Morbidity, Disability, and Long-term Care of the Elderly: Implications for Insurance Financing

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UNLIKE OTHER FORMS OF HEALTH CARE, LONG-TERM care (LTC) is generally not covered by either Medicare or private health insurance. Our current "system" for financing LTC is simple: most individuals and their families pay out of pocket until their financial resources are depleted, at which point the patient becomes eligible for Medicaid, the payer of last resort. There is agreement that the current system is no longer acceptable, but no consensus has emerged on how to design a new system. Most observers agree, however, that the contribution of private and public insurance, which currently covers 5 percent of costs, should be increased relative to that of out-of-pocket payments and Medicaid coverage (Rivlin and Wiener 1988; Meiners 1983).

A major difficulty in the expansion of LTC insurance is that there has been relatively little direct actuarial or plan experience on which to base rates. This is particularly important for private LTC insurance because of the need to balance the structure of rates so that they are high enough to cover the cost of LTC services, yet low enough to attract (and retain) clients to a voluntary insurance program. Thus, private insurance, if its role in providing coverage for LTC services is to be maximized, requires very accurate estimates of the financial risks for specific

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groups of clients. In order to provide the most accurate actuarial rates, the lack of a good experience base necessitates using nontraditional data sources: national representative longitudinal surveys with sufficient samples of elderly and oldest-old persons—the primary beneficiaries of LTC services.

The primary purpose of this article is to examine the bioactuarial data available in three large nationally representative surveys and to determine how these data could be best employed to inform the design of private LTC insurance products. A review of the data makes clear that the type of risk being insured is different from what is found in most traditional private insurance products because the services provided are potentially expended over a long period of time. Thus, the total financial exposure is strongly controlled by the *duration* of the need for services as well as the costs of specific service units. Insurance coverage for disability at younger ages has a significant duration component but differs in that disability at younger ages is a relatively rare event. In contrast, disability at advanced ages is a highly prevalent event and it is, at least currently, viewed as a natural consequence of a universal phenomenon: aging-related declines in functional status. The fact that the processes driving disability and the need for LTC services are viewed as "natural" (i.e., the risk associated with those processes is assumed to be universal) necessitates modification of actuarial concepts and measures in order to generalize the concept of risk from an event localized in time (such as an acute illness requiring hospitalization) to a process whose intensity varies over time as a consequence of natural processes. This suggests that not only must multiple data sets be examined, but also that the nature of actuarial analyses must be reconsidered and reformulated to deal with the complex and heterogeneous processes involved.

In order to address the analytic issues, age-associated changes in the linkage of morbidity, disability, and mortality must be examined and measures generalized to represent the effects of these age- and duration-weighted risks. The age-related linkage of these three types of health events defines the dynamic or process by which LTC service needs are generated (Manton and Soldo 1985); for example, certain types of chronic diseases (such as osteoporosis, arthritis, dementia) may actually generate chronic disability in elderly populations, whereas other, more rapidly lethal conditions (cancer, heart attack) are associated with shorter times between disease manifestation and death (see

Manton 1989). Conditions that follow a slower course, with slowly progressing disability, generate a larger need for LTC services over a longer period of time than more acutely lethal conditions. Future LTC needs thus will be sensitive to changes in the mix of chronic diseases prevalent in the elderly population—and to our ability to intervene in the natural history of those processes.

Changes in the age linkage of these health events can be expected naturally due to the different health experience of future elderly cohorts, which will cause differences in the future behavior of these processes for men and women, for blacks and whites, rich and poor, and urban and rural subpopulations. On this basis alone we can expect the actuarial structure of private LTC insurance to evolve over time. Furthermore, considerable interest is emerging in the biomedical research and public health communities in increasing "active life expectancy" by intervening in the age-related risks of chronic disease processes. If these efforts are successful, over the long run (e.g., 20 years) the question will emerge as to who should benefit from successful intervention in disability. That is, if because of both public and private investment in biomedical research, the future prevalence of disability is decreased, should those providing private insurance reap a financial windfall? Alternatively, it might be asked whether incentives for "healthy behavior" could be built into the premiums for LTC insurance to reduce the future risk of disability. A precedence for such incentives would be life-insurance products that offer nonsmokers beneficial rates.

It might also be asked whether the costs of LTC insurance can be altered by different benefit packages. Most LTC services today are viewed as involving personal assistance even though assistive devices and housing modifications provide LTC services to a larger proportion of the population (Manton and Suzman 1991). Except for the most severely disabled population, benefits might appropriately emphasize assistive devices. The dual options of designing both health promotion and specialized benefit packages into private LTC insurance to reduce per capita benefit costs have *not* been fully explored in past research. Our review of the national data does not directly consider these issues, although the information on the different disability and health factors is a useful starting point to consider alternative benefit packages and possible forms of health-intervention programs.

Thus, the thesis of this article is that the actuarial risk for private LTC insurance programs is more complex and involves more dimen-

sions (especially temporal) in their design than do standard health-insurance products. Knowing the functional status of a person at a point in time is not adequate to calculate or project the liability for LTC services of that person. One way to lower the risk to insurers (and, because of reduced contingency or loss requirements, premiums) is to reduce the uncertainty about the lifetime LTC service needs of a person by using more individual characteristics to produce better estimates of service needs. Thus, we consider several data sets to describe dimensions of an individual's LTC risks that, although not currently used in actuarial calculations, are relevant to the need for LTC services. Better analysis and more thorough use of the longitudinal aspects of data may significantly increase the proportion of the population with access to private insurance by lowering premiums. This highly desirable goal involves investing few new resources. Rather, premiums may be reduced by using existing data to enhance the capability of insurers to project *individual* service needs and to design the most efficient benefit packages, thereby reducing the provider's risks in two fundamental ways.

We examine three survey data sources because each has particular strengths in sample design and instrumentation in analyzing LTC needs (Manton and Suzman 1991): First is the 1984 Supplement on Aging (SOA) to the National Health Interview Survey, which covers the entire elderly population of the United States. This survey is useful to estimate the age-specific probability of functional disability among those who report specific medical conditions. The National Long Term Care Survey (NLTCS), in contrast, although covering the entire population of elderly Medicare beneficiaries, interviewed the chronically disabled elderly population in much greater depth. Thus, it provides a more detailed picture of the chronically impaired elderly noninstitutionalized population although it does not provide estimates of the *risk* of functional disability for elderly persons with a specific medical condition (because the denominator for the rate calculation must include all persons with the disorder whether disabled or not). By virtue of its longitudinal design and targeted sample, it provides the best estimates of age-related changes in functional status and the relation of those changes to mortality risks. In addition, it is linked to a lengthy time series of Medicare Part A and B expenditure files so that the relation of chronic health and functional status and informal care resources to Medicare service use can be determined on a nationally representative basis. The National Nursing Home Survey (NNHS) provides detailed

information on a large cross-sectional sample of nursing-home residents in 1985, thereby allowing detailed examination of persons in institutions. Using the three surveys in concert provides a fuller understanding of the age-related linkages of morbidity, disability, and mortality determining the incidence, duration, and mixture of LTC services use.

Data Concepts and Measures of Functioning and Morbidity

Long-term care is the extended health, social, and personal care services required by an individual to compensate for losses in independent functioning resulting from physical or cognitive impairments. LTC is provided in both institutions and the community (Doty, Liu, and Wiener 1985). Persons with LTC needs require assistance for extended periods of time with such self-maintenance activities as bathing, dressing, and mobility. LTC services are sometimes defined to include specific household tasks related to self-maintenance such as meal preparation, chore services, laundry, and other household activities. Because an important issue is the definition of the mix of services to be covered by LTC insurance, we will consider this additional set of activities that may determine whether a person can be maintained in the community. The elderly have the greatest need for LTC services because they are most likely to have chronic medical conditions producing functional disabilities.

Disabling physical and cognitive impairments are caused by a number of different types and combinations of diseases or events. There is generally not a one-to-one relationship between a chronic condition and an individual's functional disability because the level and type of functional disability often results from multiple (possibly interacting) diseases or conditions (Manton and Stallard 1991). Although complex, the interaction between specific chronic conditions and functional disability is important for accurate prediction of the LTC needs for individuals. Although different individuals may have the same level of functional disability at a point in time, the duration of the disability, and consequently the duration of LTC service requirements, may be quite different depending upon the nature of the initiating morbid events.

There are many measures of functional disability. Most widely employed are measures of limitations in performing Activities of Daily Living (ADL) (Katz et al. 1970). Measurement of ADL limitations involves determining restrictions in performing basic self-care functions (e.g., eating, toileting, bathing, dressing). Another dimension of disability is dependency in Instrumental Activities of Daily Living (IADL) (Lawton and Brody 1969), which generally reflects lower levels of impairment than dependency in ADL; that is, individuals dependent in ADL also often are dependent in IADL. An important exception would be any IADL that requires cognitive function, such as managing money, telephoning, or taking medication. Impairments of cognitive functions may represent more of a burden on informal caregivers than even severe physical impairment (Manton and Soldo 1991). A third, and direct, assessment would be degree of physical impairment (e.g., the ability to grasp objects or to climb stairs) as a more fundamental determinant of the capacity for self-maintenance (World Health Organization 1980). We included all three types of disability measures, and their relationships, in two multivariate analyses of the National Long Term Care Survey.

In addition to functional measures, self or proxy reports of prevalent medical conditions are recorded in the surveys. The medical conditions recorded are those most prevalent at later ages and are recorded at a general level so that reasonably reliable reports from persons (or proxies) can be expected. The conditions recorded include both early (e.g., diabetes and hypertension) and late (e.g., chronic heart disease and stroke) stages of disease processes. Neurological conditions such as stroke, Parkinson's disease, and Alzheimer's disease form an important class of diseases or impairments generating either ADL or IADL limitations. Many persons with Alzheimer's disease require formal LTC services. In many cases, severe cognitive impairment is manifest without a corresponding severe physical deficit (e.g., early Alzheimer's disease). Thus, survey measures assessing cognitive status are important in assessing the total need for LTC services. Survey measurement of cognitive impairment is based most often on a limited number of questions designed to evaluate disorientation and memory loss. Among the more widely used instruments are the Short Portable Mental Status Questionnaire (Pfeiffer 1975) and the Mini-Mental Status Exam (Folstein, Anthony, and Parhad 1985).

Surveys

The three surveys were designed using prevailing consensus about measurement of functional disability in population surveys.

1984 Supplement on Aging (SOA)

The Supplement on Aging of the 1984 National Health Interview Survey (NHIS), sponsored by the National Center for Health Statistics (NCHS), provides extensive information on the health characteristics of the elderly population and their formal and informal service use. The 1984 SOA included persons aged 55 years and older in the NHIS household sample. Of 16,148 persons sampled, 4,651 were 55 to 64, 7,093 were 65 to 74, 3,578 were 75 to 84, and 826 were 85+ (NCHS, Fitti, and Kovar 1987, 5). Ninety-three percent of those surveyed were self-respondents (there was a 7 percent proxy response for persons 55 and above). The SOA questionnaire elicited information on ability to perform physical activities, vision and hearing impairments, ADL and IADL limitations, and the presence of selected conditions, including Alzheimer's disease. In addition, information was elicited on sources of support in the community, characteristics of housing, and occupational and retirement history. Finally, an extensive mental health section included questions about the individual's perception of his or her own health, a depression scale, inquiries about the treatment of mental problems, the use of prescription medicines for depression, and an experimental set of items to measure memory loss. The 1984 sample has been reinterviewed in 1986 and 1988. A reinterview is planned for 1990. The surveys are being linked to the Medicare service use records for persons who signed releases and to the National Death Index (NCHS, Fitti, and Kovar 1987).

1982–84 National Long Term Care Survey (NLTCS)

The 1982 National Long Term Care Survey, conducted by the Census Bureau for the Department of Health and Human Services, was targeted to the disabled elderly. The 1982 sample was drawn from Health Care Financing Administration lists of all elderly Medicare-eligible per-

sons. For the 35,018 persons selected who were in range for the survey, a two-stage interviewing procedure was used. First, all persons were screened (80 percent by telephone and 20 percent by personal visits) to determine if they had *chronic* functional disability, defined as having one of nine ADL or seven IADL impairments that had lasted (or was expected to last) at least 90 days. In the screening procedure, 6,393 persons were eligible for a household interview, 1,992 persons were in institutions, and 26,633 were determined in the interview *not* to be chronically disabled. Of the 6,393 persons, 6,088 (95.2 percent) were eventually interviewed; 23 percent of the interviews were conducted solely with a proxy. The proxy rate is higher than in the SOA because of the selection in the NLTCS screening survey for chronic functional disability and the restriction of the sample to persons above age 65. Because the functional and vital status of all 35,018 persons was determined on the screen in 1982, the functional status transitions of all Medicare-eligible persons who survived (whether in the community or in institutions) could be identified in 1984.

In 1984, all persons who had been disabled or institutionalized in 1982 and who survived were automatically eligible for a detailed interview. This allowed all persons whose disability decreased over the two-year interval to be assessed in detail. In addition, 45.4 percent of the 26,633 persons determined not to be chronically functionally impaired in 1982 (12,100 persons) were rescreened in 1984. To have a fully representative cross-sectional sample of all Medicare-eligible elderly persons in 1984, an auxiliary sample of 5,000 persons who passed aged 65 between 1982 and 1984 was also screened. Thus, the 1984 NLTCS provided full coverage of the Medicare-eligible elderly population (as in 1982) and representative coverage of changes in functional status for all persons 65 and over in 1982 who survived to 1984.

In the household interview (which was identical in 1982 and 1984), information was gathered about the presence of 17 medical conditions and the occurrence during the previous 12 months of 12 specific medical events (such as heart attack, stroke, or broken hip). Included in this list was "dementia," determined from proxy respondents (about 10 percent prevalence in the disabled sample in each year). Questions were asked about each function in the ADL scale: eating, transferring, walking, dressing, bathing, and toileting. Respondents who denied receiving *either* personal help *or* help from specialized equipment for any of the functions were questioned further concerning whether someone

"stood by" to render assistance. Questions were included on the ability to perform IADLs such as shopping or taking medicine. Individuals reporting problems with ADLs or IADLs were asked how long ill health or age had prevented them from engaging in those activities and the condition(s) (up to four) causing the problem. Questions on the degree of impairment of specific physical functions were also asked. In 1984 the functional status of persons in institutions was assessed as well as institutional use between survey dates. A survey of the next-of-kin of persons who died between 1982 and 1984 was conducted.

All persons in the 1982 and 1984 NLTCS samples were linked to Medicare Part A and B service use records. Thus, the chronic health and functioning characteristics of persons with different levels of economic and informal care resources can be linked to temporal changes in their use of acute (i.e., hospital and physician) and postacute (i.e., skilled nursing facility [SNF] and home health) Medicare-reimbursed care. The survey thereby provides a comprehensive assessment of the characteristics of community-resident elderly persons who are most likely to utilize public or private LTC insurance.

1985 National Nursing Home Survey (NNHS)

NCHS periodically conducts nationally representative surveys of residents of nursing homes. The most recent NNHS (1985) included 5,238 current and 6,014 discharged residents.

In the current resident survey, information was gathered from most knowledgeable persons about the patient's residence immediately before entering the facility. For those discharged from a short-term, general hospital, the Diagnosis Related Group category and primary diagnosis during the hospital stay were recorded. The respondent was also asked about other conditions that developed during the resident's hospital stay, diagnostic or surgical procedures performed, and the number of nights spent at the hospital. The same type of information was obtained for any hospital stay occurring while the sample person was a resident in the nursing home. Dates of admission and discharge for each hospital stay were recorded.

In addition, the resident's primary and secondary diagnoses were recorded both for the time of admission to the nursing home and at the time of the survey. There were also questions about ten emo-

tional/mental conditions. ADL questions were included, and the expert respondent (usually an employee of the facility) was asked if the sample person was permitted to leave the facility grounds. Six forms of disruptive behavior were identified and the respondent was asked whether the current resident exhibited any of those behaviors.

In the discharge sample, extensive information on the length and number of nursing home stays was gathered.

Comparability of Survey Estimates

These three surveys can be used jointly to improve estimates of the costs of private LTC insurance. The SOA/LSOA, because it covers the entire elderly population, can be used to determine the risk of a medical condition and, given the presence of a specific medical condition, the risk of having serious disability. The 1982 and 1984 NLTCS has greater statistical power for examining the type and duration of chronic disability in elderly persons and the levels of both LTC (formal and informal) and acute health services used. Thus, the NLTCS can help assess the costs of LTC services for individuals and possible alternative benefit packages to meet the needs of persons with specific problems. The NNHS focuses on the service use of the institutional population.

In order to use the three surveys in coordinated analyses of LTC use, it is necessary to adjust for sample and instrument design differences. One issue is how comparable are measurements of functional disability in different surveys. A recent study evaluated estimates of the size of the community and institutionalized elderly disabled populations produced from the different surveys using a common set of items (Wiener and Hanley 1989). The distribution of disability in institutions estimated in the 1984 NLTCS and the 1985 NNHS is remarkably consistent (Manton and Suzman 1991). This distribution was also validated in data from the 1987 National Medical Expenditures Survey (NMES) (Wiener and Hanley 1989).

There was greater variability between surveys in estimates of the level of disability in the community population. Part of that variation appeared due to the use of different items to define disability: for example, whether persons experience any difficulty performing self-care functions; whether mechanical assistance is required; whether personal assistance is required; how much personal assistance is required. Such differences reflect measurement of different aspects of a very complex

phenomenon. This variation does not necessarily reflect a lack of reliability in the measurement of disability; it may represent substantive differences in the phenomenon, with its various aspects represented according to which instrument is used.

An assessment of the distribution of functional disability on the ADL items showed that the estimates of the 1982 and 1984 NLTCS and the 1987 NMES were in close agreement, with differences in prevalence being within the statistical precision of the estimates (Wiener and Hanley 1989). Thus, chronic functional disability can be "reliably" assessed in household interviews. In addition to "reliability" (i.e., that the same measures could be applied in independent samples and population estimates replicated) it is important to assess the predictive validity of such measures. According to Manton, Woodbury, and Stallard (1991), multivariate indices created from these measures strongly predicted mortality, morbidity, and Medicare Part A and B service use. Thus, disability as measured by these items is strongly predictive of events (e.g., death, medical expenditures) that are viewed as "hard" actuarial outcomes. For estimates of both the distribution of functional disability in the community and changes in disability over time, we rely on the NLTCS, which provides statistically the most precise estimates of the functionally disabled elderly, community-resident populations.

Disability and Morbidity

Population estimates of ADL dependency are important for estimating the *size* of potential beneficiary populations for private LTC insurance. Associations of morbidity with disability are important in defining eligibility and defining cost-effective sets of benefits because the relationship between underlying morbidity and the probability of mortality and/or poor rehabilitation is an important determinant of both the expected duration of LTC and the type and intensity of services required (e.g., community based or nursing home; assistive equipment versus personal assistance for community residents). For example, the patient with Parkinson's disease and the stroke victim may be similarly disabled at a point in time; however, whereas the former characteristically requires a prolonged period of nursing-home care, some stroke patients are rehabilitated in the community in a short period of time. This rela-

tionship is important in evaluating treatment and review plans for individuals receiving LTC services. Moreover, technological breakthroughs in the diagnosis and treatment of particular conditions (e.g., incontinence, Alzheimer's disease) could have a profound effect, not only on individuals, but also on the total size of the future LTC population (Manton and Stallard 1991) and thus, potentially, on the premiums of private LTC insurance.

Research on the prevalence of chronic diseases, and on conditions causing disabilities, has been conducted for many epidemiological and health-service purposes (Verbrugge 1984; Manton 1988, 1989). This information is important if private insurers employ medical screens for applicants to minimize "adverse selection" of enrollees. Thus the presence of medical conditions, or functional disability, could limit the access of individuals (by increasing premiums) to private LTC insurance.

To see how the presence of medical conditions affects the estimated size of the private market, we examined the prevalence of several chronic conditions reported in the 1984 SOA. Table 1 presents the percent of the population that experienced various levels of functional disability associated with five chronic conditions: heart disease, stroke, arthritis/rheumatism, diabetes, and cancer. These conditions were selected because they are frequently used in medical screens for private health insurance. Questions on the SOA about the presence of a condition used different reference periods for different conditions (e.g., lifetime, last year). These are noted in table 1 for each condition. Table 1 also disaggregates the population reporting a specific condition by ADL impairment level. A total prevalence rate for persons with a condition is derived by summing over ADL levels.

Of the five conditions, the most prevalent was arthritis/rheumatism. Thirty percent of males 55 to 64 years of age experienced this condition in the previous 12 months. Fifty percent of females in all age groups had problems with arthritis and rheumatism. Heart disease, the next most prevalent condition, was reported by about 15 percent for both sexes.

Many persons with these conditions were also functionally disabled, either as a result of the condition or for other reasons. The presence of severe disability (three or more ADLs) increased with age from 1 percent to 4.5 percent for males who had ever had heart disease. Because arthritis/rheumatism often results in serious disability, a high prevalence of these conditions will produce a high prevalence of disabilities.

TABLE 1
Percent of Population with ADL Difficulty by Specific Chronic Condition: Weighted 1984 SOA[a]
(population in thousands)

		Ever had heart disease			Ever had stroke			Arthritis/rheumatism in last 12 months			Diabetes in last 12 months			Ever had cancer		
Age	Population	No ADL	ADL = <3	ADL = 3+	No ADL	ADL = <3	ADL = 3+	No ADL	ADL = <3	ADL = 3+	No ADL	ADL = <3	ADL = 3+	No ADL	ADL = <3	ADL = 3+
Males																
55–64	10,284	10.2	3.8	1.0	1.0	1.0	0.7	24.1	6.1	1.9	5.3	1.7	0.4	4.1	1.4	0.2
65–74	7,075	13.2	5.6	1.3	2.9	2.2	1.3	30.9	10.0	2.3	6.8	2.9	0.8	8.4	2.1	0.5
75–84	2,128	11.5	6.7	2.2	2.9	4.0	2.0	24.8	14.1	3.7	5.3	3.2	1.5	9.9	4.2	0.7
85+	585	5.9	6.2	4.5	2.8	2.7	2.3	13.3	16.7	8.6	2.7	1.7	1.6	4.6	6.5	3.3
Females																
55–64	11,768	5.3	3.7	0.9	0.8	0.9	0.3	31.3	31.3	2.3	4.4	2.8	0.7	5.7	1.7	0.4
65–74	9,213	6.6	6.6	1.4	1.2	1.9	1.0	33.5	18.2	3.0	5.0	4.2	1.0	6.7	3.4	0.7
75–84	5,121	5.3	8.9	3.1	1.3	3.5	3.1	26.8	26.2	7.8	3.9	4.2	1.9	6.0	4.5	1.4
85+	1,312	3.8	9.7	5.7	1.4	5.9	4.8	13.0	27.0	17.5	0.9	2.8	3.0	2.5	6.1	3.8

Source: 1984 Supplement on Aging.
[a] Difficulty with ADL, as opposed to received personal assistance.

More than 33.6 percent of females 55 to 64 years of age who had arthritis/rheumatism had an ADL impairment, compared with 44.5 percent of the females aged 85 years and over.

The rates in table 1 represent both the risk of a chronic condition *and* the risk of disability for a person with a chronic condition. Changes in either set of risks could have important effects on the cost structure of private LTC insurance. If a disease can be prevented the disability associated with that disease is prevented. For example, heart disease and stroke mortality have declined in recent years—apparently in large part due to efforts at prevention (Blackburn 1989). Further reductions in heart disease and stroke could reduce the risk of LTC services for future elderly populations. This has been already partly reflected in the reduction of stroke prevalence in institutional populations. Rheumatism and arthritis are conditions that produce chronic disability in elderly community residents (in contrast to Alzheimer's disease, for example, which has more effect on the institutionalized population). These conditions are currently not preventable, although medical treatments to reduce the level of disability from those conditions have undergone rapid improvement. If there are further medical improvements reducing the risk of disability, then the prevalence of disability in these groups will decline. Thus, the costs of LTC benefits to a private insurance program depends both on how the risks of specific diseases, and the risk of disability for specific diseases, change. In these changes, age is an important factor because, at advanced ages, disease and some degree of disability become manifest in most persons.

Table 2 presents estimates from the 1984 SOA of the proportion of older persons who had any one of the five medical conditions, stratified by total family income and level of disability. In the table, disability level (three or greater or less than three ADLs) required that any of six ADLs (bathing, dressing, toileting, transferring in/out of bed or chair, eating, walking; the seventh getting around outside, was not used) be reported as impaired.

Table 2 shows a large proportion of the population had one or more of the conditions. Among age and income subgroups, 50 to 70 percent had one of the five conditions, with higher proportions in older and less affluent subgroups. The proportion of persons under 75 years of age who had one of the conditions declined with income—consistent with good health status being positively related to economic status.

Although most persons under 75 years of age did not have ADL im-

TABLE 2
Population (in thousands) and Percent of Population with Any One or More of Five Chronic Conditions by Income and Level of Disability: Weighted 1984 SOA

Income and age[a]	Community Population	Presence of condition: With no ADL	With <3 ADL	With 3+ ADL	Total
Less than $7,000					
55–64	2,352	42.27[a]	16.58[a]	9.88[a]	68.73[a]
65–74	2,961	52.18	17.60	5.83	75.61
75–84	2,414	43.43	22.22	7.99	73.64
85+	725	24.38	28.39	15.85	68.63
$7,000–$14,999					
55–64	4,602	44.26	11.63	3.83	59.72
65–74	5,960	51.44	11.56	4.70	67.70
75–84	3,076	45.15	16.29	7.25	68.69
85+	587	34.32	21.33	16.68	72.32
$15,000–$25,000					
55–64	5,612	44.25	6.61	2.19	53.05
65–74	4,171	50.64	8.70	2.87	62.21
75–84	1,537	49.12	13.28	7.27	69.66
85+	333	23.11	25.46	19.99	68.57
Greater than $25,000					
55–64	9,576	42.96	3.35	0.82	47.14
65–74	3,344	51.24	7.66	2.88	61.79
75–84	987	52.06	10.82	9.61	72.50
85+	354	30.55	15.49	30.39	76.44

Source: 1984 Supplement on Aging.
[a] SOA cases with missing income information were proportionally allocated to income categories in the table.

pairments at the time of the survey, the presence of both medical conditions and functional disabilities ranged from 10 to 15 percent, except for the lowest income groups. Relatively high proportions of persons with incomes less than $7,000 had functional disabilities. Among persons aged 85 years and over, the proportion with both a medical condition and severe disability (three or more ADLs impaired) increased with income. This may be because very old, disabled people with higher income are able to remain in the community by purchasing LTC services.

Their less affluent counterparts may have entered nursing homes at younger ages.

Tables 1 and 2 indicate that a high proportion of the total elderly population of the United States (even those 55 to 64 years of age) have a chronic disease. Although most of those persons are not severely functionally disabled by the conditions (or other medical problems), their risks of a recurrence of the same or other medical conditions are higher than persons with no prior history (see, for example, Tolley and Manton 1984).

By stratifying the functionally disabled, elderly community-resident population on family income, we note that both the distribution of disability and the ability to purchase private insurance varies with income. Income is only one measure of financial resources. Assets such as housing or investments are also important for a person's ability to purchase private insurance. Indeed, asset conversion, with increasing age, grows more important as a source of payment for private LTC insurance. Thus, examining income alone is an inadequate basis for determining the capacity of the elderly to purchase private LTC insurance. Wiener et al. (1991) suggest that, even accounting for both income and assets, a significant proportion of the elderly will not be financially able to purchase private LTC insurance.

Our purpose in presenting the income data, however, is not to replicate the ability-to-pay analyses, but to examine income as an independent predictor of health outcome. Even for persons with the same set of medical conditions, there is a differential in the health status of high- and low-income persons. Thus, the data suggest that persons with higher income levels may have lower lifetime LTC service needs. In this regard, it is important to note that future cohorts of elderly persons are likely to have higher lifetime earnings, assets, and education (Myers, Manton, and Bacellar 1986). Thus, the effect of higher income on the health of the elderly population as new cohorts pass age 65, and old cohorts gradually die out, could be a significant factor in the long-term design of private insurance. The lower LTC service risk of higher-income persons is enhanced by the greater life expectancy (i.e., period of premium payment) of higher income groups.

Thus, if premiums are to reflect accurately the liability for LTC services, they should take into account the interaction of income (as a predictor of future health and functional status) and current functional status. One might ask if the relation of income and health status is

causal. It appears, at least in part, to be so both because of the better early access to acute health care of higher socioeconomic status persons, and because of their generally lower lifestyle risk factor exposures (e.g., less smoking, more exercise). A potential reduction in premiums for persons with higher incomes due to their lower health risks (and greater life expectancy) may lower the overall financial threshold at which it is feasible to purchase private LTC insurance. The ultimate proportion of the population with economic access to private insurance depends on how medical conditions and disability are used to define premium levels for private insurance. Differentials in income appear, however, to be stronger at younger ages (e.g., 55 to 64). At later ages the age-increasing risk of functional disability decreases the health differential over income levels. It is fair, however, to ask again whether this is, in part, a cohort effect.

Dynamics of Disability

The presence and level of functional disability are strong predictors of both LTC utilization and mortality and provide a basis for estimating the duration of LTC needs. In this section, we present data from the 1982–1984 NLTCS to show changes in functional status and the use of LTC. Table 3 shows changes in the functional and institutional status of the elderly population between 1982 and 1984. Significant change occurred over the two-year period. Although over 80 percent of the 1982 nondisabled community-resident elderly remained nondisabled after two years, less than 40 percent of chronically disabled persons in 1982 had the same disability level and residential status in 1984. Although many persons developed higher levels of disability, large numbers of people had *lower* levels of disability after two years. We found significant improvement in disability even for the most severely disabled; almost 24 percent of persons with three or more ADL functional impairments in 1982 had lower levels of impairment in 1984. This long-term improvement in functional status has been verified in other studies such as the Supplement on Aging/Longitudinal Study on Aging (Harris et al. 1989).

Table 3 shows that the risk of dying within the two-year period is strongly related to disability level in 1982. Fifteen percent of the persons with only IADL impairments died, compared with 37 percent who

TABLE 3
Percent Distributions of Weighted Population in Disability Groups in 1984 by Disability Level in 1982 among Persons Aged 65+: 1982 and 1984 National Long Term Care Survey Samples

	1984 Status				
1982 Status	Lower disability level	Same disability level	Higher disability level	Institutionalized	Died
Nondisabled		81.6	8.8	1.5	8.1
		(9,880)	(1,196)	(190)	(1,020)
IADL only	9.3	40.8	29.0	5.7	15.2
	(183)[a]	(682)	(494)	(100)	(258)
ADL 1–2	18.2	34.4	19.1	7.7	20.7
	(343)	(663)	(368)	(151)	(398)
ADL 3–4	23.6	22.8	19.7	10.0	24.0
	(194)	(190)	(165)	(85)	(202)
ADL 5–6	22.2	30.9	—	9.7	37.2
	(206)	(291)		(93)	(352)
Institutionalized	6.2[b]			54.2	40.6
	(100)			(1,071)	(810)

Sources: 1982 and 1984 National Long Term Care Surveys.
[a] Numbers in parentheses are unweighted counts. These sum to 95.8 percent (the response rate) of the 20,451 persons in the longitudinal sample.
[b] Returned to community distributed approximately uniformly across ADL/IADL range.

had five to six ADL impairments. Rates of institutionalization also increased with the level of disability up to three to four ADL impairments. Above that level, institutionalization risks compete strongly with the risk of death (Manton 1988). Thus, to some degree, the liability of an LTC insurance program is self-limiting. That is, for persons with very high levels of disability, mortality rates are much higher, thus limiting the duration of their benefits (Manton, Woodbury, and Stallard 1991).

To show how transitions in disability status are related to morbidity, table 4 presents information for the disabled elderly population who have three medical conditions: heart disease, stroke, and cancer. Three transitions are presented: (1) to a higher disability level, (2) to institu-

TABLE 4
Transitions (in percent) between 1982 and 1984 for Persons with Heart Disease, Stroke, or Cancer in 1982: Weighted 1982–1984 National Long Term Care Survey[a]

	1984 Status								
	Higher disability			Died			Institutionalized		
1982 Status	Heart	Stroke	Cancer	Heart	Stroke	Cancer	Heart	Stroke	Cancer
Nondisabled	51.2	59.2	44.7	9.2	—	22.2	0.7	9.5	—
IADL Only	30.6	28.1	19.9	14.5	22.2	37.5	5.6	5.0	4.9
ADL 1–2	19.3	21.8	19.8	21.8	35.7	41.3	7.3	10.5	3.5
ADL 3–4	21.4	28.8	21.4	24.3	28.0	36.9	10.3	20.8	15.4
ADL 5–6	—	—	—	38.7	47.5	75.9	8.6	9.1	7.5

Source: 1982 and 1984 National Long Term Care Survey.
[a] Unweighted number of cases of heart disease (4,081), stroke (420), and cancer (361).

tions, and (3) to death. Because persons with stable or improved disability levels are excluded, the proportions do not add to 100 percent.

Table 4 shows that a large population of persons with heart disease and stroke moved to higher levels of disability in two years. The high risk of dying from cancer is seen in the second panel of the table, which shows that 20 to 40 percent of cancer patients with three to four ADL impairments died between 1982 and 1984. Cancer patients with five to six ADLs impaired in 1982 had a 75 percent chance of dying over two years. Stroke patients had a slightly higher risk of dying than heart-disease patients; their risk of death increased with the number of ADLs impaired. For heart-disease patients, disability was a good predictor of the two-year risk of death, with a fourfold increase for persons with five to six ADLs impaired in 1982.

The third panel of table 4 shows that large proportions of persons who experienced a stroke by 1982 entered nursing homes by 1984. Heart-disease and cancer patients had lower rates of institutionalization—although for different reasons. Surviving stroke patients required more institutional care than surviving heart patients because of the cognitive and neurobiological deficits associated with stroke. On the other hand, successfully treated cancer patients often have their disease re-

solved with little residual disability. For cancer patients who die, the rapidity of death limits the overall duration-weighted need for LTC services.

Tables 3 and 4 illustrate the differences in two-year outcomes for persons with different medical conditions at different ADL levels at the beginning of the interval. This information can be used to estimate the amounts of LTC services required by different subpopulations. For example, mortality in some medically defined groups (e.g., cancer patients) limits the total amount of LTC services required. Institutionalization rates determine the proportions of persons incurring nursing-home costs. Thus, persons with certain diseases may experience reduced long-term disability.

The transition analysis in tables 3 and 4 is limited by the difficulty of (a) determining the exact date of onset of chronic conditions and disability; (b) evaluating the level of disability in oldest-old persons with multiple medical conditions and heterogeneity of the disease groups; and (c) describing the different intensities of impairment for individual ADL functions. Documentation of the natural course of disabling chronic conditions is important for private insurance programs because it improves the precision of estimates of the need for LTC services for persons with pre-existing conditions and for estimating the duration of service use. Persons at high risk of dying in two years (e.g., those with high initial ADL dependency or diagnosis of cancer) require resources for short periods, whereas persons with more moderate long-term disabilities (e.g., arthritis and rheumatism) may require extended home-health and nursing-home care, although at a lower intensity. Thus, specific medical conditions imply different trajectories of LTC service use over time. Treating persons requiring LTC services as permanently disabled with long-term-survival prospects leads to an overestimation of benefits (and hence premiums).

Community LTC and Nursing-home Use by Disabled Elderly Persons

Research has demonstrated a direct relationship between functional disability and LTC use. Community-based LTC has been found in numerous studies to be related to the level of functional disability (Doty 1986; Kemper et al. 1988) with most care provided by informal care-

givers rather than formal sources (Stone, Cafferata, and Sangl 1987; Paringer 1983). One study estimated that 80 percent of disabled elderly persons receive only informal care (Liu, Manton, and Liu 1985), but that the level of disability is related to the likelihood that disabled older persons will use formal community-based care. As shown in tables 3 and 4, disability is a strong predictor of nursing-home admission (e.g., see Branch and Jette 1982; Cohen, Tell, and Wallack 1986; Coughlin, McBride, and Liu 1990).

The relationship between functional disability and requirements for specific types of LTC over time is, however, more complex than can be represented by a simple count of ADL impairments—particularly when mediated through the health and socioeconomic characteristics of disabled persons. For example, substitution may occur between formal and informal community-based care depending upon availability of informal care networks and the financial resources available to the disabled person. Thus, economic resources *and* the availability of informal caregivers may delay or preclude the need to enter nursing homes for persons with high levels of ADL impairment. Most important, the presence of functional disability is *not* simply an all-or-none situation. That is, a person is characterized by a level or degree of functional disability—an intensity that may vary over several dimensions or types of functional disability. The importance of intensity of impairment is evident in the wide range of estimates of the size of the impaired elderly population produced from different surveys using discrete impairment thresholds to define the population. Likewise, the intensity and duration of LTC services required by a person is a function of the nature and intensity of functional disability. Thus, we need procedures to generate a set of duration-weighted actuarial indicators of risk (or risk scores) that describes the individual's intensity of impairment on multiple dimensions of functioning. These risk indices can then be related to the intensity and mix of health services required.

To characterize complex functional status and health-service relationships using multivariate discrete-response data, we used a statistical methodology called the Grade of Membership (GoM) analysis (Woodbury and Manton 1982; Manton and Stallard 1991). This methodology identifies both functional impairment profiles describing the disabled population on their health and functional characteristics *and* the degree to which each individual is characterized by each of those profiles. The association of these measures to the individuals' use of LTC in the com-

munity, and their subsequent nursing-home and mortality experience, can be assessed in a statistically independent analysis to determine the predictive validity of the multivariate measures.

A set of 56 functional and medical condition measures reported on the 1982 and 1984 NLTCS surveys for all persons qualifying for a detailed interview in both years was selected for analysis (Manton and Liu 1990). In addition to the data used to construct the disability and health measures, individuals were linked to information on all skilled nursing facilities, home health, and hospital episodes identified on the Medicare Part A records for 12 months after the survey date. The linkage to the acute-service-use data is useful for several purposes. One is that it can be used to assess the predictive validity of the types. Second, if LTC benefits are extended over a period of time, and there are high acute-care expenses, then the coordination of payments for acute and LTC benefits becomes an important issue. For example, if a certain group of disabled elderly persons currently receives LTC from informal caregivers, their medical experience will be manifest as acute-care costs. If in the future the availability of informal care declines and such persons require formal LTC services, then those acute-care medical expenses will be linked to the LTC services.

The 56 measures included 29 medical conditions, 9 ADL measures, 10 IADL measures, and 8 measures of physical functioning. By representing the interaction of functional status and medical conditions, the profiles identified may be more predictive of the duration of LTC needs (as suggested by the earlier tabular analyses). By jointly analyzing medical conditions and functional status measures, the profiles defined by the procedure represent the interaction of medical conditions and impairments. By jointly analyzing 1982 and 1984 respondents, the profiles defined by the procedure will be identical for the two years. With identically defined multivariate profiles of functioning, the study of variation in service use between the two years (i.e., in the duration and frequency of all service episodes in the service-use window) can be disentangled from changes in the distribution of functional status.

What the GoM procedure does quantitatively (using Maximum Likelihood estimation procedures that adjust for the statistical weight of each case) is to select a small number of dimensions that best explains interactions of the 56 measures. These dimensions summarize the 56 measures in a way similar to factor analysis (i.e., by identifying both a small set of latent dimensions that explain the variation of the observed

variables and scores representing individual variation on those dimensions) except that the GoM procedure is explicitly designed to deal with discrete variables. In dealing with multiple discrete-response variables, the profiles of impairment (or types) extracted must explain more than the second-order moments of the data; that is, the procedure represents more than the two-way interactions to which discrete-variable factor analysis is often restricted (e.g., Christofferson 1975; Everitt 1984).

The GoM procedure has specific features that make it especially useful for actuarial and policy analyses. One is that, in addition to identifying the relation of the observed variables to the latent profiles (the coefficients in table 5), scores are calculated on each profile for each person that combine the profiles to reproduce each individual's reported functional impairments and medical conditions. That is, each person's experience is related to each one of the impairment profiles by a score that sums to 1.0 across all profiles for a person. This property of the way the scores are estimated also means that the frequency of each attribute in the population is *exactly* reproduced by the model. These properties of the individual scores make them useful as summary measures, which can be used to predict the risk of the need for certain services (i.e, as a multivariate extension of "risk scoring" or risk classification procedures; Cummins et al. 1983). This procedure has been used to examine prospective reimbursement systems for Medicare home-health services (Manton and Hausner 1987), the maintenance of nursing-home quality of care (Manton, Vertrees, and Woodbury 1990), and the cost effectiveness of such LTC programs as the "2176" demonstration projects (Vertrees, Manton, and Adler 1989).

The statistical decision rule on how many profiles or dimensions to extract depends upon the a priori specified purpose of the analysis. If the purpose of the analysis is to explain all non-random variation on the 56 measures, then one estimates models increasing the number of profiles until the χ^2 value (based on the likelihood ratio) associated with the Kth and $K + 1$st profile is no longer significant. On this basis we would decide to select six dimensions. An alternate statistical decision rule is to select the number of types necessary to predict the variation of an external set of measures.

For the first analyses presented in tables 5 and 6, we used the second decision procedure and independently generated health and functional profiles (step 1) to predict Medicare Part A (hospital, SNF, and home health) service-use patterns for 1982 and 1984 (step 2). Thus, we in-

TABLE 5
Fifty-six Health and Functional Variables Measured in the 1982 and 1984 National Long Term Care Survey Used to Define the Four Health and Functioning Types

Variables	Frequency	Type			
		1	2	3	4
Eating	7.3	0.0	0.0	0.0	37.6
Get in/out bed	30.5	0.0	21.1	0.0	100.0
Get about inside	44.3	0.0	73.5	0.0	100.0
Dressing	23.8	0.0	0.0	0.0	100.0
Bathing	48.4	0.0	60.1	34.5	100.0
Using toilet	25.3	0.0	0.0	0.0	100.0
Bedfast	1.1	0.0	0.0	0.0	4.8
No inside activity	1.9	0.0	0.0	0.0	8.4
Wheelchairfast	4.4	0.0	0.0	0.0	20.5
Heavy work	79.1	17.7	100.0	100.0	100.0
Light work	28.8	0.0	0.0	0.0	100.0
Laundry	51.1	0.0	65.1	47.8	100.0
Cooking	38.0	0.0	0.0	0.0	100.0
Grocery shopping	67.2	0.0	100.0	100.0	100.0
Get about outside	67.0	0.0	100.0	100.0	100.0
Traveling	65.6	0.0	100.0	100.0	100.0
Managing money	32.3	0.0	24.2	0.0	100.0
Taking medicine	28.4	0.0	0.0	0.0	100.0
Telephoning	18.4	0.0	0.0	0.0	88.8
Climbing 1 flight stairs					
No problem	13.8	45.7	0.0	0.0	0.0
Some	26.0	54.4	39.4	0.0	0.0
Very	34.0	0.0	43.8	82.8	3.0
Cannot	26.2	0.0	16.8	17.2	97.0
Bend for socks					
No problem	38.6	90.1	55.3	0.0	0.0
Some	27.7	9.9	41.9	50.0	0.0
Very	20.1	0.0	2.7	50.0	25.7
Cannot	13.7	0.0	0.0	0.0	74.3
Hold 10-pound package					
No problem	22.8	74.0	0.0	0.0	0.0
Some	16.1	26.0	29.9	6.7	0.0
Very	16.8	0.0	28.8	44.8	0.0
Cannot	44.3	0.0	41.3	48.5	100.0
Reach over head					
No problem	50.7	100.0	91.6	0.0	0.0
Some	22.7	0.0	8.4	55.0	24.6
Very	15.6	0.0	0.0	33.9	32.2
Cannot	11.0	0.0	0.0	11.1	43.2

TABLE 5
Continued

Combing hair					
No problem	66.4	100.0	100.0	0.0	0.0
Some	17.8	0.0	0.0	79.6	23.6
Very	8.8	0.0	0.0	20.5	32.2
Cannot	7.0	0.0	0.0	0.0	44.2
Washing hair					
No problem	48.0	100.0	86.6	0.0	0.0
Some	15.2	0.0	13.4	58.6	0.0
Very	10.5	0.0	0.0	41.4	6.0
Cannot	26.3	0.0	0.0	0.0	94.0
Grasp small objects					
No problem	62.4	100.0	100.0	0.0	27.6
Some	21.4	0.0	0.0	72.8	22.9
Very	11.5	0.0	0.0	27.2	26.3
Cannot	4.6	0.0	0.0	0.0	23.2
See well enough to read newspaper	71.5	93.3	4.3	73.2	40.8
Rheumatism arthritis	73.7	60.2	62.1	100.0	69.5
Paralysis	9.7	0.0	0.0	2.7	39.6
Permanent stiffness	25.2	8.0	2.9	64.9	32.6
Multiple sclerosis	0.9	0.3	0.3	0.0	3.2
Cerebral palsy	0.4	0.0	0.0	0.4	1.4
Epilepsy	1.0	0.4	0.0	0.8	3.0
Parkinson's disease	3.4	1.6	0.0	1.5	11.1
Glaucoma	8.8	5.2	11.4	5.9	13.0
Diabetes	19.5	9.3	8.0	41.5	23.9
Cancer	6.8	6.0	2.6	10.6	9.0
Constipation	34.6	15.0	0.0	84.7	49.2
Insomnia	42.3	22.9	0.0	100.0	41.2
Headache	19.0	0.0	0.0	75.0	15.7
Obesity	22.0	22.4	6.8	57.5	5.4
Arteriosclerosis	33.5	14.2	0.0	75.9	54.4
Mental retardation	1.7	0.0	0.0	0.0	7.5
Senile dementia	9.5	0.0	0.0	0.0	43.0
Heart attack	8.3	0.0	0.0	31.7	6.2
Other heart problem	33.7	13.1	0.0	100.0	31.3
Hypertension	46.3	35.0	21.3	100.0	36.8
Stroke	8.6	1.6	0.0	8.3	27.6
Circulation trouble	54.9	26.7	8.7	100.0	76.0
Pneumonia	7.0	0.0	0.0	24.1	7.2
Bronchitis	14.1	3.0	0.0	53.3	7.5
Influenza	16.8	10.8	0.0	50.6	12.2
Emphysema	11.5	6.0	0.0	32.9	10.8
Asthma	8.2	2.2	0.0	31.3	4.0
Broken hip	2.4	0.0	6.4	0.0	3.0
Other fractures	5.7	2.6	6.6	6.9	7.5

Source: 1982 and 1984 National Long Term Care Survey.

creased the number of types generated in step 1 until the variation that could be explained on the service-use measures (step 2) was no longer significant (using the same likelihood ratio based χ^2 measure as we used for the health and functioning variables, except that it is independently calculated for the predicted variables holding the scores generated only from the functional and health-status variables fixed; Tolley and Manton 1987). Using this decision criterion the number of types selected was four. The number of types necessary to explain variation in service use is smaller than is necessary to explain all of the variation in the health and functioning variables because certain of the service measures (e.g., SNF use) were relatively rare. This analysis of service use is different from a regression in that the profiles are generated on information *independent* of the service measures being predicted. Thus the relation of the profiles to the service-use measures will exactly replicate in independent samples, in contrast to regression, which uses dependent-variable values to optimize the relation in the particular sample used. An additional contrast to regression is that the relation to an entire set of services is determined in the model and, instead of a single prediction function, we have four separate functions. Other statistical criteria could use a weighted mixture of the two criteria or reflect additional criteria about the structure of the profiles (e.g., Singer 1989; Berkman, Singer, and Manton 1989).

In table 5, we present four profiles of probabilities relating each of the 56 measures (described in the left column) to the four functional status types.

The size of these probabilities can be compared with the probability of the attribute in the total sample contained in the first column of the table. This comparison shows that the first type is relatively functionally intact (e.g., has zero probability of any ADL). The second type has more ADL impairments than the third type, which has primarily more serious physical impairments such as reaching over head, grasping objects, bending for socks. The fourth type is highly impaired on all dimensions. In terms of morbidity, Type 1 has a moderate amount of circulatory diseases and joint problems and a few other conditions. Type 2 is characterized by a greater risk of hip and other fractures. Type 3 has a variety of cardiopulmonary problems and Type 4 has the highest risks of a range of neurological impairments (e.g., Parkinsonism, stroke, paralysis, dementia, mental retardation, multiple sclerosis, cerebral palsy, epilepsy), as well as associated chronic diseases. Al-

though Type 2 has more ADL impairments than Type 3, Type 3 has a range of physiological problems associated with its greater impairment of physical functioning.

To determine if the types are predictive of service use and demographic characteristics, we present the distribution of those characteristics in table 6. The coefficients in this table are also the type-specific probabilities for the attributes described in the left column. They were, however, estimated holding the individual scores on the four health and functioning types *fixed*. Thus, these coefficients represent the dependence of demographic attributes and informal-care use on independently defined health and functional status types; in other words, the information in these variables was *not* used to calculate the four functional and health profiles. Hence, morbidity and disability estimates were fixed in the estimation, whereas the coefficients for the service-use variables were not.

The most intact group, Type 1, has the highest proportion of males with the most frail group, Type 4, having the second highest proportion of males. This is consistent with these two types also having higher likelihoods of being married. The first group represents a younger (mean age about 74.9 years), relatively functionally intact male subpopulation with spouse present, with moderate levels of medical problems, or an average of about two medical problems per person. In other studies of changes in functional status, males have been found to have a lower prevalence of chronic disability due to a greater risk of acutely lethal conditions (Manton 1988). The fourth group, with multiple medical problems and a high degree of frailty, is the second oldest (80.2 years) group. The higher than expected frequency (relative to the proportion in the total sample) of males in this group probably represents the fact that persons at this level of frailty can only stay in the community with significant informal-care support *and* the ability to purchase formal LTC services. This is consistent with Type 4 having the highest reported income levels, the greatest percent spending more than $125/month on formal LTC care, the highest number of helpers, and more than eight days of informal care provided per week (i.e., 49 percent versus 23.7 percent on average). This group, though *not* having the highest level of Medicaid payment or food stamps, does have the most supportive housing and has, by far, the highest likelihood of receiving home nursing and physical therapy. Thus, this is a group of particular interest for private insurance in that it is an LTC benefit

TABLE 6
Associated Measures of Acute and LTC Service Use, Both Formal and Informal

Service use	Frequency	Pure type 1	2	3	4
Ever been nursing-home patient	9.6	1.4	16.6	2.1	18.8
Had hospital stay in last year	45.6	25.3	33.6	65.5	65.1
Relationship of helper(s)					
Spouse	35.0	41.1	17.7	27.1	53.6
Offspring	42.2	11.0	53.9	52.1	57.5
Other relative	29.5	7.4	44.6	33.8	34.8
Friend	12.9	3.3	21.9	21.6	6.4
Other not related	33.5	6.0	41.9	30.4	60.4
Total out-of-pocket payment to helpers					
None	70.0	93.3	65.0	68.5	48.5
Unknown	14.5	2.2	15.3	12.8	30.2
$1–$39	7.1	3.4	11.5	12.6	1.2
$40–$124	4.1	0.7	3.8	5.0	6.8
$125–$399	2.1	0.4	2.9	0.0	5.3
$400+	2.2	0.0	1.5	0.0	8.0
How many helpers					
0	14.8	40.7	6.6	6.7	1.6
1	43.8	50.8	37.9	41.9	44.1
2	23.9	7.5	33.2	29.3	27.2
3	11.2	0.6	14.4	15.7	15.7
4+	6.4	0.5	7.9	6.5	11.5
Total days of care per week provided by all caregivers					
0	23.2	62.3	10.9	13.9	3.3
1–5	18.8	14.3	31.9	29.9	1.5
6–7	32.3	22.2	32.1	37.7	46.3
8–12	11.8	1.0	14.8	13.0	18.7
13+	11.9	0.2	10.3	5.5	30.2
Current Medicaid payment	22.6	11.6	17.0	37.8	28.2
Other health insurance	62.7	72.8	67.1	52.2	54.8
Food stamps	12.1	4.5	5.4	32.1	10.1
Supportive housing	31.8	14.6	40.5	27.4	46.7
Service—home nursing	13.1	0.3	7.2	6.1	43.6
Service—therapist in last month	5.1	1.6	3.2	3.6	13.0
Service—emergency-room visit, last month	6.7	3.7	2.4	12.6	9.8
Service—MD office visit	44.0	36.3	36.9	72.6	33.5
Service—RX in last month	79.7	66.5	70.5	97.7	87.8

TABLE 6
Continued

Sex					
Male	34.7	57.9	22.2	5.0	47.0
Female	65.0	42.1	77.8	95.0	53.0
Age					
65–69	18.2	26.0	3.8	31.4	13.4
70–74	21.6	28.1	10.9	32.4	16.0
75–79	22.2	24.4	19.8	28.2	16.8
80–84	19.2	15.5	28.9	6.5	24.1
85–89	12.8	5.5	25.3	1.5	17.6
90+	6.0	0.5	11.4	0.0	12.1
Mean age	77.8	74.9	82.2	73.2	80.2
Marital status					
Married	42.9	61.7	19.7	34.3	54.4
Not married	57.1	38.3	80.3	65.8	45.6
Annual income (U.S. $)					
0–4,999	17.2	9.1	16.9	38.3	7.2
5–6,999	14.5	13.9	14.6	21.7	8.6
7–9,999	16.2	16.2	11.8	17.0	20.2
10–14,999	15.6	21.7	10.5	9.7	19.6
15–29,999	12.5	16.6	10.6	2.4	19.3
30,000+	4.9	5.1	6.2	0.1	7.6
Refused	6.5	7.1	10.9	1.8	5.5
Living quarters					
House	67.1	72.2	56.3	58.9	80.7
Duplex	6.9	5.2	9.4	8.5	4.6
Apartment	18.3	13.2	29.5	21.4	9.0
Other	7.7	9.5	4.8	11.2	5.6
Race of sample person					
White	88.5	91.6	89.2	90.1	82.6
Black	10.6	7.5	9.8	9.9	15.9
Other	0.9	0.9	1.1	0.1	1.6
Metropolitan status					
Metropolitan	65.3	65.6	80.6	45.5	66.3
Nonmetropolitan	34.7	34.4	19.4	54.5	33.7

Source: 1982 and 1984 National Long Term Care Survey.

population for which cost tradeoffs of providing institutional versus home benefits has to be considered.

In contrast to the first and fourth types, which are more likely to be male than the population on average (though each still has significant

proportions of females), the second and third types are more likely female than the total sample. Type 2, the group with the highest risk of hip fracture, is the oldest (mean age 82.2) with the highest proportion widowed. The third, in contrast, is the youngest (mean age 73.2 years) group.

The second group has somewhat higher income than the sample average and the third group has the lowest levels of income. Both groups have similar numbers of helpers and days of informal care. Type 3 is, however, much more likely to be on Medicaid, to receive food stamps, to visit the emergency room and the doctor's office. Interestingly, Type 3 is *unlikely* to have been a nursing-home patient. Types 2 and 4 were the most likely. However, Types 3 and 4 were most likely to have had a recent hospital visit. Thus, Type 3, consistent with the medical problems reported, is an acutely ill, younger patient population. This appears to be the group, predominantly female, that has the greatest economic difficulties and thus would be the least able to purchase private LTC insurance. Thus, this group, although being physically impaired, seems to be less relevant for private LTC insurance; perhaps it is most appropriate for a public-insurance program.

The four types identified on the basis of health and functional status have predictive validity in terms of acute and formal and informal LTC service use. Thus, the scores of each individual on each of the four dimensions could be used to predict the actuarial "risk" of that person for different types of services. Population (i.e., aggregate) liability can be calculated from the scores by multiplying them by individual sample weights to weight service use to the national level (see Manton, Woodbury, and Stallard 1991).

The results presented in tables 5 and 6 show that the disabled population can be defined in terms of disease and disability and that patterns of long-term care use can be related to the groups. Such information has implications for the management and pricing of private insurance. Table 6 shows that, whereas 6 percent of Type 1 patients used "other not related" caregivers, more than 60 percent of Type 4 patients did so. Moreover, the extent of out-of-pocket payments varied across the groups, with Type 4 showing the most liability. Returning to table 5, we see that Type 4 patients were also likely to be dependent in more than three ADLs. Hence, enrollees in this group would be likely to "trigger" benefit coverage and use a substantial amount of resources. Interestingly, whereas Type 2 patients also used considerable amounts of formal and paid home-care services, the ADL

profile of Type 2 suggests that most members of this group were not likely to be sufficiently ADL dependent to initiate benefits if the eligibility requirement were set at more than three ADLs.

Table 6 also shows that Types 2 and 4 had the highest relative incomes in the population, indicating that they were the most likely to be purchasers of private insurance. Hence, the most functionally disabled members of the disabled elderly population were also most likely to be the ones residing in the community with the greatest financial resources and the most use of paid home-health care. The importance of this information is that the duration and costs of the subgroups can be estimated to provide an actuarial data base for the pricing of premiums based on likely purchasers of private insurance, the functional characteristics of the enrollees, and the individuals who are likely to be eligible for coverage under different policies.

Not only can the procedure identify such groups, and describe their costs, but the results also can be directly used in designing the fiscal structure of the plan. That is because of the properties of the individual scores. Specifically, a person who has a score of 1.0 on the fourth profile has the expected service distribution in table 6. Thus, the average of the distribution represents the "expected" cost for a person in this group and the variation of the distribution represents the risks associated with insuring a person of this type (i.e., it indicates the probability of being in low-cost and high-cost benefit categories). Also, because an individual may not have all of the conditions associated with one type, he may have partial scores on multiple types. In this case, the expected costs (and the insurer's risk) for this person would be the weighted costs of the groups. This provides considerably more flexibility in predicting costs than by using a limited number of discrete categories. Such flexibility is crucial in determining underwriting factors for such complex phenomena.

In the final section, we describe the expected amount of time that age-specific cohorts of elderly persons spend in different disability states. Combined with expected costs, that duration information provides the final step in more accurate pricing of private long-term-care insurance.

Nursing Home Length of Stay (LOS)

The NLTCS provides information on how levels and changes in health and functioning affect the risk of nursing-home use of persons resident

in the community (e.g., table 3). The characteristics of nursing-home *residents* are described in the NNHS, which has sufficient sample size to estimate the length-of-stay distribution of the nursing-home population. Nursing homes are used for different purposes, ranging from short-term rehabilitative care to LTC for persons with chronic disabilities that preclude residency in the community. Short-stay patients are more likely to have, for example, hip fractures or advanced stages of cancer and to be admitted directly from hospitals. Long-stay patients fit popular concepts of nursing-home patients: persons institutionalized for many years because of long-term disabilities due to conditions such as Alzheimer's disease who eventually die in the facility (Keeler, Kane, and Solomon 1981; Liu and Manton 1983; Coughlin, McBride, and Liu 1990).

To illustrate the "bimodal distribution" of short- and long-stay nursing home patients, in table 7 a life table is presented for a synthetic nursing-home admission cohort. The life-table parameters are calculated from the LOS reported in the 1985 NNHS. These LOS estimates

TABLE 7
Length of Stay (LOS) Distribution of Nursing-home Admission Cohort

Days	Probability of discharge in interval	Expected LOS	Cumulative discharge rate
0–29	0.33	438	0
30–59	0.21	616	33
60–89	0.14	748	47
90–119	0.09	836	54
120–179	0.13	885	58
180–239	0.10	958	64
240–359	0.19	1,004	68
360–539	0.21	1,104	74
540–719	0.15	1,201	79
720–1,079	0.30	1,220	83
1,080–1,799	0.46	1,313	88
1,800–2,519	0.43	1,405	93
2,520–3,499	0.62	1,480	96
3,500+	1.00	1,958	99

Source: 1985 National Nursing Home Survey.

are subject to sample selection biases. A survey of current residents is subject to the problem of "length biased" sampling, that is, the probability of observing a long-stay person at a given point in time is higher than that for observing a person with a short stay. The distribution of LOS for a discharge sample is biased because nursing-home cohorts have grown in size (causing an upward bias in the number of more recent short stays). These biases can be removed by calculating, for a specific LOS interval (e.g., 180 to 270 days), a discharge rate in which the number of discharges for the rate denominator is taken from the current discharge survey and the number of residents, the rate numerator, is taken from the current resident sample (Manton, Liu, and Cornelius 1985).

Although the expected LOS at admission was 438 days in 1985, most persons entering nursing homes stay for short periods of time: 64 percent left within 180 days (six months). Not shown in table 7 is that half of the short stayers—30 percent of all nursing-home patients—stayed for six months or less *and* returned alive to the community. Because they stayed in nursing homes for relatively few days per admission, short stayers account for only 20 percent of nursing-home use. Persons not discharged from nursing homes within 6 months are expected to stay for another 958 days (three years).

In calculating these life tables, nursing-home *stays*, rather than persons, were employed. Although they accurately describe the aggregate volume and pattern of nursing-home use, these tables underestimate the amount of time *individuals* spend in nursing homes. If multiple episodes for a person were combined, the average LOS for a person would be longer than shown here, but the estimated proportion of persons who experienced a nursing-home stay would decline. Such changes have a number of implications for private insurance premiums. Given the smaller proportion of persons who enter a nursing home, there is a change in the risk of institutional costs (i.e, planning premiums involves both the expected cost and its variance) with possibly greater reserves required for a given average cost.

The expected LOS differed for subgroups of nursing-home patients according to their characteristics at admission. Table 8 shows that females had longer stays than males at all ages. Younger males and females (less than 65 years of age) had longer stays than their older counterparts, in part because of the presence of chronically mentally ill and mentally retarded persons, who still represent a significant portion

TABLE 8
Length of Stay for Males and Females in 1985 by Selected Characteristics

Characteristics	Males	Females
Total	311	510
Age		
<65	419	1,003
65–74	320	465
75–84	248	429
85+	277	524
Married	194	346
Not married	378	530
Payment source		
Medicare	47	48
Medicaid SNF	344	669
Medicaid ICF	493	883
Other	319	475
Prior hospital stay		
Yes	170	312
No	447	755
Admitting diagnosis		
Hip fracture	53	143
Senile dementia (organic)	332	786
Alzheimer's	—	400
Cardiovascular	162	395
Stroke	179	487
Cancer	51	29
Bedfast	22	30
Chairfast	495	1,276
Incontinent	220	432

Source: 1985 National Nursing Home Survey.

of the nursing-home population. Being married was associated with a shorter LOS for both males and females.

Major differences in LOS were found by payment source at admission. Stays covered by Medicare averaged 48 days. When Medicaid was the primary source of payment at admission, the LOS ranged from 344 days to 883 days. When private and other sources were the primary

payors at admission, LOS was long—but shorter than Medicaid. Nursing-home admissions with a prior hospital stay had shorter LOS than those without prior hospital stays. The differential can be attributed in part to inclusion in the prior hospital stay group of postacute rehabilitative patients.

Table 8 also shows the LOS for selected primary diagnoses at admission. Hip fracture and cancer produce short stays. Dementia due to organic causes is associated with long stays—particularly for females. The LOS for females with Alzheimer's disease, a subset of the organically caused dementia group, is 400 days; insufficient cases were available to estimate the LOS for males with Alzheimer's disease.

Finally, table 8 shows the relationship of the level of disability at admission and LOS. Bedfast (i.e., severely disabled) patients tend to stay in nursing homes for short periods of time. They may have been admitted to nursing homes for rehabilitation (e.g., because of hip fractures) or because of impending death. Chairfast patients, on the other hand, have above average LOS. Incontinent patients are more severely disabled than average and have shorter than average LOS.

Information on nursing-home LOS is important to calculating benefit costs and premiums. Because of the difficulty in collecting longitudinal data on nursing-home care, development of private insurance has been dependent on estimates based on surveys such as the NNHS. Analyses of these surveys indicate that LOS clearly varies by the medical condition prompting the need for nursing-home admission. Recognition of this fact resulted in exclusions from coverage of certain conditions that predicted long stays—at least in "earlier generations" of private insurance policies. Although recently offered policies tend to contain few exclusions, the medical screens for purchase of policies still contain barriers to access to private policies and consequently coverage for nursing-home care.

For private insurance to cover a major portion of the elderly population, it seems that further analysis of the LOS of nursing-home patients has to be combined with risk of admissions for subgroups of the population. In this way, costs can be calculated for the total nursing-home and community-based services. We suspect there are offsets between community-care and nursing-home costs that have not been incorporated in private insurance policies. Estimations of these offsets may have important implications both for premiums and eligibility.

TABLE
Life Table for Males and Females with Total Life Expectancy Functioning States, Calculated from 1982–1984

Age (t)	Surviving proportion (l_t)	Life expectancy (e_t)		1 Non-chronically disabled	2 Light physical impairment and early dementia
Males					
65	100.00	14.27	$\bar{g}_k$	0.93[a]	0.01
			$e_{t \cdot k}$	12.00[b]	0.37
75	64.97	9.19	$\bar{g}_k$	0.88	0.02
			$e_{t \cdot k}$	6.92	0.40
85	26.82	5.16	$\bar{g}_k$	0.68	0.07
			$e_{t \cdot k}$	3.02	0.40
95	3.13	3.14	$\bar{g}_k$	0.48	0.10
			$e_{t \cdot k}$	1.55	0.31
Females					
65	100.00	18.40	$\bar{g}_k$	0.91	0.01
			$e_{t \cdot k}$	13.48	0.55
75	79.42	11.79	$\bar{g}_k$	0.82	0.02
			$e_{t \cdot k}$	7.04	0.55
85	46.42	6.34	$\bar{g}_k$	0.51	0.06
			$e_{t \cdot k}$	2.32	0.46
95	9.08	3.53	$\bar{g}_k$	0.21	0.10
			$e_{t \cdot k}$	0.75	0.35

Source: 1982 and 1984 National Long Term Care Survey.
[a] Average g_{ik} value ($\bar{g}_k$) representing weighted prevalence at age x.
[b] Number of years expected to be lived in this state after age x.

Active Life Expectancy: Disability, Morbidity, and Mortality Estimates Integrated

Our review of the three surveys provides us with considerable information on different features of the design of private LTC insurance. The SOA tells about the risk of medical conditions, and, given the presence of a medical condition, the risk of disability. The NLTCS describes the

9
Decomposed by Time Lived in Each of Seven Physical
National Long Term Care Survey, Complete Sample

Types				
3 Light impairment and early cardiopulmonary problems	4 Cardiopulmonary and moderate physical impairment	5 Hip fracture, moderate physical impairment, and self-care needs	6 Highly frail	Institutionalized
0.01	0.01	0.02	0.02	0.01
0.31	0.17	0.43	0.44	0.56
0.02	0.01	0.03	0.02	0.03
0.25	0.15	0.39	0.42	0.67
0.03	0.02	0.05	0.05	0.09
0.21	0.10	0.35	0.38	0.70
0.04	0.02	0.08	0.09	0.18
0.14	0.07	0.25	0.28	0.53
0.02	0.14	0.02	0.01	0.01
0.71	0.43	0.88	0.68	1.68
0.34	0.20	0.04	0.03	0.04
0.56	0.35	0.80	0.64	1.84
0.06	0.03	0.08	0.06	0.20
0.38	0.23	0.56	0.57	1.82
0.06	0.03	0.09	0.12	0.39
0.22	0.12	0.31	0.45	1.35

functional and health problems of the chronically disabled population, long-term and acute-care-service requirements, and the changes in functional status over time. The NNHS describes the parameters of institutional care. Although analysis of each component is important, one also needs a general dynamic model to integrate multiple sets of data and to represent the interaction over time of the component processes.

A set of concepts and measures to represent this time-weighted need

for disability has been described in other papers (e.g., Manton and Soldo 1991; Manton and Stallard 1991). Those concepts involve survival-curve concepts applied to multiple types of health outcomes. These measures are useful because they are explicitly time weighted. To illustrate the basic concepts and the types of information generated we present, in table 9, a set of active and disabled life-expectancy estimates produced from analyses of the 1982–1984 NLTCS (Manton, Woodbury, and Stallard 1991).

In this life table, overall life expectancy for males and females at selected ages has been decomposed into a number of different levels and types of functioning. The number of types has been expanded to include transitions estimated from the institutional and nonchronically disabled sample components from the NLTCS. Life expectancies are calculated using age-dependent transition matrices and mortality functions estimated for persons in the 1982–1984 NLTCS. The estimation of both transitions and mortality involved GoM-generated multivariate scores. In this case, because we were not predicting service use, we used only 27 functional status measures in the score estimation. Both transition and mortality functions were made functions of age. The transition matrices allowed functional status to improve as well as decline.

Functional status transitions interact in the life-table calculations with mortality. Thus, if the transition moved many persons into the most frail type (6), which has the highest mortality risks of any of the types, the mortality of the total population, which is an average of the mortality of the different groups, would increase. Thus, age-dependent functional change and functional status-dependent mortality are represented in this model (Manton, Woodbury, and Stallard 1991).

Type 1 is a nonchronically disabled group. It is clearly the predominant group at age 65 (93 percent for males; 12 of 14.3 years are expected to be lived in this state after age 65), but declines with age—it is 48 percent for males at age 95 with the expectation that 1.6 of 3.1 years will be lived in this state. Type 7 represents the amount of time expected to be spent in institutions. Types 2 to 6 represent intermediate levels of functioning that are expanded beyond the four groups discussed earlier. These types are all defined using the multivariate procedure described above. Of importance for private LTC insurance are the estimates of time spent in each of the disability states. The duration expected for the sixth type is relatively low—0.44 and 0.68 years after age 65 for males and females—suggesting that these states are

highly dynamic and that a person does not live in that highly impaired functional state very long. Persons with LTC needs will thus experience rapid changes in those needs. Some will improve and some will die, with death rates being extremely high in the most frail types.

The duration-weighted estimates of disability represented here by type represent an integrated multivariate approach for evaluating LTC needs that could be used to design private LTC insurance. The functional states stratifying the life tables can be related both to the chronic conditions generating disability (Manton, Stallard, and Vertrees 1991) and to formal and informal LTC and acute health services. Thus, the effects of reducing the risk of specific chronic conditions on the need for LTC could be calculated, as could the shifts in specific types of health services associated either with primary health interventions or changes in benefit packages. The estimates provided in table 9 are actually conservative. Estimates made with maximum likelihood adjustments for missing data project both longer overall life expectancy *and* greater proportions of life expectancy to be spent in active status. Those estimates would suggest lower premium requirements (Manton and Liu 1989).

Discussion

There has been extensive analysis of the financial structure of private LTC insurance and of the market for that insurance. Those analyses have considered the duration of different types of service use as currently experienced. Some analyses have suggested that private LTC insurance, because of limits to financial access, can only play a limited role in providing LTC services. For example, Wiener et al. (1991) suggested that, depending upon the nature of the financial model, only up to about 40 percent (using equity conversion) of the elderly could afford LTC premiums.

In this article, we examine the design of private LTC insurance from a different perspective. That is, we consider the question of the role of the epidemiological determinants of the need for LTC insurance. The purpose of this article is to show how bioactuarial data from nationally representative surveys can provide information to inform the development of private long-term-care insurance. We felt this to be a particularly important endeavor in light of the paucity of data that private

insurance companies have on epidemiologically based need and use of long-term care. Although inferences from the data have been presented throughout the article, the results of our analysis highlight particular topics of relevance to the design of long-term-care insurance policies.

Prevalence of Morbidity and Disability

The information on prevalence of morbidity and disability has implications for two important private long-term-care insurance issues. First, it defines the potential market of purchasers of policies. Data from the SOA indicated that many elderly persons had experienced medical events such as stroke, cancer, and heart disease. To the extent that such conditions are viewed as exclusionary, the potential pool of purchasers for insurance is less than half of the total elderly population for all income categories. On the other hand, the data indicate that the actual prevalence of disability for persons with prior conditions tends to be less than 5 percent and does not vary with prior medical condition except for arthritis and rheumatism. Despite the fact that many medical conditions slightly increase risk of future disability, arthritis and rheumatism foreshadow substantial long-term care use. Hence, medical screens for eligibility for private insurance may preclude a greater number of potential purchasers than is necessary. Moreover, although arthritis and rheumatism may be perceived to be conditions suggesting "adverse selection," the prevalence of individuals with this condition and high ADL levels (e.g., 3+) is still less than 18 percent for females and 9 percent for males in the oldest age category (85+).

When we examined disability and morbidity by income groups, we found a higher prevalence of wealthier persons at advanced ages residing in the community with disability. This may occur because lower-income persons with similar disabilities enter nursing homes at younger ages. The implication for private insurance is that higher-income persons, who are most likely to purchase private insurance, would be extended users of home care and probably only short-term users of nursing homes. Because most private policies now include home care, it is likely that this component of a benefit package will be extensively used by the expected purchasers of the insurance, who would presumably be able to supplement the insurance benefit with other funds. On the other hand, costs for nursing-home care for the more affluent purchasers of private insurance may be considerably less than the average

costs of users of nursing homes if most of their disabled lives are spent in the community.

Because of the limited information on wealth in the surveys, we used income as a proxy. This situation will improve in the 1989 NLTCS because the income and assets module from the Survey of Income and Program Participation was included. Information on assets would have significantly enhanced the analyses of disability and patterns of long-term-care use, but this analysis will have to wait for the 1989 survey data. Nonetheless, the difference in disability patterns by income highlights the importance of stratifying the population by financial status. The implication is that if more affluent members of the population—those most likely to purchase private insurance—have different overall use rates of service (both nursing homes and home health), then premium rates based on experience ratings of these groups may be commensurately different from those for the overall population.

The second set of implications of the population prevalence of morbidity and disability is that they define the number of persons who would have the severity of disability to "trigger" the use of benefits. For example, most private policies currently specify that a policy holder has to be dependent in three or more ADLs before he or she is covered for home-health services. Analysis of the SOA indicated that less than 10 percent of the population under 85, and who were likely to be able to afford private insurance (i.e., an income of $15,000 or more), have that level of disability. Less than 30 percent of those over age 85 had that level of disability. If individuals with arthritis and rheumatism were excluded from the average, the proportion of people eligible for benefit is considerably smaller—possibly half. Fundamentally, information on the prevalence of morbidity and disability provides bioactuarial data important for setting eligibility levels and corresponding premium rates than can maximize the number of potential insurance purchasers.

Transitions

Data from the NLTCS and NNHS showed transitions in the use of long-term care over time. This information shows how much service use is required once benefits are triggered. Individuals in the community do not use home care indefinitely because they are subject to improvement in functional status or death, as well as to deterioration and nursing-home admission. In the ADL 3+ group, those for whom home

care benefits would apply, half got better or died in two years. For persons with five to six ADLs, 60 percent get better or die. Moreover, only 10 percent of each group are in nursing homes after two years. These numbers are important for assessing potential costs of home care for private insurers. One important implication is that even if benefits are triggered, almost half of the disabled population does not require home care after two years; cancer patients, for example, are at particularly high risk of dying within two years. Hence, the total use of long-term-care services (both nursing home and home health) by cancer patients is *lower* than average. Unless the onset of disability commences shortly after entry into an insurance plan, individuals with prior history of cancer are not likely to reflect adverse selection of enrollees. Finally, the major changes in disability status in two years indicate that screening plan beneficiaries at appropriate periods is an important element of design necessary to assess continuing eligibility for benefits.

Similar to the home-care situation, the NNHS data showed that large proportions of patients do not remain in nursing homes for a long period of time. Although the lifetime use of nursing-home care is greater than depicted in the episode lifetables, many admissions nonetheless are short stayers and either return to the community or die in nursing homes. How long individuals remain in nursing homes depends in large part on the conditions underlying the disability. Cancer patients are very likely to be terminal-care patients, who may die shortly after admission. Alzheimer's patients, on the other hand, could have very long stays. The implication of the morbidity-based nursing-home length-of-stay data is that the composition of nursing-home admissions strongly affects the expected cost of nursing-home benefits under private insurance.

Subgroups

Using data from the various surveys, we identified subgroups of the disabled elderly population with different bioactuarial trajectories of need. These subgroups are easily identifiable in terms of their health-status characteristics. Because of the nature of our GoM analysis—which defines the groups solely on the basis of the underlying epidemiological characteristics of the disabled elderly population—the disability patterns are defined in a comparable fashion over time. Relating the groups to their long-term-care service patterns provides a pic-

ture of how the characteristics are related to service use in the current market. It is clear that changing the market (e.g., through public policy changes) would change the pattern of service use. However, because the scores representing the underlying epidemiological composition of the population are defined independently of service use, the subgroups can be employed to examine the effects of policy changes, which may result in substitution of services or in "woodwork" effects.

In tables 5 and 6 we presented the characteristics of the subgroups, which showed how they differed in terms of underlying epidemiological characteristics and the trajectory of long-term-care services used. The culmination of the synthesis was table 9, which described both the population distribution of the disabled population and the expected time spent in the various states over their remaining lifetime. In essence, this table described the expected liability for long-term care of the cohort of disabled elderly persons. The proportion of days experienced by the cohort in different states can be related to coverable services by the type and amounts of service used (including institutional care). Actuarial analysis of long-term-care insurance products can use the information as a basis for estimation of premium rates, eligibility screens, standards of care, and composition of benefits packages. Clearly variants of table 9 can be developed for specific income subgroups to account for likely purchasers of private insurance.

Public Policy

This article has focused on information that would be important for designing private long-term-care insurance. Private LTC insurance necessarily has an impact on public programs because public programs will respond to needs not covered by private insurance. This will occur whether the public program is designed on an insurance model based on actuarial principles with payments to a trust fund or is funded from current general revenues. Even if the public LTC program is based on an insurance model, there will be significant differences in that it must have universal coverage with the possibility of deficit financing if cost projections are inaccurate.

Public policies for long-term care can employ the same information for the development of publically subsidized products. However, some important differences exist. For example, whereas private insurance policies can expect nursing-home costs to be less, and home-care costs

to be more for privately insured disabled elderly persons, the reverse can be expected for public policies. Simply stated, public policies have to cover a set of persons complementary to those most likely to have private policies. Where privately insured individuals used more (or less) care than the average, public policies would have to cover less (or more) care than the average. We presented information that described the general population. Tradeoffs between private and public insurance would describe the variation around the average.

Conclusions

The successful development of private long-term-care insurance is dependent on accurate information on the risks and duration of long-term-care service use. Because there has been a paucity of such data, private insurers have been restrained in developing policies that reflect the underlying epidemiological characteristics of the potential market of purchasers.

In examining that data, we found that the LTC population was highly dynamic, especially at higher disability levels. As a consequence, costs, independent of current acute-care expenses, may be less than expected on an individual basis—at least in the community population. These dynamics need to be better represented in the LTC insurance calculations. If the accuracy of individual service predictions can be increased, then reserve requirements and overall costs can be reduced.

The fundamental conclusion of the analysis is that the design of LTC insurance involves many features quite different from the design of other insurance products. Current estimates of the coverage of the population by private LTC insurance have not adequately considered the range of options possible. If the nascent private long-term-care insurance industry is to provide coverage for a substantial portion of the population of the United States, product features will have to reflect the underlying morbidity and disability characteristics of the elderly population. These analyses will have to reflect both inputs to (i.e., health determinants) and outputs from (i.e., the composition of benefits required; possible substitution of assistive and modified housing for personal care) the health and functional status of the elderly population to be covered.

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