Home Health and Skilled Nursing Facility Use: 1982-90

Kenneth G. Manton, Ph.D., Eric Stallard, A.S.A., M.A.A.A., and Max A. Woodbury, Ph.D., M.P.H.

In this article, analyses are made of home health and skilled nursing facility (SNF) use for the period 1982-90 using Medicare records linked to data on community and institutional residents from the National Long-Term Care Surveys (NLTCSs) of 1982, 1984, and 1989. The combined survey and administrative data analyses are performed to ascertain how the chronic health and functional characteristics of community and institutional residents using Medicare-reimbursed services changed during the period. During this period, changes had been made in the Medicare system that affected the use of services for persons with specific health and functional problems.

INTRODUCTION

There have been large recent increases in home health agency (HHA) and SNF use by elderly Medicare beneficiaries. The increases can be due to changes in the size and structure of the U.S. elderly Medicare-eligible population, changes in its health and functional status, or in its service use. In evaluating changes, it is important to determine if increased HHA and SNF use is due to persons substituting HHA and SNF use for other services (e.g., short-stay hospitals) or to increased use by persons with specific health problems.

For the period analyzed (1982-90), Medicare changes occurred that affected HHA use by groups with different health and functional problems. In 1983, the prospective payment system (PPS) was instituted to control the growth of Medicare hospital reimbursement. Initially, PPS controlled both the duration and rate of hospitalization. There was concern whether HHA or SNF services would buffer potentially adverse effects of changes in hospital use—e.g., for vulnerable groups such as the oldest-old (persons 85 years of age or over) or persons with multiple chronic diseases or disabilities. Anticipated increases in HHA use in the mid-1980s did not materialize because of U.S. General Accounting Office studies (1981, 1986) that critiqued HHA accounting and management practices. Findings of these studies were confirmed by a 1984 HCFA evaluation (Helbing, Sangl, and Silverman, 1992). Denial rates for HHA services increased because of intensified review in 1986 and 1987 (i.e., denial rates of 6.0 percent and 7.9 percent, respectively [Helbing, Sangl, and Silverman, 1992]). Steps began in 1987 to return denial rates to pre-1986 levels: 2.5 percent in 1984 and 3.4 percent in 1985 (Health Care Financing Administration, 1990). Use increased from 1987 to 1990 (and beyond) because of the settlement of litigation on HHA coverage (*Duggan vs. Bowen*, 1988), which had two effects: (1) a broadening of the definition of part-time or intermittent care (effective November 1988) and (2) revision of manuals clarifying definitions of benefit eligibility (effective July 1, 1989).

A factor affecting SNF use was the Medicare Catastrophic Coverage Act (MCCA) of 1988. Through the MCCA, SNF provisions (removal of the 3-day prior hospital stay criterion; an increase in covered

This research was supported by Health Care Financing Administration (HCFA) Grant Number 500-89-0047 and National Institute on Aging Grant Numbers AG 01159 and AG 07025. The authors are with the Center for Demographic Studies, Duke University. The opinions expressed are those of the authors and do not necessarily reflect the views or policy positions of HCFA, the National Institute on Aging, or the Center for Demographic Studies, Duke University.

SNF days from 100 to 150; elimination of the episode-of-illness concept, providing a renewed 150-day eligibility in each year; changed copayment structure) were repealed in 1989. The provisions yielded a quadrupling of SNF use from 1988 to 1989. After MCCA's repeal, SNF eligibility criteria returned to 1988 standards. However, because of national nursing home changes (e.g., 1,624 new SNFs became Medicare-certified between December 1988 and December 1990; they contained 75,000 Medicare SNF beds [Helbing, 1992]) and changes in the definition of nursing home services in the 1987 Omnibus Budget Reconciliation Act (OBRA 1987), SNF use remained higher in 1990 than in 1988. It is likely to continue to increase because: (1) many SNFs invested in staff, equipment, and training; (2) nursing homes that had avoided Medicare participation were attracted by higher financial rewards; (3) a better geographic distribution of SNFs was achieved, especially in rural areas (also, many States required nursing homes to participate in Medicare to remain Medicaid-eligible); and (4) OBRA 1987 required Medicaid nursing homes to meet Medicare SNF standards (Office of Inspector General, 1991).

Although Medicare changes affected HHA and SNF use, we do not here examine how those changes affected use (Helbing and Cornelius, 1992; Helbing, Sangl, and Silverman, 1992), but rather how changes in use are distributed among persons with specific health and functional characteristics identified from a nationally representative longitudinal survey and how service changes relate to health and functional changes in the Medicare-eligible U.S. elderly population.

A prior analysis of Medicare HHA use showed significant changes in the health and functional status of the population using services over time. In 1982, many cases had dementia as a comorbidity requiring extended HHA care (Manton and Hausner, 1987). PPS initially reduced both Medicare-reimbursed hospital length of stay and admission rates for elderly persons, which increased the dependence of persons discharged early on the use of HHA and SNF services. A comparison of the characteristics of persons using HHAs in 1984-85 and of those using HHAs in 1982-83 showed use increased most for persons without a spouse. Married persons living with a spouse had similar HHA use before and after PPS (Manton et al., 1993). We did not find an increased incidence of adverse effects (i.e., increased mortality or rehospitalization) resulting from a reduced hospital use except possibly among the oldest-old. That latter finding was not conclusive (Manton and Liu, 1990; Liu and Manton, 1991). Sager et al. (1989) evaluated PPS quality of care effects by analyzing State-by-State changes in nursing home use by examining the place of death reported on death certificates. Our analysis of changes in the place of death, specific to cause of death, did not confirm that finding (Manton et al., 1991).

To examine how the Medicare HHA user population changed, we needed data on changes in their health and functional characteristics and a multivariate methodology appropriate to analyzing self-reported health and functional characteristics. These data were found in the NLTCS. Functioning and health measures from each survey were analyzed to define characteristic health and functional profiles for elderly persons. Profiles were defined identically in all 3 years to track health changes. The surveys and Medicare data were linked to see how service use changed for persons with specific health profiles.

From 1982 to 1989, the NLTCS showed that the prevalence of chronic disability

and institutional residence declined for both genders and for all persons 65 years of age or over (Manton, Corder, and Stallard, 1993a). In 1989, chronically disabled persons used more special equipment or assistive housing, either as the sole or as a supplementary form of help to deal with disability. Many of these changes occurred before Medicare coverage changes, or at least before Medicare changes had time to affect service use nationally (Manton, Corder, and Stallard, 1993a, 1993b). Health changes were linked to increased education and economic resources among the new elderly (those 65 years of age or over) and oldest-old cohorts (Maddox and Clark, 1992; Manton and Stallard, 1994). These changes will continue until 2015 (Preston, 1992). It is likely that socioeconomic changes affect: (1) the self-perception by the elderly of which health changes were due to "normal aging" and which could be modified (affecting individual motivation) and (2) the ability to identify and comply with both medical technological and lifestyle behavioral changes (Manton, 1994). The NLTCS also showed declines in morbidity prevalence from 1982 to 1989 adjusted for age- and gender-specific declines in disability (Manton, Stallard, and Corder, 1994). This suggests continuing declines in disability prevalence.

Thus, there are changes both in the Medicare program and in the patterns of health and functional status in the elderly U.S. population that interacted to cause changes in HHA and SNF use from 1982 to 1990. To evaluate the changes, we examined the distribution of health and functional impairment in the three surveys. First, we examined individual differences on 27 measures of disability (9 chronic activity of daily living [ADL] impairments, 10 chronic instrumental activity of daily living [IADL] impairments, and 8 physical performance items). Then we examined individual differences on 29 medical conditions and the 27 functional measures. Linking Medicare data to survey records for 12 months after each survey allowed us to examine HHA and SNF use for persons with specific health or health and functional profiles over time.

DATA

Health and functioning data came from the 1982, 1984, and 1989 NLTCSs. These longitudinal surveys are based on a list sample (n~30,308) of Medicare-eligible elderly persons. Being based on an administrative list, the entire sample can be tracked through Medicare data systems. In area-probability samples where sample listing is integrated with interviewing, tracking individuals is more difficult and less complete. The NLTCS sample was supplemented, after the 1982 survey, by screening for chronic disability a new sample of 5,000 persons who passed age 65 in the interval between two surveys (i.e., 1982 to 1984; 1984 to 1989). In each year, all chronically disabled persons (i.e., those having had, or expecting to have, a disability for 90 days or more) or institutional residents from a prior survey were given a community or institutional interview. Samples of non-disabled persons from prior surveys were rescreened to identify incident cases of disability (or institutionalization). Because survey records are linked to Medicare files, dates of death are known for all interviewees, making it possible to adjust for mortality. Persons were also tracked into and out of institutions, making it possible to adjust for institutionalization.

During the community interview, questions were asked about impairments in ADLs (Katz and Akpom, 1976), in IADLs (Lawton and Brody, 1969), and about the

difficulty of performing specific physical tasks. To be recorded, disability with an ADL or IADL had to last, or be expected to last, 90 days or more. A person had an ADL disability if he could not perform a function without the help of another person or the use of special equipment. A person had an IADL disability if he could not perform a function because of age or health. The response rates in all 3 years were more than 95 percent, producing a total of 16,485 community respondents. There were 3,300 institutional respondents in 1984 and 1989. In 1982, 1,992 institutional residents were identified on the screen. They did not receive a detailed interview in 1982.

Because our prime interest is the growth of HHA use, we used the 16,485 community respondents in multivariate analyses. For this group, we have survey data on chronic morbidity and disability. The 1984 and 1989 institutional surveys only assessed ADL impairments and cognitive status. Although institutionalized persons were not included in multivariate analyses, they were linked to Medicare HHA and SNF data. SNF and HHA use were both evaluated because:

- They represent types of post-acute care that could compensate for shortened hospital stays.
- They experienced contemporaneous rapid growth (i.e., from 1988 to 1989 for SNFs [because of MCCA] and for HHAs [because of changes in eligibility]).
- They are complementary in that, in general, HHA services are less medically intensive than SNF services, so the two services are used by persons with different health problems.

There were enough community respondents reporting no disability to make precise national estimates of HHA and SNF use for non-disabled persons in the multivariate analyses by appropriately weighting cases. (Persons previously disabled or institutionalized who regain function are tracked in subsequent surveys along with false positive screen responses; there were 550 such persons in 1982 and 950 in both 1984 and 1989). Because the entire sample was screened for disability, HHA and SNF use for persons reporting no disability on the screen can be reweighted to provide an alternate national estimate of HHA and SNF service use.

In tabulating service use, changes in Medicare data systems were reviewed. Data linked to the 1982 NLTCS come from Medicare bills for the period 1981-83. PPS was introduced when a hospital's new fiscal year started after October 1, 1983. The Medicare Automated Data Retrieval System (MADRS) was introduced in 1984. Analyzing some MADRS data is complex because PPS was introduced in stages during 4 years and, though the growth of hospital costs and use moderated, there was a tendency over time to assign cases to higher cost diagnosis-related group (DRG) categories, i.e., DRG "creep." A new Medicare statistical analysis data system was started in 1989 that contains more detail on diagnoses and procedures for non-hospital services.

To total service use for survey respondents, we summed all reimbursements and services used in the 12 months after the final survey date. Thus, 1982 survey records were linked to HHA and SNF use from October 1, 1982, through September 30, 1983. Survey records for 1984 were linked to service data for October 1, 1984, through September 30, 1985. Records for 1989 were linked to service data for October 1, 1989, through September 30, 1990. These dates were selected so that service data could be collected during a common timeframe and after interviewing

was complete. Interviewing took about 4 months each year. In 1982 and 1984, the start of the interval used to tabulate service data coincided with the end of interviewing. Because interviewing took 4 months, the average time from survey completion to the start of the service recording interval was 2 months. Adjustment of sample weights was necessary because some persons died during that time. In 1989, interviewing ended about 2 months earlier, which made additional adjustment of sample weights necessary. The average 2 to 3 month gap also means that "noise" is added to the relation of health and service use so that the estimated associations tend to be "conservative," i.e., the size of the relation is biased downward because health changes occur between the interview and the beginning of the period for tabulating service use. The relation may also be attenuated by health changes during the 12-month interval. By tabulating services forward from a date on which health and functional status is known, cases are also lost from the cohort as a result of death. Mortality, being concentrated in less healthy groups, will reduce between-group differences, i.e., the estimated effects of health on service use will be again downwardly biased and conservative.

Three alternate strategies could be used to define the interval during which service use was tabulated. First, one could estimate all expenditures made in a fixed period (e.g., a calendar year) by tabulating the services used by all persons eligible, becoming eligible, or dying during the period. Thus, in 1990, one would tabulate data not for 30.96 million persons (the July 1, 1990 Medicare-enrolled elderly population) but roughly 34.0 million persons—the population present on January 1, 1990, persons becoming 65 years of age in that year (about 2.0 million persons—a low-service use group), and persons who died in that year (about 1.5 million persons over 65 years of age—a high-service use group). Second, using only persons eligible for an entire year loses data on persons dying between the start of the year and the intervening period from May to October (Manton and Stallard, 1992). Both persons becoming eligible or dying in the year are excluded. Data would be tabulated on 29.5 million persons who are 65 years of age or over on January 1 and who survive the year. Because terminal-care costs are high, this excludes many high-cost cases. Third, services could be measured from the date of each interview. This would make estimates of functional status more precise but would introduce noise because the 12 months for which services were tabulated would not be the same for each person. The amount of noise depends on how fast service use changed during a 16-month period (i.e., the 4 months of interviewing plus 12 months of service-use observation).

Thus, one has to compare the benefits of having a fixed interval over which to measure service use with some loss in precision of disability assessment, with improvements in precision of disability assessment, and with information lost because of differences in individual service-use periods. Given that chronic (i.e., persistent) disability was measured and service changes were rapid (compared with, say, age changes in disability incidence), we used a fixed time period to tabulate service use.

METHODS

To analyze the survey data, one has to deal with the measurement properties of self- or proxy-reported health and functional status (e.g., Dorevitch et al., 1992; Reuben, Siu, and Kimpau, 1992). First, the data are categorical. Second, self- reports are subject to error—other errors are

introduced by proxy respondents. Third, many health measures are rare, and many are highly correlated. Finally, representing disability by discrete, homogeneous categories can be misleading at late ages where, although many persons have functional limitations, many remain socially autonomous (Manton et al., 1994). To represent changes in the amount of human capital in an elderly population, a scoring system is needed to reflect an individual's degree of disability on multiple dimensions (Manton, Woodbury, and Stallard, 1991).

To analyze categorical data reported without error, one can use models for analyzing tables (e.g., Bishop, Fienberg, and Holland, 1975) with J multinomial variables, x_{ij}, each with L_j responses. Individual responses are summed to form tables. The cell counts in a table are used to calculate probabilities, λ_{jl}, $\lambda = 1,\ldots, L_j$. If there are K discrete, homogeneous subgroups, then K binary (0,1) variables, g_{ik}, $k = 1,\ldots, K$, can be used to define K tables with cell probabilities λ_{kjl}. Here the g_{ik} are observed having the value of 0 or 1 for each individual.

If x_{ij} are reported with error and subgroup membership is not known (i.e., g_{ik} is unobserved), we need to use latent class analysis (LCA; [Lazarsfeld and Henry, 1968]), where λ_{kjl}s and g_{ik}s are jointly estimated. The λ_{kjl}s are cell probabilities in K latent tables. The g_{ik}s are again 0 or 1, reflecting the K subgroups being discrete and homogeneous, even though g_{ik}s are unobserved and must be estimated. In LCA, instead of estimating g_{ik}s, which are discrete variables (causing difficulty in maximizing the likelihood), the posterior probability of being in the kth subgroup is estimated (i.e., $p_{ik} = \text{Prob}[g_{ik} = 1]$) using an E-M algorithm to solve a "discrete mixture" problem (Everitt, 1984; McLachlan and Basford, 1987).

LCA performs best when J is "small" (e.g., $J < 12$) so that stable estimates of λ_{kjl} can be made for a "small" number of table cells. If J is large (e.g., $J > 20$), it is difficult to describe the data by a small number of homogeneous groups. In this case, a more parsimonious model (i.e., K remains small) that describes heterogeneity in each of K groups is the grade of membership (GoM) model (Manton, Woodbury, and Tolley, 1994) where the g_{ik}s are convex weights (i.e., $g_{ik} = 1.0$; $0.0 \le g_{ik} \le 1.0$). The λ_{kjl}s in GoM are cell probabilities as in the two other models. However, in GoM, a person's characteristics are described as a continuously weighted mixture of the λ_{kjl}s using g_{ik}s as weights. LCA is a special case of GoM in which all classes are homogeneous (i.e., g_{ik} = 0 or 1 for all is, ks). Thus, GoM has an additional variance component resulting from variation of the g_{ik} within the K groups. The GoM and LCA models can be evaluated by testing the significance of the heterogeneity represented by allowing g_{ik}s to vary. This is done with a likelihood ratio approximation to x^2 because the LCA model is parametrically nested in GoM. If the x^2 is significant, then variability of g_{ik}s within each class is necessary to describe the data.

In GoM, it is computationally efficient to use individual records (because g_{ik}s are estimated) by coding each x_{ij} into binary indicators showing which of L_j responses a person had, i.e., $y_{ijl} = 1$ for the response l occurring; other y_{ijl} are zero. The equation for each data item is

$$P_{ijl} = \text{Prob}(y_{ijl} = 1.0) = (1)\sum_k g_{ik} \cdot \lambda_{kjl} . \quad (1)$$

There are $I \times \sum_{j=1}^{J} L_j$ such constrained equations to be solved simultaneously for a data set with I cases and J variables. The g_{ik}s and λ_{kjl}s are estimated by maximum likelihood (ML). The likelihood is evaluated

by sequentially updating the λ_{kjl} using the g_{ik}s from a prior step and updating the g_{ik} using λ_{kjl}s from a prior step. Thus, g_{ik} estimates are constrained across variables (index j) by prior λ_{kjl} values, and λ_{kjl} estimates are constrained over individuals by prior g_{ik} values. To deal with temporal variation, a person's response at each time is treated as an independent observation (conditional on variables measured at that time), where t = 1, 2, 3 for 1982, 1984, or 1989, respectively. To track individual changes, we constrain $\lambda_{kjl}(t)$ to be equal over t (i.e., $\lambda_{kjl}[\cdot]$) and represent health changes by $g_{ik}(t)$. If health profiles emerge or disappear over time, we need a K large enough to represent health dimensions present in any of the three surveys. To start the calculations, K discrete groups are selected (i.e., setting each g_{ik} = 0,1) to provide initial λ_{kjl} estimates. If the initial grouping is "informative" (e.g., based on age) about the solution, then, if one gets a "local" likelihood solution, it will be in a meaningful region of the parameter space (i.e., near groups ordered on age) and meaningful in a Bayesian sense (i.e., the initial partition is an informed "prior" distribution that is statistically mixed with the data in the likelihood (Manton et al., 1994; Woodbury, Manton, and Tolley, 1994; Orchard and Woodbury, 1971).

By constraining parameters in the likelihood, we can construct prediction equations for M variables (e.g., number of HHA visits) in a second likelihood step. Specifically, if for J variables, we estimated g_{ik} and λ_{kjl} and hold those equations (and parameter values) fixed, we can solve equations for M variables estimated conditionally on those K profiles. Below, we use 27 and 56 variables to define functional and health and functional status profiles, respectively. Then we estimate M service-use measures for each of 3 years (1982, 1984, and 1989), conditional upon the functional (or health and functional) profiles. Changes in K, the number of profiles, caused by including health variables indicate whether they contain unique information.

The 3 x M equations solved in the second likelihood step are,

$$\text{Prob}(y_{iml}(t) = 1.0) = \sum_{k=1}^{k} g_{ik}(t) \cdot \lambda_{kml}(t), \quad (2)$$

where $g_{ik}(t)$ are calculated from the J variables and $\lambda_{kml}(t)$ are ML time-specific estimates of regression coefficients of those $g_{ik}(t)$ on M dependent variables. In the likelihood, estimates are generated for a year by setting data on the mth variable for the two other years to "missing."

To estimate an individual's service use for the mth variable from (2) we use the average cost, $\bar{x}_{kml}$, for the l_mth category of the kth group, or

$$\text{cost}_{im} = \sum_{l=1}^{L_m} \sum_{k=1}^{K} g_{ik}(t) \cdot (\lambda_{kml} \cdot \bar{x}_{kml}). \quad (3)$$

The average cost (or use) for service type m for the kth group is

$$\text{cost}_{km} = \sum_{l=1}^{L_m} (\lambda_{kml} \cdot \bar{x}_{kml}). \quad (4)$$

The total costs for a population with a different $g_{ik}(t)$ distribution is

$$\text{cost}_m = \sum_{k=1}^{K} = \sum_{l=1}^{L_m} \bar{g}_k(t) \cdot (\lambda_{kml} \cdot \bar{x}_{kml}) \quad (5a)$$

$$= \sum_{k=1}^{K} \bar{g}_k(t) \cdot \text{cost}_{km} \quad (5b)$$

where $\bar{g}_k(t)$ is the mean of the g_{ik}s, weighted to another population distribution. The g_{ik}s may be used to directly estimate costs, i.e.,

$$\text{cost}_{km} = \left[\sum_{i=1}^{I} \bar{g}_{ik}(t) \cdot w_i(t) \cdot x_{im}(t)\right] \Big/ \left[\sum_{i=1}^{I} \bar{g}_{ik}(t) \cdot w_i(t)\right]. \quad (6)$$

This provides flexibility in using ancillary data. If, for example, institutional residents can be described as a discrete group, then a g_{ik} can be created for them and (6) used to estimate costs for that group as well as for different community disabled groups. This is because the g_{ik}s and sample weights (w_i) reproduce the marginal distribution for the augmented population.

In analyzing M "dependent" variables, category boundaries are defined for continuous variables like HHA visits. One can use categories of equal size (i.e., same interval length) or of equal density (i.e., categories have the same number of cases). In general, equal-density categories give better "resolution" in predicting a dependent variable. When using equal-density categories, one can create a "zero" (no-use) category of any size. This avoids the need to use a two-part regression (e.g., one to predict the probability of use and one to predict the amount used by those using any service) by estimating a single discrete-density distribution with a zero-use category. This is possible because GoM is "non-parametric" density estimation. The metric of a variable is retrieved after estimating the categorical probabilities by using empirical means for each category. Thus, the convex properties of GoM parameters provide tools to examine both individual and population costs, contingent on health status, with adjustments for errors in variables. Because the g_{ik} have the property of convexity, service measures can be additively decomposed. Convexity also allows the model to be augmented with ancillary data on discrete sets of persons.

RESULTS

Service Changes by Disability Class

In Tables 1 and 2, the weighted number of HHA visits and SNF days used in 1982-83 and 1989-90 are presented for discrete disability classes. Because sample weights sum to the July 1 U.S. Bureau of the Census population estimate, we adjust each weight by the ratio of that population to the number of elderly hospital insurance enrollees. (HHA and SNF use is funded by Medicare hospital insurance.)

In Tables 1 and 2, service use in 1982-83 and 1989-90 are compared for non-disabled persons, persons at four levels of disability, and institutional (primarily nursing home) residents. These tables show the average number of HHA visits (or SNF days) used by all enrollees in a disability class, the proportion of persons in a class using HHA or SNF services, and the total number of persons at each disability level for 1982-83. Comparable 1989-90 statistics are also shown. Total service use (i.e., HHA visits or SNF days), average number of HHA visits (or SNF days) consumed by those using the service in each disability group, and the number of persons in each disability class using services are shown.

Between 1982-83 and 1989-90, the proportion using some HHA services increased for all disability groups. For example, the average number of HHA visits used by non-disabled persons (weighted up from the number of persons identified as non-disabled on the screen in either 1982 or 1989) almost doubled from 0.62 visits per non-disabled enrollee (19.9 million non-disabled persons in 1982; 12.4 million HHA visits) to 1.22 (23.1 million non-disabled persons in 1989; 28.1 million HHA visits). This is an increase from 34.5 percent to 39.0 percent of all HHA visits used by the non-disabled population from 1982-83 to 1989-90. Although this population is not chronically disabled or institutionalized, it may have medical problems—a factor explored in multivariate analyses.

Table 1

Use of HHA Services in 1982-83 and 1989-90: National Long-Term Care Survey (NLTCS) Sample Populations

Disability Level	1982-83 Visits per Enrollee; Percent Using Services; and Population[1]	1982-83 Total HHA Visits; Population Using Services[2]	1982-83 Average HHA Visits per User	1989-90 Visits per Enrollee; Percent Using Services; and Population[1]	1989-90 Total HHA Visits; Population Using Services[2]	1989-90 Average HHA Visits per User	Expected Service Use (Visits) In 1989-90 Based on 1982-83 Rates; Expected Persons Using Service[2]	Ratio of Expected 1989-90 Service Use (Visits) to 1989-90 Annual Use
Total								
	1.38	36,130,059	27.6	2.42	72,133,533	38.8	41,218,262	57.1
	5.01	1,307,066		6.23	1,860,799		1,496,402	80.4
	26,114,950			29,868,306				
Non-Disabled								
	0.62	12,447,457	21.2	1.22	28,148,128	30.8	14,339,766	50.9
	2.95	587,852		3.95	914,074		682,297	74.6
	19,930,300			23,128,703				
IADL Only								
	1.67	2,322,118	24.6	40.45	5,853,870	37.7	2,197,842	37.5
	6.79	94,442		11.81	155,396		89,361	57.5
	1,390,951			1,316,073				
1-2 ADLs								
	3.39	5,719,722	26.5	4.860	9,379,624	34.0	6,538,120	69.7
	12.81	216,140		14.32	276,232		246,803	89.3
	1,687,911			1,928,649				
3-4 ADLs								
	7.020	4,986,526	35.8	9.710	10,142,062	41.1	7,329,147	72.3
	19.61	139,346		23.66	247,036		204,736	82.9
	710,407			1,044,038				
5-6 ADLs								
	10.70	9,750,042	41.6	21.06	17,288,621	72.5	8,783,565	50.8
	25.76	234,222		29.05	238,463		211,462	88.7
	909,280			820,894				
Institutional								
	0.61	904,194	25.8	0.81	1,321,228	44.6	994,269	75.3
	2.36	35,064		1.82	29,598		38,467	130.0
	1,486,101			1,629,949				

[1]These three labels refer to the three column entries within each category of disability level.
[2]Population size.

NOTES: HHA is home health agency. IADL is instrumental activity of daily living. ADL is activity of daily living.

SOURCE: Tabulations of HHA use for the 1982 and 1989 NLTCS sample population prepared by the Center for Demographic Studies, Duke University.

Table 2

Use of SNF Services in 1982-83 and 1989-90: National Long-Term Care Survey (NLTCS) Sample Populations

Disability Level	1982-83 Days per Enrollee; Percent Using Services; and Population[1]	1982-83 Total SNF Days Used; Population Using Services[2]	1982-83 Average SNF Days per User	1989-90 Days per Enrollee; Percent Using Services; and Population[1]	1989-90 Total SNF Days Used; Population Using Services[2]	1989-90 Average SNF Days per User	Expected Service Use (Days) in 1989-90 Based on 1982-83 Rates; Expected Persons Using Service[2]	Ratio of Expected 1989-90 Service Use (Days) to 1989-90 Annual Use
Total								
	0.30	7,932,988	32.0	0.84	25,138,785	41.1	8,960,491	35.6
	0.95	248,182		2.05	611,845		283,749	46.4
	26,114,950			29,868,306				
Non-Disabled								
	0.14	2,721,898	30.7	0.28	6,463,368	32.4	3,238,018	50.1
	0.45	88,752		0.86	199,774		104,079	52.1
	19,930,300			23,128,703				
IADL Only								
	0.41	569,967	32.8	0.97	1,282,992	47.9	539,580	42.1
	1.25	17,397		2.04	26,799		16,451	61.4
	1,390,951			1,316,073				
1-2 ADLs								
	0.71	1,191,714	33.0	1.65	3,175,828	33.1	1,369,341	43.1
	2.14	36,164		4.97	95,880		41,271	43.0
	1,687,911			1,928,649				
3-4 ADLs								
	0.62	441,119	27.2	2.00	2,089,871	30.0	647,304	31.0
	2.29	16,243		6.67	69,664		23,908	34.3
	710,407			1,044,038				
5-6 ADLs								
	1.35	1,228,997	32.9	2.79	2,292,191	40.8	1,108,207	48.3
	4.11	37,404		6.85	56,196		33,739	60.0
	909,280			820,894				
Institutional								
	1.20	1,779,293	34.1	6.03	9,834,535	60.1	1,955,939	19.9
	3.51	52,222		10.03	163,532		57,211	35.0
	1,486,101			1,629,949				

[1]These three labels refer to the three column entries within each category of disability level.
[2]Population size.

NOTES: SNF is skilled nursing facility. IADL is instrumental activity of daily living. ADL is activity of daily living.

SOURCE: Tabulations of SNF use for the 1982 and 1989 NLTCS sample population prepared by the Center for Demographic Studies, Duke University.

For those with 1 to 2 ADL impairments, the proportion using HHAs in 1982-83 was 12.8 percent, increasing to 14.3 percent in 1989. The largest increase in the average number of HHA services used by enrollees in a disabled group was for those with 5 to 6 ADL impairments. The average number of HHA visits used in this group was 10.7 in 1982-83 and 21.1 in 1989-90. This was due to both an increased proportion of persons with 5 to 6 ADL impairments using services (i.e., 25.8 percent in 1982-83 and 29.1 percent in 1989-90) and an increase in the average number of HHA visits used by persons using HHAs—from 41.6 to 72.5. Despite the large per enrollee and per user increase in HHA visits used by persons with 5 to 6 ADLs, the proportion of all HHA visits consumed by this highly disabled group dropped from 27.0 percent (9.75 million out of 36.13 million visits in 1982-83) to 24.0 percent (17.29 million out of 72.13 million visits in 1989-90). The decline was due to a drop in the prevalence of the group with 5 to 6 ADL impairments, from 3.48 percent of the total 1982 population to 2.75 percent of the 1989 population, and the increased proportions reporting no disability in 1989. The only group without increases in the proportion using HHA were institutional residents. They had a small decrease (2.4 percent to 1.8 percent) compensated for by increased SNF use (3.5 percent to 10.0 percent). The average number of HHA visits used in 1989-90 increased significantly at all levels of disability (as well as for the non-disabled). There are large increases for the non-disabled, those with only IADL impairments, and those with 5 to 6 ADL impairments. The increase in the rate of use was large for all groups, but relatively larger for the non-disabled and numerically large for those with 5 to 6 ADL impairments.

The total estimated number of HHA visits increased from 36.1 million (by 1.31 million persons in 1982-83) to 72.1 million visits (by 1.86 million persons in 1989-90). The overall average number of HHA visits for persons using services in 1982-83 was 27.6. For 1989-90, the average number of HHA visits for persons using services was 38.8. These are similar to Medicare's calendar-year program statistics; that is, of the 1.2 to 1.4 million persons served in 1982 and 1983, there was an average of 27.0 (versus our estimate of 27.6) HHA visits used in 1982-83 (Helbing, Sangl, and Silverman, 1992). In 1989-90, the difference is larger, with an estimated 1.85 million elderly persons using an average of 35.3 (versus our estimate of 38.8) HHA visits in 1990. The number of elderly community residents using HHA services increased 42.4 percent (from 1.31 to 1.86 million) from 1982-83 to 1989-90, whereas the total U.S. population 65 years of age or over increased 14.7 percent (from 26.9 to 30.9 million persons). Thus, there were increases resulting from the larger average number of HHA visits used by each person using services and from larger numbers of HHA service users. The two factors nearly doubled the total number of HHA visits used between 1982-83 and 1989-90. The survey estimate of HHA visits for 1989-90 is insignificantly higher than the average for 1990 program statistics (Helbing, Sangl, and Silverman, 1992). The relative confidence interval for the survey estimate is 5 percent. Program data suggest increases in HHA use continue. About 98 million HHA visits were made in 1991 (Helbing, Sangl, and Silverman, 1992).

Described in Table 2 is SNF use in 1982-83 and 1989-90. The proportion using SNFs increased at every disability level—over doubling from 0.95 percent to 2.05 percent. For example, of the estimated 710,407 elderly persons with 3 to 4 ADL impairments in 1982, 2.3 percent used SNFs; of the 1,044,038 persons with 3 to 4 ADL

impairments in 1989, 6.7 percent used SNFs, a relative increase of 291 percent. An increase was also manifest in the average number of SNF days used in 12 months of followup, both overall (i.e., from 32.0 to 41.1 days) and for each disability subgroup. The smallest increases in per capita use among those using SNFs were for the non-disabled (30.7 to 32.4) and for those with 1 to 2 ADL impairments (33.0 to 33.1).

From 1984 to 1990, the elderly community population using SNFs increased 146.5 percent, from 248,182 to 611,845 persons; total Medicare SNF reimbursements increased 290.2 percent, from $449 to $1,752 million, and to $2,128 million (a 21.2-percent increase) by 1991 (Helbing and Cornelius, 1992). The average elderly Medicare enrollee using SNFs had 1.25 admissions per year in 1990 (Helbing, Sangl, and Silverman, 1992). This, combined with the number of persons using services in Table 2, implies that in 1989-90, there were 764,806 admissions—or 5 percent higher than the 710,669 admissions for elderly persons in 1990 program statistics (Helbing and Cornelius, 1992). The higher survey estimate is reasonable because SNF use declined from 1989 to 1990, and the survey estimate is partly weighted to the higher 1989 estimate. As discussed in the introduction, despite MCCA's repeal in 1989, SNF use remained high in 1990 and is expected to increase because of OBRA 1987 provisions and national changes in SNF access (Office of Inspector General, 1991). For persons using SNFs, the average number of days used increased from 32.0 to 41.1. In 1990, because 1.25 admissions were used by each enrollee using SNFs, the per admission day average is 32.8, close to the weighted average for 1989 and 1990 program statistics. The total estimated 7,932,988 SNF days used by community residents in 1982-83 increased to 25,138,785 days in 1989-90.

Thus, both HHA and SNF use increased markedly from 1982-83 to 1989-90. SNF use, measured in the total number of SNF days used, or the average number of days used by persons using SNFs, increased relatively more (217 percent) than did HHA (99.6 percent) use. The increase in the number of SNF users was also greater (146 percent) than the number of HHA users (42.4 percent). Thus, though the total volume of use is greater for HHA visits, the rate of increase and greater costs per service unit (i.e., SNF days) mean that growth in the use of both types of post-acute service are large. There is complementarity of the two service use patterns in that the proportion using SNFs at the highest disability levels increased relatively more than for HHAs. In contrast, the relative increase in HHA use by the non-disabled and by those with only IADL impairments was greater than that for those using SNFs. SNF services for those two groups decreased from 41.5 to 30.8 percent of the total SNF services used; HHA use by these two groups increased from 40.8 to 47.1 percent of the total HHA use. Thus, the increases, though both large, are complementary with proportionately more HHA services used by less disabled enrollees and proportionately more SNF services used by more disabled enrollees. Thus, a separate consideration of the two services, each responding to different health and functional subgroups, may be artificial, i.e., they comprise two components of post-acute care such that, if action is taken on one (e.g., HHA use), there may be compensating increases in the use of the other type of service. This also suggests that declines in disability prevalence among the elderly will tend to raise HHA use on a relative level while moderating the growth of SNF use.

In Tables 1 and 2, we "standardized" temporal comparisons by multiplying the 1989 disability-specific populations by the 1982 service-use rates for each group. This produced the number of HHA visits (or SNF days) that would be used in each disability group in 1989-90 if 1982-83 rates had not changed. At the top of each HHA and SNF use column is the standardized sum of services used by all groups, i.e., the national volume of services that would have been used in 1989-90 if the 1982-83 rates had not changed. A comparison of the standardized and unstandardized volume of services used shows the effects of changes in the use rates for each disability group. We also multiplied the standardized values by the average number of HHA visits (or SNF days) used in 1982-83 to identify the effect of changes in per capita use in each disability group.

The number of HHA visits used in 1989-90 would be 42.9 percent less if the 1982-83 rates had not changed. The number of persons using HHA services in 1989-90 based on 1982-83 rates is 19.6 percent less. If HHA use rates and per capita numbers of HHA visits for each disability group were reduced to 1982-83 levels, there would have been 36,003,474 fewer HHA visits used in 1989-90 (assuming the 1990 average reimbursed visit cost of $52.85 for persons 65 years of age or over [Helbing, Sangl, and Silverman, 1992]) implying a reduction of 1.9 billion dollars in HHA costs. If the 1982-83 HHA use rates had not changed, the absolute increase in HHA visits in 1989-90 would have been 5.1 million (from 36.1 to 41.2 million), and costs would have risen $269.5 million (using the 1990 estimated reimbursed cost of $52.85 per HHA visit for elderly enrollees). The number of persons using HHA services would decline by 553,733. Thus, not surprisingly, the gain in HHA use is due largely to changes in HHA rates of use, especially per capita use, though there is variation in changes in use rates by different disability groups. For example, for community residents, the proportion using HHA services varied by 8.7 to 1 across disability groups in 1982-83 (25.8 percent versus 2.95 percent). The ratio for the proportion using SNFs across disability groups was sizeable and also declined from 9.1 to 1 in 1982-83 to 8.0 to 1 in 1989-90.

Had 1982-83 rates not changed, the number of persons using SNFs in 1989-90 would be 53.6 percent smaller (1-0.464). Using the 1982-83 per capita SNF use rates, the 1989-90 number of SNF days declines 64.4 percent (1-0.356). These effects reflect lower rates of service use and per capita daily use in 1982-83 in all disability groups. The overall reductions are also larger because of the shift in the proportions of the population using SNFs at each disability level, i.e., greater proportions of the 1989-90 population were non-disabled or had lower disability levels.

Thus, the results in Tables 1 and 2 have several major implications. First, increases in both HHA and SNF use would be much smaller if 1982-83 rates had not changed (i.e., most of the change is in utilization patterns). Second, HHA and SNF use are complementary, with one increasingly a service used by less disabled enrollees (HHAs) and the other used by more disabled enrollees (SNFs). Third, though HHA use is higher in absolute volume, the growth in SNF use has been relatively faster. Thus, policy should consider coordinated changes in both. Finally, the large volume of services used by the non-disabled suggest we need analyses that take into account chronic health factors not represented by the disability measures.

Because our estimates of HHA use are moderately higher than those in program statistics, we compared our 1989-90 estimates with estimates from the 1992 National Home and Hospice Care Survey (Hing, 1994). In that survey, 3,897 current patients and 3,654 discharged patients were interviewed in 1,500 agencies sampled from 8,036 listed in the 1991 National Provider Inventory. The discharge sample was drawn from agency rolls for the 12 months before the survey. It was estimated that there were 2,274,500 persons 65 years of age or over discharged in the 12 months prior to the survey who used HHA services. Of these, 1,887,835 (83 percent) had Medicare as a primary payer. This is 1.5 percent higher than our 1989-90 estimates of 1.86 million elderly persons using Medicare-reimbursed HHA visits.

Functional Status Profiles

In the first multivariate analysis, we generated profiles from 27 functional measures made in the 1982, 1984, and 1989 NLTCSs. The 27 measures represent a wide range of disability intensities and types. For example, ADL impairments are more severe than IADL impairments, though three IADL measures (taking medication, using the phone, managing money) are indicators of early dementia. The physical performance measures describe the physical limitations producing disabilities—e.g., lower limb impairment (difficulty climbing stairs, etc.) may cause bathing or toileting problems. A review of surveys showed U.S. prevalence estimates of disability were robust to differences in measurement (Weiner et al., 1990). Thus, the additional measures reflect the same basic disability concepts in Table 1 but provide more detail on disability mechanisms. The 27 measures could be explained in GoM (based on a likelihood ratio test of the order, K, of the model) by six profiles. The λ_{kj}s describing the profiles are in Table 3.

By comparing the λ_{kj}s with marginal frequencies, we can describe the substance of the six profiles. Below we summarize "salient" characteristics of each and provide a working "label" for each to use in subsequent discussions.

- The first type is "physically challenged" with IADL problems associated with mobility but no ADL problems.
- The second type is "active" with no ADL impairments and little IADL or physical disability.
- The third type is "active with moderate physical impairment," moderately more physically challenged than type 2.
- The fourth type is "IADL impaired" with no ADLs but a number of IADL impairments, including those implying early dementia.
- The fifth type is "mobility challenged" with ADL and IADL impairments suggesting problems with lower limbs and mobility; manual dexterity is maintained.
- The sixth type is "frail," with many ADL, IADL, and physical impairments.

In Table 3, we present the means (s) of the g_{ik}s for each year adjusted for: (1) sample weights (i.e., the mean generated after multiplying each person's g_{ik}s by his or her sample weight adjusted for non-response) and (2) the addition of screen non-disabled persons to type 2 and the creation of a seventh discrete institutional group. The combined scores for types 2 and 3, which are not chronic ADL or IADL impairments (i.e., the screening interview definition of chronic disability), increased from 82.3 percent in 1982 to 83.8 percent in 1989, or 1.5 percent, an estimate of the decline in disability similar to the age-weighted declines in chronic disability prevalence

Table 3

Multivariate Values of Functional Status for the 16,485 Persons in the Combined 1982, 1984, and 1989 National Long-Term Care Survey Community Samples

Functional Status	Unweighted Population Frequency	Pure Type: Physically Challenged (1)	Active (2)	Active Moderately Physically Impaired (3)	IADL Impaired (4)	Mobility Challenged (5)	Frail (6)	Institutional[1] (7)
Patient Needs Help With:				Percent				
ADL Function								
1. Eating	7.0	0.0	0.0	0.0	0.0	0.0	53.6	—
2. Getting In/Out of Bed	26.2	0.0	0.0	0.0	0.0	87.1	100.0	—
3. Walking Around Inside	39.9	0.0	0.0	0.0	0.0	100.0	100.0	—
4. Dressing	19.4	0.0	0.0	0.0	0.0	0.0	100.0	—
5. Bathing	43.1	0.0	0.0	0.0	0.0	100.0	100.0	—
6. Toileting	21.7	0.0	0.0	0.0	0.0	53.4	100.0	—
7. Is Bedfast	0.8	0.0	0.0	0.0	0.0	0.0	5.4	—
8. No Inside Activity	1.5	0.0	0.0	0.0	0.0	0.0	10.0	—
9. Is Wheelchairfast	7.0	0.0	0.0	0.0	0.0	20.4	24.9	—
IADL Function								
10. Heavy Work	71.9	100.0	0.0	100.0	100.0	100.0	100.0	—
11. Lightwork	22.6	0.0	0.0	0.0	0.0	0.0	100.0	—
12. Laundry	41.5	62.2	0.0	0.0	100.0	44.0	100.0	—
13. Cooking	29.8	0.0	0.0	0.0	100.0	0.0	100.0	—
14. Grocery Shopping	56.9	100.0	0.0	0.0	100.0	100.0	100.0	—
15. Getting Around Outside	59.1	100.0	0.0	0.0	63.9	100.0	100.0	—
16. Traveling	52.9	100.0	0.0	0.0	100.0	100.0	80.7	—
17. Managing Money	26.8	0.0	0.0	0.0	100.0	0.0	100.0	—
18. Taking Medicine	0.8	0.0	1.4	0.5	0.8	0.4	1.0	—
19. Using Telephone	16.0	0.0	0.0	0.0	93.3	0.0	80.7	—
Physical Performance								
20. Climbing Stairs								
None	18.6	0.0	64.8	0.0	0.0	0.0	0.0	—
Some	29.1	0.0	35.2	100.0	100.0	0.0	0.0	—
Very	31.4	87.6	0.0	0.0	0.0	63.6	0.0	—
Cannot	21.0	12.4	0.0	0.0	0.0	36.4	100.0	—
21. Bending for Socks								
None	43.5	0.0	100.0	0.0	100.0	100.0	0.0	—
Some	27.9	0.0	0.0	100.0	0.0	0.0	0.0	—
Very	18	100	0.0	0.0	0.0	0.0	0.0	—
Cannot	10.6	0.0	0.0	0.0	0.0	0.0	100.0	—
22. Holding a 10-lb. Package								
None	29.6	0.0	100.0	0.0	0.0	0.0	0.0	—
Some	18.1	0.0	0.0	100.0	0.0	0.0	0.0	—
Very	15.9	49.7	0.0	0.0	82.2	25.6	0.0	—
Cannot	36.4	50.3	0.0	0.0	17.8	74.4	100.0	—
23. Reaching Overhead								
None	56.1	0.0	100.0	0.0	100.0	100.0	0.0	—
Some	21.2	29.0	0.0	100.0	0.0	0.0	27.8	—
Very	13.9	55.5	0.0	0.0	0.0	0.0	25.9	—
Cannot	8.8	15.5	0.0	0.0	0.0	0.0	46.4	—
24. Combing Hair								
None	71.6	0.0	100.0	100.0	100.0	100.0	0.0	—
Some	16.0	77.4	0.0	0.0	0.0	0.0	21.1	—
Very	7.0	22.6	0.0	0.0	0.0	0.0	28.2	—
Cannot	5.4	0.0	0.0	0.0	0.0	0.0	50.7	—
25. Washing Hair								
None	55.8	0.0	100.0	100.0	100.0	100.0	0.0	—
Some	14.8	61.1	0.0	0.0	0.0	0.0	0.0	—
Very	9.4	38.9	0.0	0.0	0.0	0.0	0.0	—
Cannot	20.0	0.0	0.0	0.0	0.0	0.0	100.0	—

See footnote at end of table.

Table 3—Continued

Multivariate Values of Functional Status for the 16,485 Persons in the Combined 1982, 1984, and 1989 National Long-Term Care Survey Community Samples

Functional Status	Unweighted Population Frequency	Pure Type: Physically Challenged (1)	Active (2)	Active Moderately Physically Impaired (3)	IADL Impaired (4)	Mobility Challenged (5)	Frail (6)	Institutional[1] (7)
				Percent				
26. Grasping Small Objects								
None	66.0	0.0	100.0	0.0	100.0	100.0	18.2	—
Some	20.3	49.0	0.0	100.0	0.0	0.0	28.6	—
Very	10.1	51.1	0.0	0.0	0.0	0.0	25.5	—
Cannot	3.6	0.0	0.0	0.0	0.0	0.0	27.7	—
27. See Well Enough to Read Newspaper	74.3	100.0	100.0	100.0	0.0	100.0	46.2	—
Population Weighted								
$\bar{g}_k$ 1982	3.1	79.8	2.5	2.5	3.2	3.3	5.7	—
$\bar{g}_k$ 1984	2.9	79.8	2.8	2.5	3.5	3.0	5.5	—
$\bar{g}_k$ 1989	2.4	80.8	3.0	1.5	3.6	3.3	5.5	—

[1]Not included in the GoM analysis.

NOTES: GoM is grade of membership. IADL is instrumental activity of daily living. ADL is activity of daily living.

SOURCE: Multivariate analyses of data from the 1982, 1984, and 1989 National Long-Term Care Surveys prepared by the Center for Demographic Studies, Duke University.

based on the ADL and IADL measures defined later (1.97 percent).

The predictive validity of the profiles represented by their relation to socioeconomic and health factors is shown in Table 4. The λ_{kjl}s were estimated by using M service use variables in the second likelihood estimation step described earlier.

These characteristics relate well to the six profiles. The two least disabled types (2 and 3) are the youngest. The IADL impaired (with IADL impairments implying dementia; type 4) is the oldest. The most frail (types 5 and 6) have intermediate ages. Subjective health is worst for types 1 and 6. It is best for type 2. Type 6 is evenly divided on gender, not distinctive on education, and was likely (43.7 percent) to have been in a nursing home—as was type 5 (47.8 percent) who, in contrast to 6, was more likely female (i.e., 83.8 percent versus 65.5 percent).

In terms of medical conditions (which were not used to generate these profiles), the following apply:

- Type 1 persons have the most arthritis and permanent stiffness and significant amounts of hypertension, diabetes, other heart trouble and a moderate degree of pulmonary problems. That is, the physically challenged type has both acute and chronic cardiopulmonary problems.
- Type 2 persons have the lowest prevalence of medical problems; they are active and healthy.
- Type 3 persons have activity and joint problems and multiple medical problems—especially cardiopulmonary. Despite having little impairment, 62.8 percent reported having only fair health.
- Type 4 persons have few joint problems but the most glaucoma and circulatory problems. They have the second highest rate of dementia (consistent with its IADL impairments and advanced age).
- Type 5 persons have significant arthritis and joint problems, including the most fractures.
- Type 6 persons have the most dementia, cancer, stroke, and circulatory disease.

Table 4

Predictive Validity of 6 Types Generated From 27 Functional Status Variables for the 1982, 1984, and 1989 National Long-Term Care Survey, Assessed on Sociodemographic and Medical Conditions

Sociodemographics and Medical Conditions	Unweighted Population Frequency	Pure Type: Physically Challenged (1)	Active (2)	Active Moderately Physically Impaired (3)	IADL Impaired (4)	Mobility Challenged (5)	Frail (6)
Sociodemographic Variables				Percent			
Gender:							
Male	34.5	2.1	49.1	39.9	43.0	16.2	42.8
Female	65.5	98.0	51.0	60.1	57.0	83.8	57.2
Age:							
65-66 Years	4.5	8.8	5.3	6.7	0.2	2.6	2.8
67-69 Years	11.1	13.4	14.9	18.9	0.0	7.2	8.2
70-74 Years	21.7	26.0	28.0	34.6	3.5	15.4	15.7
75-79 Years	22.6	24.1	27.1	23.9	15.0	21.4	18.4
80-84 Years	19.6	17.5	16.6	12.9	28.8	24.3	20.3
85 Years or Over	20.6	10.3	8.1	3.0	52.5	29.2	34.7
Mean Age	78.0	76.6	75.7	74.2	84.0	80.0	80.2
Marital Status:							
Married	42.7	28.8	57.3	53.5	24.7	23.7	50.3
Not Married	57.3	71.2	42.7	46.6	75.4	76.4	49.7
Education:							
None	3.2	1.7	1.8	1.7	8.0	2.0	6.8
Grade School	21.6	33.1	15.9	14.9	47.3	9.9	22.8
Junior High School	32.6	41.8	31.3	30.8	28.3	33.7	30.6
Senior High School	29.4	19.1	35.3	36.1	12.2	35.6	26.8
College	11.0	4.0	12.5	14.0	4.3	15.9	11.6
Graduate School	2.1	0.4	3.3	2.5	0.0	3.0	1.4
Income:							
$0-$9,999	16.9	37.5	11.5	10.5	16.6	19.8	11.6
$5,000-$6,999	14.2	18.4	13.3	14.8	14.7	16.6	8.9
$7,000-$9,999	15.9	16.0	15.6	18.0	14.0	14.9	16.9
$10,000-$14,999	16.0	6.9	20.1	20.1	9.3	14.6	19.0
$15,000-$29,999	12.9	4.6	15.5	17.5	12.1	7.7	17.8
$30,000+	5.0	0.4	5.6	4.5	7.1	4.4	7.3
Refused	6.9	3.7	8.6	6.5	5.4	8.0	6.5
Don't Know	12.3	12.5	10.0	8.1	20.9	14.0	12.1
Subjective Healing:							
Excellent	13.3	1.1	30.2	1.9	13.0	12.8	3.0
Good	32.2	8.5	51.2	25.0	38.6	39.6	11.7
Fair	33.4	45.3	18.0	62.8	35.6	36.9	20.4
Poor	21.1	45.1	0.6	10.3	12.8	10.8	64.9
Have You Ever Been a Patient in a Nursing Home?							
Yes	17.1	1.5	1.6	6.2	4.8	47.8	43.7
No	82.9	98.5	98.4	93.8	95.2	52.2	56.3

See note at end of table.

Table 4—Continued

Predictive Validity of 6 Types Generated From 27 Functional Status Variables for the 1982, 1984, and 1989 National Long-Term Care Survey, Assessed on Sociodemographic and Medical Conditions

Sociodemographics and Medical Conditions	Unweighted Population Frequency	Pure Type: Physically Challenged (1)	Active (2)	Active Moderately Physically Impaired (3)	IADL Impaired (4)	Mobility Challenged (5)	Frail (6)
Medical Conditions				Percent			
Rheumatism/Arthritis	72.8	98.9	61.1	90.2	43.1	84.3	66.8
Paralysis	8.5	5.2	1.2	3.9	0.0	10.5	34.7
Permanent Stiffness	23.4	43.2	10.6	28.4	7.7	26.0	34.9
Multiple Sclerosis	0.6	0.7	0.0	0.7	0.0	1.2	1.4
Cerebral Palsy	0.4	0.4	0.1	0.0	0.4	0.3	1.0
Epilepsy	0.8	1.1	0.5	0.1	0.6	0.1	2.4
Parkinson's	2.8	1.1	0.7	4.7	2.5	1.0	9.3
Glaucoma	9.2	7.1	5.4	5.7	27.9	5.7	11.8
Diabetes	16.3	22.4	8.9	18.3	17.3	16.0	23.6
Cancer	6.0	5.1	5.0	6.7	4.3	4.3	11.1
Constipation	30.8	50.4	15.3	34.1	29.3	26.8	45.8
Insomnia	39.3	75.5	24.3	50.6	25.8	31.3	43.8
Headache	16.6	44.3	7.5	20.5	15.8	5.3	19.4
Obesity	23.6	41.0	24.2	31.8	0.0	29.5	11.9
Arteriosclerosis	27.8	38.0	12.5	28.3	42.5	17.4	49.0
Mental Retardation	1.4	0.0	0.1	0.0	5.8	0.1	4.9
Dementia	7.8	0.0	0.5	0.7	27.7	0.4	33.5
Heart Attack	5.8	11.7	1.8	6.9	6.3	5.1	8.3
Other Heart Problems	29.3	56.5	16.1	37.2	26.0	21.4	34.0
Hypertension	45.6	69.9	37.4	52.2	29.6	48.9	41.7
Stroke	6.6	2.9	0.9	5.7	6.4	4.1	24.7
Circulation Trouble	50.2	83.0	25.5	63.7	36.9	47.6	68.1
Pneumonia	5.8	9.4	2.4	6.2	5.9	4.1	10.9
Bronchitis	13.6	29.0	8.7	21.7	7.3	6.4	14.7
Influenza	17.8	30.5	13.8	27.2	12.2	12.4	16.0
Emphysema	9.7	16.1	6.3	14.3	8.4	5.5	12.1
Asthma	7.3	18.3	4.6	11.6	2.4	3.8	6.2
Broken Hip	2.1	0.3	0.3	0.5	0.0	7.6	4.6
Other Broken Bones	5.22	8.25	3.22	2.99	0.00	9.27	7.75

NOTE: IADL is instrumental activity of daily living.

SOURCE: Multivariate analysis of community residents in the 1982, 1984, and 1989 National Long-Term Care Surveys prepared by the Center for Demographic Studies, Duke University.

Thus, for sociodemographic and medical conditions, the profiles have good predictive validity.

HHA service use for these six profiles (and the institutional group) are given in Table 5. There are three rows of statistics for HHA visits (or reimbursements) in 1982-83, 1984-85, and 1989-90. These were calculated using the g_{ik}s multiplied by sample weights. They reproduce the population statistics. First are the proportion using services. For HHA use in 1982-83, the average number of visits per user varies by type, from 22.0 to 43.1, whereas the proportion using services varied much more, from 26.72 to 3.2 percent—a factor of 8.5. Total 1982-83 HHA reimbursements averaged $1,032.60 per user, with type 6 and type 1 having the highest costs ($1,569.92 and $1,116.38, respectively). Types 2 and 3 had the lowest costs per user.

There was more variation in HHA use in 1989-90 across types (as there was in Table 1). Type 2 again used the fewest visits per user (31.6), type 6 the most (62.8), followed by type 1 (45.2). The conditional average number of visits for those with 5 to 6 ADL impairments (72.5) is higher than the conditional average for type 6 (62.8)—though this is still much higher than for other

Table 5

HHA Services Used in 1982, 1984, and 1989 Community Populations 65 Years of Age and Over and Eligible for Hospital Insurance: Total and by Pure Type Defined in Table 3

HHA Services	Total Population	Pure Type						
		Physically Challenged (1)	Active (2)	Moderately Physically Impaired (3)	IADL Impaired (4)	Mobility Challenged (5)	Frail (6)	Institutional (7)
HHA Visits								
1982-83:								
Percent Using Services	5.01	14.17	3.16	9.02	13.11	14.96	26.72	2.36
Number of Visits per Enrollee	1.38	4.38	0.70	2.12	3.41	4.40	11.51	0.61
Average Visits per User	27.54	30.91	21.99	23.56	26.01	29.40	43.08	25.79
1984-85:								
Percent Using Services	5.59	15.41	3.42	11.20	14.79	19.29	31.38	2.11
Number of Visits per Enrollee	1.41	4.39	0.67	2.69	3.86	5.28	12.08	0.53
Average Visits per User	25.20	28.47	19.56	24.01	26.13	27.39	38.50	24.91
1989-90:								
Percent Using Services	6.23	18.42	4.29	13.94	16.32	18.17	27.78	1.82
Number of Visits per Enrollee	2.41	8.33	1.36	4.85	6.56	7.33	17.44	0.81
Average Visits per User	38.76	45.19	31.61	34.80	40.18	40.33	62.77	44.64
HHA Reimbursements								
1982-83:								
Percent Using Services	5.00	14.15	3.16	9.00	13.10	14.86	26.68	2.36
Costs per Enrollee	51.61	157.95	27.00	78.96	121.62	159.40	418.81	22.34
Average Cost per User	1,032.60	1,116.38	853.92	877.57	928.44	1,072.94	1,569.92	946.81
1984-85:								
Percent Using Services	5.56	15.32	3.42	11.01	14.58	18.88	31.29	2.06
Costs per Enrollee	60.84	186.15	28.82	113.29	163.50	224.19	533.69	24.07
Average Cost per User	1,094.92	1,214.88	843.21	1,029.32	1,121.03	1,187.39	1,705.72	1,169.63
1989-90:								
Percent Using Services	6.20	18.39	4.26	13.91	16.32	18.14	27.78	1.82
Costs per Enrollee	123.75	419.95	71.98	253.63	333.85	370.33	832.41	45.79
Average Cost per User	1,994.84	2,283.90	1,688.23	1,822.73	2,045.78	2,041.83	2,996.51	2521.73
HHA Visits—Ratio of 1989-90 to 1982-83								
Percent Using Services	1.24	1.30	1.36	1.55	1.24	1.21	1.04	0.77
Number of Visits per Enrollee	1.75	1.90	1.94	2.29	1.92	1.67	1.52	1.33
Average Visits per User	1.41	1.46	1.44	1.48	1.54	1.37	1.46	1.73
HHA Reimbursements — Ratio of 1989-90 to 1982-83								
Percent Using Services	1.24	1.30	1.35	1.55	1.25	1.22	1.04	0.77
Costs per Enrollee	2.40	2.66	2.67	3.21	2.75	2.32	1.99	2.05
Average Cost per User	1.93	2.05	1.98	2.08	2.20	1.90	1.91	2.66

NOTES: HHA is home health agency. IADL is instrumental activity of daily living.

SOURCE: Disability scores calculated from the 1982, 1984, and 1989 National Long-Term Care Surveys and service-use data from linked Medicare files by Center for Demographic Studies, Duke University.

types. The costs per HHA user increased from 1982-83 to 1988-90 by 93 percent, from $1,032.60 to $1,994.80. Table 5 shows how HHA visits and reimbursements changed on a relative basis. The percent using HHA services increased only 24 percent, whereas the average number of HHA visits per user increased 41 percent and the average cost per user increased 93 percent.

The temporal change for the disability types varied from an increase of 55 percent more type 3 persons using HHAs to a decline of 23 percent for institutional persons. Reimbursements among users varied less, from a 98-percent increase for the most active group to a 166-percent increase for the institutional group. The main reason for the difference is the change in the average HHA visits used per user, which increased from 37 percent to 73 percent.

In Table 6, we present the same statistics for SNF use. In 1982-83, type 2 had a 0.47-percent chance of using a SNF compared with a 4.16-percent chance for type 6 (i.e., a ratio of 8.9 to 1). In 1989-90, the lowest likelihood of SNF use is again for type 2 (0.95 percent), with the second highest for type 6 (7.5 percent) and the most for the institutional group (10.0 percent) (i.e., the ratio is now 10.5 to 1). The second row shows the average number of days spent in a SNF. The third row shows the conditional average SNF days used, i.e., how many SNF days are used by a person of a given type (i.e., g_{ik} = 1.0) who used some of the services.

In Table 6, for 1982-83, the variation in the proportion using SNFs, and the average days used across the six types, is similar to that shown in Table 2. Furthermore, the average number of days used, as well as reimbursements, varies by roughly 50 percent between the types using the most and the least SNF care. For 1989-90, SNF use doubled with the variation from the type in the community using the least services (type 2) to that using the most (type 6) being about the same as in 1982-83. For SNF users, the amount of use varies little (as do reimbursements) with those in institutions who were identified by the survey as using the most SNF care and having the highest expenditures.

As in Table 5, we provide the relative rates of change from 1982-83 to 1989-90 for various measures. Although the overall percent using SNFs increased 116 percent, type 6 had the lowest relative increase (80 percent) and the institutional group had the highest (186 percent). There is more variation in the number of days used by the disability groups with a 2-percent decline for type 1 and a 77-percent increase for the institutionalized. The average cost per user increased 138 percent, with the smallest increase for type 1 (71 percent) and the largest for type 6 (159 percent) and the institutionalized (227 percent). It is of interest that type 3, moderately physically impaired, had a large proportional increase in the percent using services (143 percent) as well as in the average cost per user (157 percent). Thus, these changes confirm a more rapid relative rate of increase for SNFs than for HHAs.

Health Transitions: 1982-89

Earlier, we examined changes that occurred from 1982 to 1989 for each of six community disability groups. It is important to ascertain how disability groups changed in prevalence and how such changes affect future HHA use. The changes in the disability scores used in Table 5 are presented at the bottom of Table 3. Changes in prevalence of the disability groups in Tables 1 and 2 are presented in Table 7.

Declines occurred between the age-standardized and observed 1989 proportion for all groups except those with 3 to 4

Table 6

SNF Services Used in 1982, 1984, and 1989 Community Populations 65 Years of Age or Over and Eligible for Hospital Insurance: Total and by Pure Type Defined in Table 3

SNF Services	Total Population	Pure Type						
		Physically Challenged (1)	Active (2)	Moderately Physically Impaired (3)	IADL Impaired (4)	Mobility Challenged (5)	Frail (6)	Institutional (7)[1]
Days Spent in an SNF								
1982-83:								
Percent Using Services	0.95	2.27	0.47	1.52	2.50	2.10	4.16	3.51
Number of Days per Enrollee	0.30	0.79	0.14	0.53	0.75	0.62	1.37	1.20
Average Days per User	31.96	34.72	30.43	35.17	30.15	29.42	32.89	34.07
1984-85:								
Percent Using Services	1.10	2.11	0.64	1.81	2.35	3.42	4.16	3.12
Number of Days per Enrollee	0.32	0.58	0.18	0.58	0.77	1.06	1.26	0.97
Average Days per User	29.64	27.75	28.35	32.17	32.68	30.97	30.27	30.96
1989-90:								
Percent Using Services	2.05	4.58	0.95	3.75	4.81	5.37	7.50	10.03
Number of Days per Enrollee	0.84	1.55	0.31	1.44	1.81	1.69	2.84	6.03
Average Days per User	41.09	33.94	32.69	38.34	37.54	31.50	37.89	60.14
SNF Reimbursements								
1982-83:								
Percent Using Services	0.94	2.27	0.46	1.52	2.50	2.10	4.16	3.51
Costs per Enrollee	14.05	41.51	7.37	26.03	37.96	32.05	55.02	43.27
Average Cost per User	1,488.15	1,826.56	1,589.74	1,715.54	1,518.25	1,526.46	1,323.81	1,231.41
1984-85:								
Percent Using Services	1.09	2.11	0.64	1.81	2.35	3.37	4.02	3.07
Costs per Enrollee	18.04	25.87	11.52	26.06	32.78	60.48	62.48	46.54
Average Cost per User	1,659.56	1,228.14	1,804.26	1,441.31	1,397.63	1,794.75	1,555.71	1,515.07
1989-90:								
Percent Using Services	2.01	4.52	0.93	3.70	4.47	5.14	7.38	10.08
Costs per Enrollee	71.40	141.39	30.08	163.46	152.51	170.61	253.39	405.64
Average Cost per User	3,547.30	3,126.75	3,236.41	4,417.41	3,410.51	3,316.43	3,433.86	4,023.51
SNF Days—Ratio of 1989-90 to 1982-83								
Percent Using Services	2.16	2.02	2.02	2.47	1.92	2.56	1.80	2.86
Number of Days per Enrollee	2.80	1.96	2.21	2.72	2.41	2.73	2.07	5.03
Average Days per User	1.29	0.98	1.07	1.09	1.25	1.07	1.15	1.77
SNF Reimbursements—Ratio of 1989-90 to 1982-83								
Percent Using Services	2.14	1.99	2.02	2.43	1.79	2.45	1.77	2.87
Costs per Enrollee	5.08	3.41	4.08	6.28	4.02	5.32	4.61	9.37
Average Cost per User	2.38	1.71	2.04	2.57	2.25	2.17	2.59	3.27

NOTES: SNF is skilled nursing facility. IADL is instrumental activity of daily living.

SOURCE: Disability scores calculated from the 1982, 1984, and 1989 National Long-Term Care Surveys and service use data from linked Medicare files by Center for Demographic Studies, Duke University.

Table 7

Changes in Prevalence Distribution of Chronic Disability in the United States: Observed and Age Standardized for 5-Year Age Categories, 1982-89

Chronic Disability	1982 Observed Rates	1982 Rates Age Standardized to 1989 Population	1989 Observed Rates	Percent Difference Between 1989 Observed and Age Standardized
Non-Disabled	76.3	75.4	77.4	1.97
IADL Impaired Only	5.3	5.4	4.4	-0.99
1-2 ADLs Impaired	6.5	6.6	6.5	-0.16
3-4 ADLs Impaired	2.7	2.8	3.5	-0.69
5-6 ADLs Impaired	3.5	3.6	2.7	-0.86
Institutionalized	5.7	6.1	5.5	-0.65

NOTES: IADL is instrumental activity of daily living. ADL is activity of daily living.

SOURCE: 1982 and 1989 National Long-Term Care Surveys observed rates and 1982 rates age standardized to 1989 population by Center for Demographic Studies, Duke University.

ADL impairments—which increased 0.69 percent. The overall increase in the non-disabled group is 1.97 percent, compared with the 1.5-percent increase in the non-disabled score in the multivariate analyses. Of importance for changes in HHA and SNF use is that the disability category changes showed a lot of variation. The 1.97-percent increase in the non-disabled population implies a more rapid increase in HHA use. From the multivariate analysis, this increase may be traced to larger increases for type 3, a group with little disability but often reporting only fair health (Table 4). The declines in the 5 to 6 ADL and institutionalized groups suggest some moderation of SNF use, though the correspondence of these categories to the disability dimensions is less clear. The large age-adjusted decline (-0.65 percent) in institutionalized persons suggests that patterns of institutional use are changing, with nursing home stays becoming shorter and more medically intensive. The shift out of long institutional stays may be due to the greater availability nationally of SNFs and the availability of HHA services to help moderately impaired persons through shorter term disabilities that are due to acute illnesses. This implies that Medicare may already be systematically adapting to provide specialized types of long-term care (LTC) due to increased use of HHA benefits (in terms of the number of allowed visits) and to improved access to SNF services. These trends would be accelerated by increased education of elderly cohorts who could better cope in community settings with HHA and SNF care than could less educated persons. If true, then the rapid increase in both HHA and SNF use has to be interpreted in a different way, i.e., not as an increase in services used by the same population but possibly as an extension of Medicare benefits to cover certain types of LTC needs. If this interpretation is correct then the growth in service use has to be interpreted differently in policy terms, i.e., as meeting a component of LTC need in a potentially cost-effective fashion.

Health and Functional Status Profiles

The analysis showed large differences between disability profiles in SNF and HHA use, differences that paralleled Tables 1 and 2. However, there was still

considerable use by the non-disabled population that was likely due to chronic medical problems that do not cause ADL or IADL impairments but are correlated to those profiles in Table 3. Thus, to refine the multivariate analysis, we identified profiles using an expanded set of 56 health and functional measures from the 1982, 1984, and 1989 NLTCSs. Although we can roughly compare disability groups (Tables 1 and 2) and functional profiles (Table 3), the addition of the health measures required a multivariate procedure. The λ_{kj}s for the 7 profiles necessary to describe the 56 variables are shown in Table 8.

The seven profiles may be described as follows:

- The "acutely ill" (type 1) has trouble with one ADL (bathing), three IADLs, and physical impairments. It has multiple medical problems, e.g., cancer (21.6 percent), heart attack (33.1 percent), other heart problems (100.0 percent), and pulmonary problems.
- The "active and healthy" (type 2) has no ADL or IADL problems, little physical impairment, and only a small prevalence of medical problems.
- The "circulatory problem" (type 3) has no ADLs, one IADL, and a few physical impairments. Most serious are circulatory, cardiovascular, and stroke problems as well as diabetes.
- The "IADL, vision impaired, and dementia" (type 4) has IADL impairments, poor vision, glaucoma, and dementia.
- The "mobility challenged" (type 5) has ADL and IADL impairments related to mobility, physical problems related to lower limb problems, arthritis, some paralysis, and the highest likelihood of hip and other fractures.
- The "IADL impaired with physical problems" (type 6) has mobility and moderate physical and medical problems, i.e., arthritis and circulatory problems.
- The "frail" (type 7) is impaired on most ADLs, IADLs and physical functions. There are multiple medical problems including stroke and dementia.

At the bottom of Table 8 are g_ks weighted to show changes in the aggregate health and functioning of the population. Type 2 increased 1.3 percent, suggesting that controlling for health, there is a net increase of elderly persons free of both chronic disability and morbidity.

These seven types were used to predict sociodemographic factors as shown in Table 4. Their relation (λ_{kj}) to those factors are shown in Table 9.

Even for this sample of persons 65 years of age or over, the mean ages of the profiles vary by more than 16 years. The acutely ill (type 1) are the youngest (71.2 years), and type 4 are the oldest (mean age 87.5 years). Type 7 are the second oldest (82.1 years), with type 5 the third oldest (81.5 years). The active and healthy (type 2) have a mean age of 75.5 years. In terms of marital status, types 4, 5, and 6 are least likely married. Even the frail (type 7) have a significant proportion married. In terms of gender, females predominate in types 1, 3, 5, and 6. The best educated are type 2. The least educated are types 1 and 4. Type 3 now has worse subjective health (91.2 percent fair or poor), suggesting a better discrimination of types 2 and 3. Thus, the seven types have good predictive validity on sociodemographic measures.

HHA use by the seven types and the institutionalized group is shown in Table 10. Adding the medical conditions redefines type 2 to be healthier. The effect on service use of the additional health variables was to identify an additional subtype. Effects on HHA use of the active type 2 (compared

Table 8

Seven Pure Types Estimated From 56 Health and Functioning Variables From the 1982, 1984, and 1989 National Long-Term Care Surveys (NLTCSs)

Health and Functioning Variables	Unweighted Population Frequency	Pure Type: Acutely Ill (1)	Active and Healthy (2)	Circulatory (3)	IADL, Vision Impaired, and Dementia (4)	Mobility Challenged (5)	IADL Impaired With Physical Problems (6)	Frail (7)	Institutional[1] (8)
Patient Needs Help With:					Percent				
ADL Function									
1. Eating	7.0	0.0	0.0	0.0	0.0	0.0	0.0	63.0	—
2. Getting In/Out of Bed	26.2	0.0	0.0	0.0	0.0	100.0	0.0	100.0	—
3. Walking Around Inside	39.9	0.0	0.0	0.0	0.0	100.0	0.0	100.0	—
4. Dressing	19.4	0.0	0.0	0.0	0.0	0.0	0.0	100.0	—
5. Bathing	43.1	60.1	0.0	0.0	0.0	100.0	0.0	100.0	—
6. Toileting	21.7	0.0	0.0	0.0	0.0	62.8	0.0	100.0	—
7. Is Bedfast	0.8	0.0	0.0	0.0	0.0	0.0	0.0	6.1	—
8. No Inside Activity	1.5	0.0	0.0	0.0	0.0	0.0	0.0	11.2	—
9. Is Wheelchairfast	7.0	0.0	0.0	0.0	0.0	23.0	0.0	26.4	—
IADL Function									
10. Heavy Work	71.9	100.0	0.0	100.0	100.0	100.0	100.0	100.0	—
11. Lightwork	22.6	0.0	0.0	0.0	0.0	0.0	0.0	100.0	—
12. Laundry	22.6	0.0	0.0	0.0	0.0	0.0	0.0	100.0	—
13. Cooking	29.8	0.0	0.0	0.0	100.0	0.0	0.0	100.0	—
14. Grocery Shopping	56.9	100.0	0.0	0.0	100.0	100.0	100.0	100.0	—
15. Getting Around Outside	59.1	0.0	0.0	0.0	69.8	100.0	100.0	100.0	—
16. Traveling	52.9	100.0	0.0	0.0	100.0	100.0	100.0	78.8	—
17. Managing Money	26.8	0.0	0.0	0.0	100.0	0.0	0.0	100.0	—
18. Taking Medicine	23.5	0.0	0.0	0.0	100.0	0.0	0.0	100.0	—
19. Using Telephone	16.0	0.0	0.0	0.0	100.0	0.0	0.0	100.0	—
Physical Performance									
20. Climbing Stairs									
Missing	6.5	0.0	1.0	0.0	1.1	5.9	1.0	27.0	—
None	18.6	0.0	61.9	0.0	0.0	0.0	0.0	0.0	—
Some	29.1	0.0	38.1	86.1	100.0	0.0	0.0	0.0	—
Very	31.4	71.2	0.0	13.9	0.0	55.3	100.0	0.0	—
Cannot	21.0	28.8	0.0	0.0	0.0	44.7	0.0	100.0	—
21. Bending Over									
None	43.5	0.0	100.0	0.0	100.0	34.3	0.0	0.0	—
Some	27.9	0.0	0.0	100.0	0.0	0.0	81.3	0.0	—
Very	18.0	100.0	0.0	0.0	0.0	65.7	18.7	14.3	—
Cannot	10.6	0.0	0.0	0.0	0.0	0.0	0.0	85.7	—
22. Holding a 10-lb. Package									
None	29.6	0.0	100.0	0.0	0.0	0.0	0.0	0.0	—
Some	18.1	0.0	0.0	100.0	100.0	0.0	0.0	0.0	—
Very	15.9	0.0	0.0	0.0	0.0	0.0	100.0	0.0	—
Cannot	36.4	100.0	0.0	0.0	0.0	100.0	0.0	100.0	—
23. Reaching Overhead									
None	56.1	0.0	100.0	0.0	100.0	100.0	0.0	0.0	—
Some	21.2	0.0	0.0	100.0	0.0	0.0	84.0	0.0	—
Very	13.9	72.7	0.0	0.0	0.0	0.0	16.0	35.0	—
Cannot	8.8	27.3	0.0	0.0	0.0	0.0	0.0	65.0	—
24. Combing Hair									
None	71.6	0.0	100.0	100.0	100.0	100.0	0.0	0.0	—
Some	16.0	0.0	0.0	0.0	0.0	0.0	100.0	13.4	—
Very	7.0	100.0	0.0	0.0	0.0	0.0	0.0	28.3	—
Cannot	5.4	0.0	0.0	0.0	0.0	0.0	0.0	58.3	—
25. Washing Hair									
None	55.8	0.0	100.0	100.0	100.0	100.0	0.0	0.0	—
Some	14.8	0.0	0.0	0.0	0.0	0.0	58.9	0.0	—
Very	9.4	100.0	0.0	0.0	0.0	0.0	14.1	0.0	—
Cannot	20.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	—

See footnote at end of table.

Table 8—Continued

Seven Pure Types Estimated From 56 Health and Functioning Variables From the 1982, 1984, and 1989 National Long-Term Care Surveys (NLTCSs)

Health and Functioning Variables	Unweighted Population Frequency	Pure Type: Acutely Ill (1)	Active and Healthy (2)	Circulatory (3)	IADL, Vision Impaired, and Dementia (4)	Mobility Challenged (5)	IADL Impaired With Physical Problems (6)	Frail (7)	Institutional[1] (8)
26. Grasping Small Objects					Percent				
None	66.0	0.0	100.0	100.0	100.0	100.0	0.0	14.4	—
Some	20.3	0.0	0.0	0.0	0.0	0.0	100.0	18.3	—
Very	10.1	100.0	0.0	0.0	0.0	0.0	0.0	31.6	—
Cannot	3.6	0.0	0.0	0.0	0.0	0.0	0.0	35.7	—
Medical Condition									
27. See Well Enough to Read Newspaper	74.3	100.0	100.0	100.0	0.0	100.0	100.0	41.6	—
28. Rheumatism or Arthritis	72.8	100.0	53.6	100.0	0.8	100.0	100.0	66.6	—
29. Paralysis	8.5	0.0	0.0	2.3	0.0	12.5	0.0	45.3	—
30. Permanent Stiffness	23.4	95.3	0.0	76.0	0.0	13.1	0.0	38.0	—
31. Multiple Sclerosis	0.6	2.8	0.0	0.0	0.0	1.8	0.0	1.1	—
32. Cerebral Palsy	0.4	3.4	0.0	0.0	0.0	0.0	0.0	0.9	—
33. Epilepsy	0.8	8.1	0.0	0.0	0.0	0.0	0.0	1.9	—
34. Parkinson's Disease	2.8	0.0	0.0	7.7	0.0	0.0	0.0	12.3	—
35. Glaucoma	9.2	0.0	0.0	0.0	67.2	0.0	0.0	0.0	—
36. Diabetes	16.3	0.0	0.0	83.3	0.0	0.0	0.0	33.1	—
37. Cancer	6.0	21.6	4.2	8.1	4.5	0.0	0.0	12.2	—
38. Constipation	30.8	100.0	0.0	100.0	0.0	0.0	0.0	52.6	—
39. Insomna	39.3	100.0	0.0	100.0	0.0	0.0	0.0	44.1	—
40. Headache	16.6	100.0	0.0	0.0	0.0	0.0	0.0	0.0	—
41. Obesity	23.6	18.9	9.8	100.0	0.0	22.0	0.0	12.8	—
42. Arteriosclerosis	27.8	60.5	0.0	100.0	33.9	0.0	0.0	59.4	—
43. Mental Retardation	1.4	0.0	0.0	0.0	6.9	0.0	0.0	5.3	—
44. Dementia	7.8	0.0	0.0	0.0	37.0	0.0	0.0	38.3	—
45. Heart Attack	5.8	33.1	0.0	19.9	0.0	0.0	0.0	7.2	—
46. Other Heart Problems	29.3	100.0	0.0	100.0	0.0	0.0	0.0	37.4	—
47. Hypertension	45.6	98.8	20.2	100.0	0.0	37.1	18.4	47.1	—
48. Stroke	6.6	0.0	0.0	14.6	0.0	0.0	0.0	33.3	—
49. Circulation Trouble	50.2	100.0	0.0	100.0	0.0	11.3	44.9	79.0	—
50. Pneumonia	5.8	89.2	0.0	0.0	0.0	0.0	0.0	0.0	—
51. Bronchitis	13.6	100.0	0.0	0.0	0.0	0.0	0.0	0.0	—
52. Influenza	17.8	100.0	0.0	0.0	0.0	0.0	0.0	0.0	—
53. Emphysema	9.7	100.0	0.0	0.0	0.0	0.0	0.0	0.0	—
54. Asthma	7.3	100.0	0.0	0.0	0.0	0.0	0.0	0.0	—
55. Broken Hip	2.1	0.0	0.0	0.0	0.0	11.3	0.0	3.1	—
56. Other Broken Bones	5.2	25.3	2.6	0.0	0.0	12.1	2.8	5.2	—
Weighted $\bar{g}_k$s									
$\bar{g}_k$ 1982		1.4	79.3	2.8	2.2	3.1	2.2	3.3	5.7
$\bar{g}_k$ 1984		1.3	79.5	3.2	2.3	3.2	2.2	2.7	5.5
$\bar{g}_k$ 1989		1.3	80.6	2.9	1.6	3.3	1.9	2.9	5.5

[1]Not included in the GoM analysis.

NOTES: IADL is instrumental activity of daily living. ADL is activity of daily living.

SOURCE: Multivariate analyses of 1982, 1984 and 1989 NLTCS by Center for Demographic Studies, Duke University.

Table 9

Assessment of Predictive Vaillidity of 7 Pure Types Generated from 56 Variables Using Sociodemographic and Selected Factors

Sociodemographic and Selected Factors	Unweighted Population Frequency	Pure Type: Acutely Ill (1)	Active and Healthy (2)	Circulatory (3)	IADL, Vision Impaired, and Dementia (4)	Mobility Challenged (5)	IADL Impaired With Physical Problems (6)	Frail (7)
Gender:					Percent			
Male	34.5	30.1	52.6	24.9	49.1	12.6	6.3	43.6
Female	65.5	69.9	47.4	75.1	50.9	87.4	93.7	56.4
Age:								
63 Years	4.5	13.6	4.9	6.5	0.0	2.6	4.3	2.1
67 Years	11.1	24.6	14.3	17.6	0.0	5.7	7.0	7.3
70 Years	21.7	38.5	27.3	34.1	0.2	12.6	20.9	15.1
75 Years	22.6	23.3	26.3	32.4	11.5	19.2	18.4	19.6
80 Years	19.6	0.0	18.3	9.3	30.9	28.2	25.3	22.0
85 Years	13.3	0.0	7.8	0.0	33.9	21.4	19.5	16.8
90 Years	7.3	0.0	1.2	0.0	23.5	10.4	4.5	17.0
Mean Age	—	71.2	75.7	73.4	87.5	81.5	79.1	82.1
Marital Status:								
Married	42.7	56.5	56.9	56.4	22.1	19.6	18.5	52.1
Not Married	57.3	43.5	43.1	43.6	77.9	80.4	81.5	48.0
Education:								
None	3.2	1.6	2.1	0.1	9.2	2.3	2.7	7.0
Grade School	21.6	50.8	13.8	20.3	46.0	8.6	23.5	21.6
Junior High School	32.6	39.8	29.6	38.3	23.7	33.6	38.0	31.0
Senior High School	29.4	7.6	37.1	32.0	13.6	35.6	26.1	27.7
College	11.0	0.0	13.8	8.2	6.5	16.8	9.1	11.5
Graduate School	2.1	0.2	3.7	1.1	1.1	3.1	0.6	1.3
Income:								
$0-$9,999	16.9	40.0	9.8	15.2	13.9	20.5	30.9	9.7
$5,000-$6,999	14.2	24.8	11.7	20.7	11.6	15.2	15.0	7.9
$7,000-$9,999	15.9	18.9	15.2	20.1	11.7	14.8	13.7	17.4
$10,000-$14,999	16.0	9.7	20.4	20.5	9.2	13.6	6.9	19.9
$15,000-$29,999	12.9	3.8	16.5	13.8	14.3	6.7	7.8	18.9
$30,000	5.0	0.0	6.3	1.9	9.2	4.7	1.0	7.8
Refused	6.9	0.0	9.7	1.4	7.9	8.5	8.3	6.1
Don't Know	12.3	2.7	10.5	6.4	22.2	16.0	16.4	12.3
Subjective Healing:								
Excellent	13.3	0.0	32.3	0.0	17.5	13.8	1.7	1.6
Good	23.2	0.0	56.1	9.1	49.4	46.2	23.9	8.1
Fair	33.4	33.4	11.6	75.7	29.5	34.2	54.7	20.2
Poor	21.1	66.6	0.0	15.2	3.5	5.8	19.7	70.0
Have You Ever Been a Patient In a Nursing Home?								
Yes	17.1	3.4	2.1	1.7	7.3	53.0	3.3	44.3
No	82.9	96.6	97.9	98.3	92.7	47.0	96.7	55.7

NOTE: IADL is instrumental activity of daily living.

SOURCE: Multivariate analyses of National Long-Term Care Surveys for 1982, 1984, and 1989 by Center for Demographic Studies, Duke University.

Table 10

HHA Services Used in 1982, 1984, and 1989 Community Populations 65 Years of Age and Over and Eligible for Hospital Insurance: Total and by Pure Type Defined in Table 8

HHA Services	Total Population	Pure Type: Acutely Ill (1)	Active and Healthy (2)	Circulatory (3)	IADL, Vision Impaired, and Dementia (4)	Mobility Challenged (5)	IADL Impaired With Physical Problems (6)	Frail (7)	Institutional (8)
HHA Visits									
1982-83:									
Percent Using Services	5.01	14.67	3.14	10.34	13.69	15.51	13.29	26.58	2.36
Number of Visits per Enrollee	1.38	5.63	0.69	2.62	3.65	4.63	3.74	11.36	0.61
Average Visits per User	27.64	38.37	21.91	25.35	26.64	29.85	28.15	42.75	25.79
1984-85:									
Percent Using Services	5.59	16.56	3.43	11.07	15.22	19.70	15.37	31.15	2.11
Number of Visits per Enrollee	1.41	4.85	0.67	2.83	3.92	5.46	4.31	12.13	0.53
Average Visits per User	25.20	29.32	19.52	25.59	25.76	27.71	28.06	38.96	24.91
1989-90:									
Percent Using Services	6.23	16.38	4.28	15.58	16.30	18.61	17.51	27.94	1.82
Number of Visits per Enrollee	2.41	7.78	1.33	6.34	6.87	7.70	7.41	17.67	0.81
Average Visits per User	38.76	47.53	31.04	40.72	42.14	41.36	42.32	63.24	44.64
HHA Reimbursements									
1982-83:									
Percent Using Services	5.00	14.67	3.14	10.33	13.66	15.40	13.25	26.53	2.36
Costs per Enrollee	51.61	209.85	26.64	96.76	132.14	167.00	132.91	412.68	22.34
Average Cost per User	1,032.60	1,430.44	849.30	936.97	967.11	1,084.12	1,003.39	#1,555.81	946.81
1984-85:									
Percent Using Services	5.56	16.42	3.42	10.87	15.06	19.31	15.27	31.05	2.06
Costs per Enrollee	60.84	206.79	28.76	121.52	165.32	234.17	179.35	536.64	24.07
Average Cost per User	1,094.92	1,258.99	840.86	1,117.77	1,098.12	1,212.50	1,174.39	1,728.18	1,169.63
1989-90:									
Percent Using Services	6.20	16.36	4.25	15.55	16.30	18.59	17.46	27.94	1.82
Costs per Enrollee	123.75	384.06	70.64	325.53	347.91	386.73	377.40	842.39	45.79
Average Cost per User	1,994.83	2,347.15	1,663.42	2,092.99	2,134.00	2,080.58	2,161.15	3,015.03	2,521.73
HHA Visits—Ratio of 1989-90 to 1982-83									
Percent Using Services	1.24	1.12	1.36	1.51	1.19	1.20	1.32	1.05	0.77
Number of Visits per Enrollee	1.75	1.38	1.93	2.42	1.88	1.66	1.98	1.56	1.33
Average Visits per User	1.40	1.24	1.42	1.61	1.58	1.39	1.50	1.48	1.73
HHA Reimbursements—Ratio of1989-90 to 1982-83									
Percent Using Services	1.24	1.12	1.35	1.51	1.19	1.21	1.32	1.05	0.77
Costs per Enrollee	2.40	1.83	2.65	3.36	2.63	2.32	2.84	2.04	2.05
Average Cost per User	1.93	1.64	1.96	2.23	2.21	1.92	2.15	1.94	2.66

NOTES: HHA is home health agency. IADL is instrumental activity of daily living.

SOURCE: Calculated from disability scores prepared from analysis of the 1982, 1984, and 1989 National Long-Term Care Surveys and linked Medicare files by Center for Demographic Studies, Duke University.

with Table 5) are small. Compared with the physically challenged ([type 1], Table 5), the acutely ill ([type 1], Table 10) experienced a decline in 1989-90 in the proportion using HHA services and in HHA reimbursements even though the average number of visits per user increased from 45.2 (Table 5) to 47.5 (Table 10) in 1989-90. This is because the 1982-83 per capita use of HHA visits was much higher in the second analysis. HHA visits and costs increased marginally for type 7. The primary health differentiation occurs for types 3-6 in Table 10, representing types 3-5 in Table 5. The most significant difference in trend is for type 3, which increased its use of services (i.e., HHA visits increased from 34.8 [Table 5] to 40.7 [Table 10]). All four of the new types used more HHA visits in 1989-90 than the three types in Table 5. These increases are derived from the small per capita decline in HHA use for the largest type (type 2). This analysis of HHA use has the advantage that we defined a type 2 which is less contaminated by moderate health problems. Thus, the seven-type analysis would provide better targeting of the health needs of groups, especially for HHA services.

In Table 11, we present the corresponding statistics for SNF use. A comparison of Table 11 with Table 6 shows that the addition of health factors has changed the SNF use for type 3 dramatically, with use lower in Table 11. A smaller decline occurred for type 1. Thus, the addition of health factors helped isolate types with decreased SNF use (with moderate impairment but considerable medical problems) but with continuing or increasing HHA use. Therefore, the complementarity of HHA and SNF use implied in Tables 1 and 2 was identified by the two multivariate analyses. This observation has different implications for SNF and HHA use and has potential for targeting groups with specific health needs.

SUMMARY

In this article, we first examined change in HHA and SNF use from 1982 to 1990. In those comparisons, we adjusted the data for community residents for changes in health and function in three ways. First, we used discrete categories based directly on the survey reports of IADL and ADL impairments. Second, we used a multivariate procedure to adjust HHA and SNF use on 27 functional items taken from the NLTCS. Six dimensions were required to describe the variation of those 27 measures. Third, we did a multivariate analysis of 56 health and functional measures. To explain the variation in the 56 measures, a seventh type was required. Again, the relation of those seven profiles to HHA and SNF use were examined.

For each of these analyses we tabulated Medicare service use for 12 months after each survey date. By forming "external" variables in the GoM analyses, we could generate conditional estimates of service use in 1982, 1984, and 1989 for each of the six disability dimensions or for each of the seven health and disability dimensions. From the analyses, we could estimate the service use of the total U.S. elderly population by using sample weights. There were large differences between these health dimensions related both to changes in the likelihood of a type of person using a service and change in the volume of service used by a type of person.

The differences identified in the two analyses indicated that, as in the simple tabulation of disability (Tables 1 and 2), there was complementarity in HHA and SNF use. HHA services tended to be used by persons with serious health problems whose disability appeared to be more a consequence of illness and whose chronic-

Table 11

SNF Services Used in 1982, 1984, and 1989 Community Populations 65 Years of Age and Over and Eligible for Hospital Insurance: Total and by Pure Type Defined in Table 8

SNF Services	Total Population	Pure Type: Acutely Ill (1)	Active and Healthy (2)	Circulatory (3)	IADL, Vision Impaired, and Dementia (4)	Mobility Challenged (5)	IADL Impaired With Physical Problems (6)	Frail (7)	Institutional (8)
Days Spent in an SNF									
1982-83:									
Percent Using Services	0.95	1.85	0.47	1.59	2.69	2.13	2.45	4.17	3.51
Number of Days per Enrollee	0.30	0.61	0.15	0.51	0.78	0.61	0.88	1.38	1.20
Average Days per User	31.96	32.78	30.87	32.27	28.93	28.68	35.71	33.13	34.07
1984-86:									
Percent Using Services	1.10	2.08	0.64	1.67	2.55	3.31	2.36	4.15	3.12
Number of Days per Enrollee	0.32	0.52	0.18	0.52	0.84	1.02	0.69	1.29	0.97
Average Days per User	29.64	25.24	28.34	31.45	32.92	30.93	29.33	31.00	30.96
1989-90:									
Percent Using Services	2.05	4.12	0.96	3.34	5.16	5.48	4.99	7.46	10.03
Number of Days per Enrollee	0.84	1.20	0.32	1.08	1.88	1.81	1.74	2.87	6.03
Average Days per User	41.09	29.14	33.43	32.45	36.34	33.10	34.87	38.44	60.14
SNF Reimbursements									
1982-83:									
Percent Using Services	0.94	1.85	0.46	1.59	2.69	2.13	2.45	4.17	3.51
Costs per Enrollee	14.05	28.28	7.32	30.31	37.61	32.82	44.38	55.65	43.27
Average per Use Cost	1,488.15	1,528.51	1,583.29	1,907.00	1,400.15	1,541.69	1,810.27	1,335.55	1,231.41
1984-85:									
Percent Using Services	1.09	2.06	0.64	1.67	2.53	3.25	2.36	4.03	3.07
Costs per Enrollee	18.04	27.96	11.59	24.49	36.30	57.00	32.14	62.96	46.54
Average per Use Cost	1,659.56	1,355.12	1,801.06	1,468.75	1,433.91	1,754.99	1,363.40	1,562.11	1,151.07
1989-90:									
Percent Using Services	2.01	4.11	0.94	3.27	4.91	5.24	4.89	7.34	10.08
Costs per Enrollee	71.40	109.85	31.31	119.28	175.46	173.66	178.47	248.14	405.64
Average per Use Cost	3,547.30	2,670.65	3,333.84	3,652.07	3,575.04	3,312.25	3,646.69	3,382.66	4,023.51
SNF Days—Ratio of 1989-90 to 1982-83									
Percent Using Services	2.16	2.23	2.04	2.10	1.92	2.57	2.04	1.79	2.8
Number of Days per Enrollee	2.80	1.97	2.13	2.12	2.41	2.97	1.98	2.08	5.03
Average Days per User	1.29	0.89	1.08	1.01	1.26	1.15	0.98	1.16	1.77
SNF Reimbursements—Ratio of 1989-90 to 1982-83									
Percent Using Services	2.14	2.22	2.04	2.06	1.83	2.46	2.00	1.76	2.87
Costs per Enrollee	5.08	3.88	4.28	3.94	4.67	5.29	4.02	4.46	9.37
Average Cost per User	2.38	1.75	2.11	1.92	2.55	2.15	2.01	2.53	3.27

NOTES: SNF is skilled nursing facility. IADL is instrumental activity of daily living.

Source: Calculated from disability scores prepared from the 1982, 1984, and 1989 NLTCS and Medicare linked services by Center for Demographic Studies, Duke University.

ity may have been tied to the duration of the health problem. SNF use seemed to be concentrated among those with serious functional disability of potentially longer standing. The rates of growth of both HHA and SNF use were large and began in 1988-89. HHA use started to increase because of litigation that led to a clearer definition of the HHA benefit. SNF use was stimulated by MCCA, which appeared to have the effect of improving access to SNFs, especially in rural areas.

The types identified in the analysis could be used to target efforts to constrain SNF and HHA use. However, the results raise a larger question of whether they are serving a specialized component of LTC needs. If this is the case, the argument for restriction of growth in these services (e.g., caps on the number of HHA visits) is not as compelling as it would be if per capita use of HHA services were increasing for persons with limited post-acute care needs. Thus, one needs to ask whether the growth of HHA and SNF services has served, in part, to meet the acute-care correlates of persons with LTC needs. If so, how much does meeting that component of need respond to the most pressing LTC service needs? It may be that the ability to cope with LTC needs has been enhanced by the increasing education and socioeconomic resources of at least a significant proportion of more recent elderly cohorts and that, with that enhanced capacity, a large proportion of persons may be able to continue functioning with improved HHA and SNF benefits and accessibility. If so, a careful analysis of the precise health and functional characteristics of individuals relative to the patterns of HHA and SNF use may lead to ways to better target extended HHA and SNF benefits to meet the most serious and acute components of LTC needs in a cost-effective fashion. Evidence suggesting that this may be the way LTC services are evolving naturally is the reduction (age-adjusted) in long-term institutional use and the increased provision of medical services that moderate functional disability (e.g., cataract surgery; one of the largest Medicare-cost categories). Thus, more detailed analyses of health and functioning could be useful in policy deliberations oriented to deciding: (1) whether the growth in HHA and SNF use is too rapid; (2) whether there are cost substitutions occurring that justify some of the growth in use; or (3) whether the increase in services is having a beneficial impact on the quality of life of elderly disabled persons (e.g., their ability to remain in the community rather than transferring to and becoming long-term institutional residents).

ACKNOWLEDGMENT

We acknowledge the helpful comments and suggestions of Nancy Miller of the Office of Research and Demonstrations, Health Care Financing Administration.

REFERENCES

Bishop, Y., Fienberg, S., and Holland, P.: *Discrete Multivariate Analysis: Theory and Practice.* Cambridge, MA., and London, England. MIT Press, 1975.

Dorevitch, M.I., Cossar, R.M., Bailey, F.J., et al.: The Accuracy of Self and Informant Ratings of Physical Functional Capacity in the Elderly. *Journal of Clinical Epidemiology* 45(7):791-798, 1992.

Duggan vs. Bowen: U.S. District Court for the District of Columbia, Number 87-0383. August 1, 1988.

Everitt, B.S.: *An Introduction to Latent Variable Models.* London and New York. Chapman and Hall, 1984.

Health Care Financing Administration: Fiscal Year Data Derived From Bureau of Programs Operations Quarterly. Supplement to Intermediary Workload Report, HCFA Form 1566-A. Spring 1990.

Helbing, C.: Hospital Insurance Short-Stay Hospital Benefits. *Health Care Financing Review* 1992 Annual Supplement. Pp. 55-96, 1992.

Helbing, C., and Cornelius, E.S.: Skilled Nursing Facilities. *Health Care Financing Review* 1992 Annual Supplement. Pp. 87-124, 1992.

Helbing, C., Sangl, J.A., and Silverman, H.A.: Home Health Agency Benefits. *Health Care Financing Review* 1992 Annual Supplement. Pp. 125-148, 1992.

Hing, E.: *Characteristics of Elderly Home Health Patients: Preliminary Data From the 1992 National Nursing Home and Hospice Care Survey.* National Center for Health Statistics, Center for Disease Control and Prevention. U.S. Department of Health and Human Services Public Health Service, 1994.

Katz, S., and Akpom, C.: A Measure of Primary Sociobiological Functions. *International Journal of Health Services* 6:493-508, 1976.

Lawton, M.P., and Brody, E.M.: Assessment of Older People: Self-Maintaining and Instrumental Activities of Daily Living. *Gerontologist* 9:179-186, 1969.

Lazarsfeld, P., and Henry, N.: *Latent Structure Analysis.* Boston. Houghton Mifflin, 1968.

Liu, K., and Manton, K.G.: Nursing Home Length of Stay and Spend-Down: Connecticut, 1977-1986. *The Gerontologist* 31:165-173, 1991.

Maddox, G.L., and Clark, D.O.: Trajectories of Functional Impairment in Later Life. *Journal of Health and Social Behavior* 33:114-125, 1992.

Manton, K.G.: Trends for the Elderly—Implications for Income Support, Health and Provision for Long-Term Care. In Ross, S.G., and Walker, D.M., eds.: *Measuring Future Income Security and Health Care Expenditures for the Aged and Disabled.* Proceedings of the Conference sponsored by the Social Security and Medicare Boards of Trustees, Baltimore, MD., October 7-8, 1993. In press. 1994.

Manton, K.G., Corder, L.S., and Stallard, E.: Estimates of Change in Chronic Disability and Institutional Incidence and Prevalence Rates in the U.S. Elderly Population From the 1982, 1984, and 1989 National Long Term Care Survey. *Journal of Gerontology Social Sciences* 47(4):S153-S166, 1993a.

Manton, K.G., Corder, L.S., and Stallard, E.: Changes in the Use of Personal Assistance and Special Equipment 1982 to 1989: Results From the 1982 and 1989 NLTCS. *The Gerontologist* 33:168-176, 1993b.

Manton, K.G., and Hausner, T.: A Multidimensional Approach to Case Mix for Home Health Services. *Health Care Financing Review* 8(4):37-54, 1987.

Manton, K.G., and Liu, K.: Recent Changes in Service Use Patterns of Disabled Medicare Beneficiaries. *Health Care Financing Review* 11(3):51-66, 1990.

Manton, K.G., and Stallard, E.: An Analysis of Demographic Underwriting Factors for the AAPCC. *Health Care Financing Review* 14:117-132, 1992.

Manton, K.G., and Stallard, E.: Medical Demography: Interaction of Disability Dynamics and Mortality. In Martin, L., and Preston, S.H. eds.: *The Demography of Aging.* Washington, DC. National Academy Press, 1994.

Manton, K.G., Stallard, E., and Corder, L.S.: Changes in Morbidity and Chronic Disability in the U.S. Elderly Population: Evidence From the 1982, 1984, and 1989 National Long-Term Care Surveys. *Journal of Gerontology.* In press.

Manton, K.G., Stallard, E., Woodbury, M.A., and Dowd, J.E.: Time Varying Covariates of Human Mortality and Aging: Multidimensional Generalization of the Gompertz. *Journal of Gerontology: Biological Sciences* 49:B169-B190, 1994.

Manton, K.G., Wrigley, J.M., Cohen, H., and Woodbury, M.: Cancer Mortality, Aging, and Patterns of Comorbidity: United States, 1968 to 1986. *Journal of Gerontology* 46:S225-S234, 1991.

Manton, K.G., Woodbury, M.A., and Stallard, E,: Statistical and Measurement Issues in Assessing the Welfare Status of Aged Individuals and Populations. *Journal of Econometrics* 50:151-181, 1991.

Manton, K.G., Woodbury, M.A., and Tolley, H.D.: *Statistical Applications Using Fuzzy Sets.* Wiley-Interscience Publication. New York. John Wiley & Sons, 1994.

Manton, K.G., Woodbury, M.A., Vertrees, J.C., and Stallard, E.: Use of Medicare Services Before and After Introduction of the Prospective Payment System. *Health Services Research* 28(3):269-292, 1993.

McLachlan, G.J., and Basford, K.E.: Mixture Models: Inference and Clustering Applications. In *Statistics & Monographs* Series, Vol. 4. New York. Marcel Dekker, 1987.

Office of Inspector General: *Influences on Medicare Skilled Nursing Benefit.* U.S. Department of Health and Human Services, Washington, DC., June 1991.

Omnibus Budget Reconciliation Act: Public Law 100-203, 1987.

Orchard, R., and Woodbury, M.A.: A Missing Information Principle: Theory and Application. In LeCam, L., Heyman, J., and Scott, E., eds.: *Sixth Berkley Symposium on Mathematical Statistics and Probability.* Berkeley, CA. University of California Press, 1971.

Preston, S.H.: Demographic Change in the United States, 1970-2050. In Manton, K., Singer, B., and Suzman, R., eds.: *Forecasting the Health of Elderly Populations.* New York. Springer-Verlag, 1992.

Reuben, D.B., Siu, A.L., and Kimpau, S.: The Predictive Validity of Self-Support and Performance-Based Measures of Function and Health. *Journal of Gerontology: Medical Sciences* 47(4):M106-M110, 1992.

Sager, M., Easterling, D.V., Kindig, D.A., and Anderson, O.W.: Changes in the Location of Death After Passage of Medicare's Prospective Payment System: A National Study. *New England Journal of Medicine* 320:433-439, 1989.

U.S. General Accounting Office: *Medicare Home Health Service: A Difficult Program to Control.* U.S. Government Printing Office. Washington, 1981.

U.S. General Accounting Office: *Need to Strengthen Home Health Care Payment Controls and Address Unmet Needs.* U.S. Government Printing Office. Washington, 1986.

U.S. General Accounting Office: *Medicare: Increased Denials of Home Health Claims During 1986 and 1987.* U.S. Government Printing Office. Washington, 1990.

Weiner, J., Hanley, R., Clark, R., and Van Nostrand, J.: Measuring the Activities of Daily Living: Comparisons Across National Survey. *Journal of Gerontology: Social Sciences* 45(6):S229-S227, 1990.

Woodbury, M.A., Manton, K.G., and Tolley, H.D.: A General Model for Statistical Analysis Using Fuzzy Sets: Sufficient Conditions for Identifiability and Statistical Properties. *Information Sciences* 1:149-180, 1994.

Reprint Requests: Kenneth G. Manton, Ph.D., Duke University, Center for Demographic Studies, 2117 Campus Drive, Box 90408, Durham, North Carolina 27708-0408.