	62.63	7.68	29.68
White	84.91	4.16	10.93	65.56	7.44	26.99
Low Education[a]						
Nonwhite	81.57	3.72	14.72	56.75	6.48	36.77
White	82.53	4.43	13.05	62.32	7.45	30.23

[a]High education = 12 or more years; low education = less than 12 years.
Rows may not sum to 100 due to rounding.

TABLE 10

PERCENT DIFFERENCE IN MEAN PERCENTAGE OF COHORT IN NURSING HOME FOR FEMALES: LIVING IN A STATE WITH GENEROUS SUPPLY AND DEMAND POLICIES COMPARED WITH LIVING IN A STATE WITHOUT THESE POLICIES

Subgroup	Age 75	Age 80
All	23	27
Nonwhite	10	16
White	24	27
High Education[a]		
Nonwhite	5	14
White	21	28
Low Education[a]		
Nonwhite	12	17
White	31	25

[a]High education = 12 or more years; low education = less than 12 years.

TABLE 11

MEAN LENGTH OF RESIDENCE IN COMMUNITY AND NURSING HOME IN MONTHS, BY GENDER, RACE, AND EDUCATIONAL STATUS IN STATES WITH GENEROUS SUPPLY AND DEMAND POLICIES

Subgroup	Community	Nursing Home
	Males	
All	115.5	39.6
Nonwhite	129.9	32.8
White	114.2	39.9
High Education[a]		
Nonwhite	146.6	32.5
White	123.4	38.5
Low Education[a]		
Nonwhite	122.4	32.9
White	99.1	41.9
	Females	
All	37.0	50.3
Nonwhite	146.8	81.5
White	136.2	48.9
High Education[a]		
Nonwhite	157.1	87.8
White	136.1	47.1
Low Education[a]		
Nonwhite	142.1	77.8
White	136.5	52.9

[a]High education = 12 or more years; low education = less than 12 years.

TABLE 12

FREQUENCY DISTRIBUTION OF NUMBER OF EPISODES AT EACH RESIDENCE STATE, BY GENDER, RACE, AND EDUCATIONAL STATUS IN STATES WITH GENEROUS SUPPLY AND DEMAND POLICIES

	Community Episodes (in percent)				Nursing Home Episodes (in percent)			
Subgroup	**0**	**1**	**2**	**3+**	**0**	**1**	**2**	**3+**
					Males			
All	0.0	90.0	9.3	0.8	81.9	16.5	1.4	0.1
Nonwhite	0.0	93.7	6.0	0.3	90.1	9.3	0.6	0.0
White	0.0	89.6	9.6	0.8	81.1	17.2	1.5	0.1
High Education[a]								
Nonwhite	0.0	94.0	5.7	0.3	91.4	8.0	0.5	0.0
White	0.0	89.4	9.8	0.8	82.2	16.3	1.4	0.1
Low Education[a]								
Nonwhite	0.0	93.6	6.1	0.3	89.5	9.9	0.6	0.0
White	0.0	89.9	9.3	0.8	79.9	18.7	1.7	0.2
					Females			
All	0.0	84.0	14.2	1.8	63.6	30.9	5.0	0.6
Nonwhite	0.0	98.8	1.2	0.0	78.5	21.3	0.3	0.0
White	0.0	82.6	15.4	1.9	62.1	31.8	5.4	0.7
High Education[a]								
Nonwhite	0.0	98.2	1.8	0.0	75.0	24.8	0.3	0.0
White	0.0	80.7	17.0	2.3	60.4	32.7	6.2	0.8
Low Education[a]								
Nonwhite	0.0	99.1	0.9	0.0	80.1	19.7	0.3	0.0
White	0.0	86.3	12.5	1.2	65.5	30.2	4.0	0.3

[a]High education = 12 or more years; low education = less than 12 years.
Rows may not sum to 100 due to rounding.

TABLE 13

PERCENTAGES OF INDIVIDUALS' LIFETIME RISK OF USING NURSING HOME SERVICES

Study	Percentage Using Nursing Home Services
Laditka	27.8 - 31.0
Males	16.7 -18.1
Females	32.3 - 36.4
Dick, Garber, and MacCurdy	35
Kemper and Murtaugh	37
Males	32
Females	42
Murtaugh, Kemper, and Spillman	36.5
Males	27.6
Females	45

Endnotes

1. Methodological approaches used include: weighting procedures (e.g., Kemper and Murtaugh 1991; Murtaugh, Kemper, and Spillman 1990), life tables (e.g., Cohen, Tell, and Wallack 1986; Liang and Tu 1986), and microsimulation (e.g., Dick, Garber, and MaCurdy 1992; Ellwood and Kane 1990; Wiener, Illston, and Hanley 1994).

2. A prominent exception to the finding that nursing home use increases with increasing age is found in the research of Palmore (1976).

3. The sample and covariates used to develop functional status transition estimates are described in detail in Laditka (1995).

4. The design of the LSOA is described in detail in Kovar 1986a, 1986b and the U.S. Department of Health and Human Services 1992).

5. The design of the NLTCS is described in detail in Manton (1988) and Manton, Corder, and Stallard (1993).

6. This index was developed by Little (1991) for her analysis of variation in Medicaid costs and payments across U.S. states (Little 1991: 27).

7. To maximize the sample size for this research, I made two minor modifications to Little's (1991) classification scheme. First, I classify Washington D.C., which was not included in this portion of Little's analysis, to be a more generous Medicaid payment state (i.e., I assume this state's index exceeds 1.0). Second, I classify Arizona as a less generous Medicaid payment state. My rationale for these classification decisions are as follows: First, Washington D.C. has a medically needy program. The results of a chi square test (not shown) between states that have medically needy programs and more generous Medicaid payment states indicate that these two factors are significantly positively related. Thus it seems reasonable to assume that Washington D.C. would be a more generous Medicaid payment state. As for Arizona, this state does not cover long-term care services for its residents. Thus, it seems reasonable to assume that, at least with regard to generosity to people who require assistance with long-term care services, Arizona can be classified as a less generous Medicaid payment state.

8. For a detailed description of this methodology, see Laditka (1995) and Laditka and Wolf (1995).

9. For details about the Gauss "optmum" program used for this research, see Aptech Systems, Inc. (1992).

10. I took two additional steps to prepare these data for the hazard models. First, I eliminated all information about nursing home episodes that began prior to 1982. This step was necessary to confine the nursing home information to the NLTCS study period. Second, for people interviewed in 1984 but not 1989, nursing home spells in progress at the time of the 1984 interview are right-censored at that month. This is because no subsequent information is known. All nursing home episodes that are in progress at the 1989 interview are right-censored at that month, for the same reason.

11. Taking the natural antilogarithm of a dichotomous (0, 1) variable provides the relative hazard, or odds ratio, for the factor associated with the dichotomous variable, holding all of the other covariates constant. Log odds values that exceed 1.0 indicate an increased risk of nursing home admission or discharge, while log odds values less than 1.0 indicate a decreased likelihood of nursing home admission or discharge. Allison (1984) provides additional details about these calculations and their interpretation.

12. In my microsimulation of nursing home use I assume that the entire cohort of males and females resides in the community during the first month of the microsimulation. This explains why no males or females experience zero community episodes.

13. In addition to the results of the studies shown in Table 13, my findings are reasonably similar to those earlier studies of lifetime use of nursing home services. For example, Palmore (1976) estimates that 25 percent of individuals will use nursing home services over the course of their lifetimes. The corresponding percentages for Vincente, Wiley, and Carrington (1979), and Cohen, Tell, and Wallack (1986) are 39 and 43.1, respectively.

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