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Retirement and Health: Estimates and Projections of Acute and Long-Term Care Needs and Expenditures of the U.S. Elderly Population

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Abstract

Standard static-component methods for projecting the future health care costs of the U.S. elderly population are based on independent analyses of mortality and health care data. For example, in its recent annual reports to Congress, the Board of Trustees of Social Security and Medicare used population projections from the Social Security reports as starting points for the Medicare projections. The Social Security population projections are based on specific assumptions about rates of decline in death rates for ten disease categories, but the Medicare projections take no explicit account of these assumptions, even though they strongly imply continuing improved health for all age groups served by Medicare.

This paper employs a static-component projection methodology as a first step in a more complex research agenda focusing on developing detailed population projections in which mortality, disability, and disease are represented as linked phenomena with changes in any one impacting the other two. The methodology exploits the additional detail available from the 1982–84–89–94 National Long Term Care Surveys (NLTCS) and the linked Medicare Expenditure and Mortality files for 1982–95. These data are relevant because long-term-care recipients exhibit a range of chronic disabilities that are predictive of acute and long-term-care needs and mortality. Estimates of acute and long-term-care needs and expenditures are developed from the NLTCS data and applied to population projections of the U.S. elderly developed by the Social Security Administration. These estimates are stratified to reflect the effects of gender differences and the availability of family support structures—spouse, children, and relatives—to provide community-based long-term care in an informal way and as a supplement to paid formal care. The implications of these projections for financial planning for retirement are considered.

Introduction

Those responsible for retirement planning can ill afford to neglect the financial consequences of increased health care utilization among the elderly. As important as this is today, it will become even more important as the initial waves of the Baby Boom generation reach retirement ages in 2008 and begin to place unprecedented demands on both public and private retirement programs—programs that include both pension and retiree-health financing systems.

Recently the pension needs of current and future retirees have received increased attention—motivated, in part, by the recognition that the Social Security Trust Fund is projected insolvent in 2034 and continuing shift from defined-benefit to defined contribution plans in private retirement pension programs (American Academy of Actuaries Task Force on Trends in Retirement Income Security 1998).

However, the health needs of current and future retirees have received substantially less attention, even though the Medicare Part A Trust Fund is projected insolvent in 2015 and there are no generally accessible public programs that cover long-term-care costs. This reduced attention may be due to a general lack of awareness of exactly what acute and long-term-care services Medicare and Medicaid cover and the greater difficulty in projecting health care costs both at the population and at the individual level.

Medicare is a health insurance program that is generally accessible to the public, but it was designed primarily to meet the acute health care costs of the elderly, not their long-term-care costs. Medicaid is a welfare program that covers long-term-care costs, but these benefits are accessible only to persons who can demonstrate personal income at or near the federal poverty level or for persons in nursing facilities or other institutions who can demonstrate assets and income below specified thresholds. From a financial-planning perspective, the attainment of Medicaid eligibility is the worst possible outcome, representing a complete loss of financial independence. A contrary view, however, is expressed by Moses (1998), who argues that Medicaid-funded long-term care is, in fact, the program of choice for many Americans.

Health care costs are difficult to predict at the population level because of the continuing evolution of the state-of-the-art of acute health care delivery and services. Health care costs are difficult to predict at the individual level because of the random nature of acute health events and the inability of our current models to predict the occurrence and timing of disability requiring long-term care. This contrasts with pension costs, which are essentially fixed, or are highly predictable, for each future year of life lived beyond retirement.

Health care costs are large and will continue to increase. In 1999 Medicare costs were estimated to be 69% of Social Security retirement pension costs (Board of Trustees of Social Security and Medicare 1999). By 2025 Medicare costs are projected to be 80%, and by 2050 to be 90% of Social Security retirement pension costs (Board of Trustees of Social Security and Medicare 1999). Thus, we can anticipate that it will be increasingly difficult to push back the date of insolvency for the Medicare Part A Trust Fund in the period beyond 2015. Furthermore, these Medicare projections do not take account of long-term-care costs.

The typical retiree can look forward to large expenditures for both acute and long-term care. The Congressional Budget Office (1996) estimated that the average man retiring in 1995 at age 65 had a discounted present value of lifetime Medicare benefits equal to $80,442, and the average woman had a corresponding value equal to $98,581. Assuming an average Medicare co-payment rate of 14%, these estimates imply a discounted present value of lifetime acute care costs in the range $93,500–114,600. The Congressional Budget Office provided no comparable estimates for lifetime long-term-care costs. However, the American Academy of Actuaries Committee on Long-Term Care (1998) estimated that the single-premium cost at age 65 for a typical long-term-care policy with $100 per day nursing home benefits, $50 per day home health care benefits, a 90-day elimination period, and 5% compounded inflation protection would be in the range $57,000–67,000. The corresponding level annual premium was estimated as $2,900–3,200 per year, with inflation protection accounting for about half of the premium amount. The single-premium cost can serve as a ballpark estimate of the discounted present value of lifetime long-term-care costs faced by the average retiree at age 65, assuming that the savings generated by the insurance underwriting process are approximately equal to the portion of the premium attributable to the insurer's profits and expenses. Combining these two cost estimates, we find that the discounted present value of future health care costs for a new retiree could be in the range $150,000–182,000, with Medicare responsible for 50–55% of these costs under current law, and Medicaid potentially responsible for an unspecified percentage of the remaining costs.

Good financial planning for retirement will have as a goal the avoidance of Medicaid eligibility and the ability to withstand cutbacks in the generosity of Medicare benefits as the financial constraints imposed by the impending insolvency of the Part A Trust Fund will likely continue to impact proposals for Medicare "reform" throughout the first few decades of the next century. The lack of a coherent national policy for dealing with the financing of long-term care combined with the potentially catastrophic size of long-term-care costs faced by some individuals means that it will be particularly important to deal with these contingent costs in developing financial plans for retirement.

At the individual level a choice will likely have to be made between (1) self-insuring all long-term-care costs, (2) purchasing private long-term-care insurance, (3) planning on attaining Medicaid eligibility for long-term-care benefits, or (4) some combination of the preceding options.

These options focus attention on the question of who should pay for long-term care. A more fundamental question, however, is how much and what kinds of long-term-care services will, in fact, be needed. Once this question is answered adequately, it will be possible to address questions related to financing this care. The difficult part of this task is determining the expected amounts, types, and costs of future long-term-care services for individuals or groups of individuals. This will require generating new estimates and projections that differ fundamentally from currently available estimates and projections.

This paper addresses issues involved in developing population projections suitable for determining the amounts, types, and costs of future long-term-care services, and ancillary acute care services, for groups of individuals. An innovative aspect of these projections will be that mortality, disability, and disease are represented as linked phenomena with changes in any one impacting the other two. The development of this class of projection models is part of the author's ongoing research program, whose long-range goal is to provide detailed, realistic, and accurate projections of the future health status of elderly Americans, at a level of detail comparable to in-person assessments of health status for individual sample-survey respondents. Generating highly detailed projections means that the underlying projection model must accurately portray all important interactions between measured variables and accurately characterize the changes over time of measured physiological and functional-status variables in an aging population. This type of model building effort is best accomplished in multiple stages, with each stage elaborating on the modeling structure developed at a prior stage.

The estimates and projections in this paper exemplify the first two stages of model development and provide baseline comparisons for further stages of model development. These results are of interest since they provide detailed characterizations of the acute and long-term-care status of the U.S. elderly population throughout the period 1995–2080. The results for the early part of this projection period should be reliable since it is unlikely that future model elaboration will have a major impact here. Future model elaboration will likely lead to some revisions for the latter parts of this projection period, and it is possible that those revisions could be substantial.

This paper contains five sections:

1. The Background section provides basic information on the definitions used to characterize the long-term-care disabled population, and the costs and sources of funds for long-term-care services in the U.S.
2. The Data section provides basic information on the National Long-Term-Care Surveys, and related administrative data files from Medicare, that are used as the basis of our acute and long-term-care estimates.
3. The Methods section describes two types of projection methodologies: (a) a static-component health projection model based on population projections developed by the Social Security Administration for 1995–2080; and (b) a Markov chain model used to develop estimates of incidence and continuance rates for long-term-care disability statuses, based on estimates from the 1984–89 NLTCS.
4. The Results section presents the two types of projections, with emphasis on the more detailed static-component projections.
5. The Discussion section considers the implications of these projections for financial planning for retirement.

Background

Long-term care is a wide range of health and social services that may include adult day care, custodial care, home health care, hospice care, intermediate care, respite care, and skilled nursing care. Long-term care is generally necessitated by the development of chronic disability, which may result from a variety of medical conditions such as cancer, heart disease, chronic lung disease, arthritis, osteoporosis, stroke, Parkinson's disease, AIDS, Alzheimer's disease, and other diseases and medical conditions. Long-term care does not generally include short-stay hospital care.

In contrast, acute health care generally refers to skilled, medically necessary care provided by medical and nursing professionals for conditions of relatively short duration that have a specific and foreseeable end. Acute care is typically associated with medically unstable conditions, with the primary goal being to restore the patient to a stable state that may, or may not, involve a cure for the underlying medical condition. The chronicity of the underlying medical condition and the relative stability of the patient distinguishes long-term care from acute care.

There are many classification systems for describing people in need of long-term-care services, but the most important is the system introduced by the Health Insurance Portability and Accountability Act of 1996 (HIPAA). HIPAA focuses primarily on severely disabled persons with activity of daily living (ADL; Katz and Akpom 1976) limitations, but it also introduced specific criteria for dealing with cognitive impairments that are not associated with ADL limitations. HIPAA provides favorable tax treatment for certain types of long-term-care insurance policies under which a licensed health care practitioner certifies the policyholder will need assistance for at least 90 days. Specifically, under HIPAA's definitions for tax-qualified long-term-care insurance, a policyholder is eligible for long-term-care insurance benefits only if a licensed health care practitioner certifies that the individual satisfies one of three criteria (triggers):

1. ADL Trigger—the individual is unable to perform without "substantial assistance" from another individual at least two out of six ADLs (bathing, dressing, toileting, transferring, continence, and eating) for at least 90 days because of a loss of functional capacity, or
2. Similar Level Trigger—the individual has a level of disability similar to the level in the ADL Trigger, or
3. Cognitive Impairment Trigger—the individual requires "substantial supervision" to protect him or herself from threats to health and safety because of "severe cognitive impairment."

HIPAA permits but does not require a long-term-care insurer to use any subset of the three benefit triggers in determining a given policyholder's eligibility for long-term-care benefits. Persons satisfying any one of the three triggers are defined as "chronically ill individuals" by HIPAA. Furthermore, HIPAA includes references to the NAIC Long-Term-Care Insurance Model Act, which defines "long-term-care insurance" as any insurance policy or rider designed to provide coverage for at least 12 consecutive months for each covered person on an expense incurred, indemnity, prepaid, or other basis. Chronicity is an integral part of the eligibility definition: HIPAA clearly excludes acute care needs from the benefit triggers of qualified long-term-care insurance policies.

HIPAA's ADL Trigger specifies six ADLs, but HIPAA allows insurers to delete one of these; that is, the ADL Trigger may be interpreted as requiring limitations in two of five ADLs as the operative benefit qualifier. The HIPAA ADL trigger does not count ADLs whose limitations can be appropriately resolved by the use of special equipment such as wheelchairs, walkers, canes, crutches, handrails, ramps, bed lifts, elevators, bed pans, portable toilets, special underwear, catheters, or similar devices. This differs from the NLTCS ADL Trigger, which recognizes such limitations.

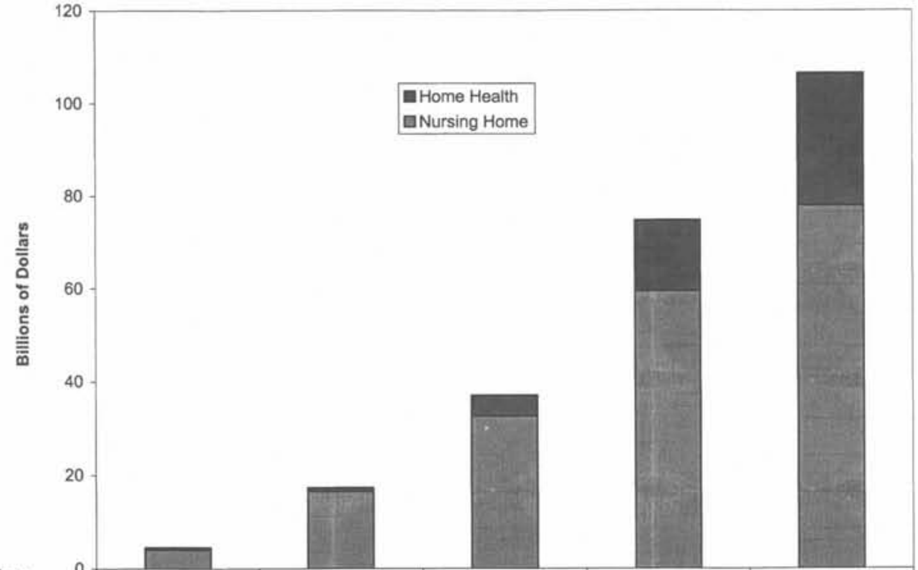
HIPAA does not specifically mention instrumental activities of daily living (IADLs; for example, housework, laundry, cooking, grocery shopping, outside mobility, travel, money management, taking medications, and telephoning; see Lawton and Brody 1969) in defining long-term-care benefit triggers, but it is likely that persons who are so severely impaired that they satisfy the cognitive impairment trigger would have difficulty with at least some IADLs. Certain combinations of ADLs and IADLs might also satisfy the Similar Level Trigger, and the IRS has requested comments on the types of disability that should be included under the Similar Level Trigger (Internal Revenue Service 1997; Kassner and Jackson 1998).

The private long-term-care insurance market is small but is growing rapidly. The Health Insurance Association of America (Coronel 1998, p. 13) reports that the cumulative number of long-term-care policies sold increased from 815,000 in 1988 to 4.96 million in 1996. With recent sales growth at 14% per year, this projects to about 6.5 million long-term-care policies sold by 1998.

The American Academy of Actuaries Committee on Long-Term Care (1998) estimated that over 3.5 million long-term-care policies continue in-force, with more than 60% owned by the elderly. Equivalently, about 6–7% of the 34 million elderly currently own long-term-care policies.

Although long-term-care costs have been increasing rapidly, there is no simple way to measure these increases because no one source tracks all costs. Perhaps the most accessible data source for historical trends is the National Health Accounts (NHA). Under the definitions used in the NHA, long-term-care expenditures include care received through freestanding nursing homes and home health agencies (Levit et al. 1996, p. 188). However, these costs include only about 90% of actual long-term-care expenditures and do not include certain long-term-care expenditures made by Medicaid, nor do they account for long-term care provided without charge by family members. In addition, because these costs represent payments to providers of long-term-care services, one cannot readily partition these costs between subacute and long-term-care patients. Long-term-care cost estimates derived from the NHA are displayed in Figure 1 for 1960–95 (in constant 1995 dollars). Long-term-care costs have doubled during each decade since 1970, reaching an annual level of $106.5 billion in 1995, consisting of $28.6 billion for home health care and $77.9 billion for nursing home care. The growth from 1990 to

FIGURE 1
LTC EXPENDITURES, 1960–95, IN CONSTANT 1995 DOLLARS



Year	1960	1970	1980	1990	1995
Home Health	0.5	0.8	4.4	15.3	28.6
Nursing Home	4.1	16.5	32.6	59.4	77.9

Source: Data from Levit et al. (1996, p. 201), inflated to constant 1995 dollars using the ratio of the annual average consumer price index (CPI-U; Bureau of Labor Statistics, U.S. Department of Labor) for 1995 to the annual average consumer price index for the reference year.

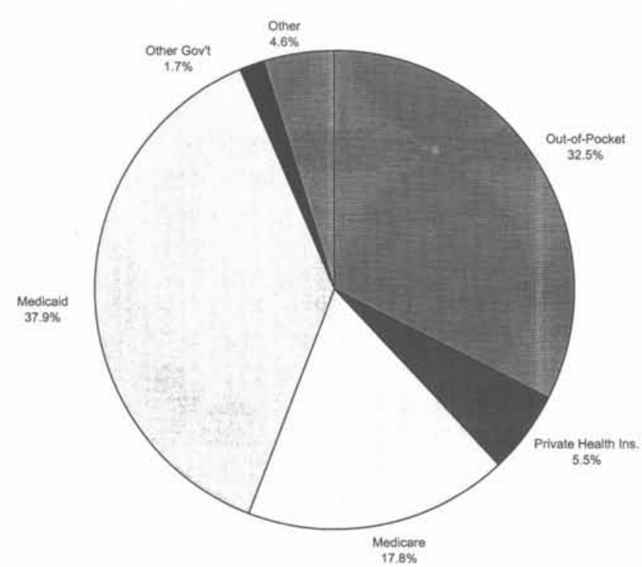
1995 was primarily in home health care (+90.7%), not nursing home care (+33.4%).

The sources and relative distributions of funds for long-term care in the 1995 NHA are displayed in Figure 2. Public funds pay for 57.4% of long-term-care services, private funds 42.6%. Medicaid is the largest public source (37.9%); Medicare is second (17.8%). Out-of-pocket payments are the largest private source (32.5%); private health insurance is second (5.5%). Clearly, Medicaid and private out-of-pocket funds pay for most long-term care, Medicare ranks third, and private long-term-care insurance ranks a distant fourth.

Two programs are particularly relevant to our analysis: Medicare and Medicaid. Most Americans are aware of these programs, but there is a general lack of information about how they are financed and what types of long-term-care services are covered. Many are surprised to learn that Medicare is an acute care program that was never intended to cover long-term-care costs.

Welch et al. (1996) argued, however, that Medicare's home health care visits are used primarily to provide

FIGURE 2
1995 DISTRIBUTION OF LTC EXPENDITURES



Source: Data from Levit et al. (1996, p. 188).

long-term care. Sixty-one percent of Medicare-covered home health care visits in 1993 were to enrollees who received home health care for six months or more. Medicare's home health agency (HHA) program has grown rapidly: from $1.9 billion in 1988 to $15.4 billion in 1995 (HCFA 1997, Table 46). The Congressional Budget Office (1997) projected continued growth for this program with expenditures of $43 billion in 2007, assuming a growth rate above 10% through 2002 and near 8% thereafter. The Balanced Budget Act of 1997 implemented a series of controls to curb this growth and shifted the financing of a significant amount of home health care from Part A to Part B of the Medicare program (Levit et al. 1998). These changes affect home health services that do not follow a hospital or skilled nursing facility stay, services that are more clearly identifiable as long-term-care services. The rapid growth of the Medicare home health care program underscores the difficulty in delineating acute and long-term-care services, especially given the higher than average acute care needs of long-term-care recipients.

In contrast with Medicare, the Medicaid program was designed to cover costs of institutional long-term-care services for qualified individuals. In 1996 Medicaid paid for 48% of nursing home care costs (Levit et al. 1997). In addition, a broad range of home and community-based (HCB) long-term-care services is covered through the standard Medicaid home health and personal care programs or through the innovative Medicaid state waiver programs. In 1996 Medicaid paid about $10.5 billion for HCB long-term-care services (Kassner and Tucker 1998).

Eligibility for Medicaid HCB long-term-care services is generally tied to the income levels for the federally funded Supplemental Security Income (SSI) Program (for example, for individuals, $494 per month income and $2,000 in countable assets; Kassner and Tucker 1998). Because of the much higher costs of institutionalized nursing home care, eligibility for Medicaid nursing home benefits is more lenient. However, these costs are so expensive that about 40% of patients admitted to nursing homes are eligible for Medicaid assistance at the time of admission; and about 30% of those who enter as private-pay patients convert to Medicaid-pay status during their stay (Wiener, Sullivan, and Skaggs 1996). Thus, there is a tremendous disincentive for persons with low or moderate income levels to establish adequate financial resources to cover their long-term-care needs. Instead, there is a significant incentive for many people to rely on the high probability of Medicaid eligibility (Moses 1998). For many Americans, the Medicaid program has become a de facto form of long-term-care insurance.

The National Academy on Aging (1997) estimated that 12.8 million Americans needed long-term care in 1997. The age breakdown of these estimates, however, shows that most persons who need long-term care are elderly, although a significant number of nonelderly are also in need:

1. Direct stratification of the 12.8-million estimate by age yields 420,000 children aged 0–17 years (3%); 5.09 million adults aged 18–64 years (40%); and 7.33 million adults aged 65+ years (57%).
2. Calculation of the fraction of the total population in each age group in need of long-term care, using U.S. Census Bureau population projections for 1995 (Day 1996) to estimate the at-risk population, yields prevalence rates of 0.6%, 3.2%, and 22%, respectively, for ages 0–17, 18–64, and 65+.

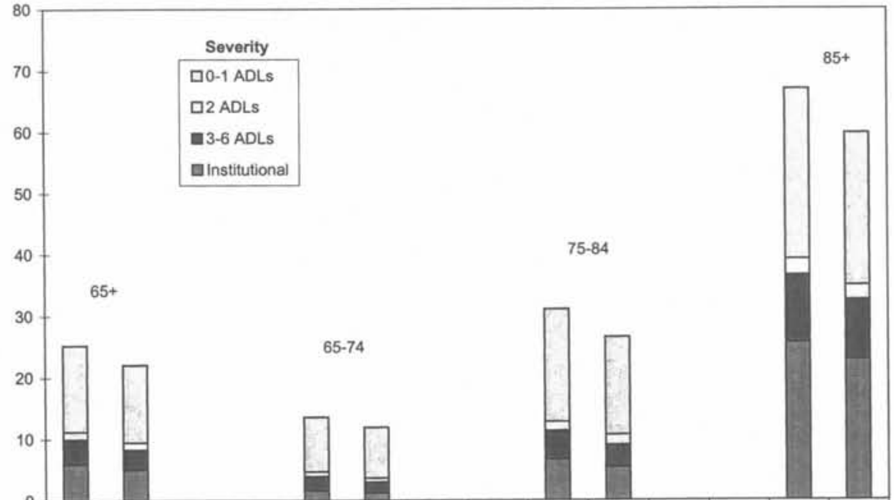
Thus, the elderly are at a risk level seven times larger than that of the working-age population. This is important for retirement planning because it implies that most of the disabled elderly were able-bodied during their working years. Thus, their disability and their need for long-term care represents a loss of functional capacity during their retirement years.

The elderly population's long-term-care needs increase dramatically with age, but the situation has been improving over time (Manton, Corder, and Stallard 1997a). This is shown in Figure 3, where the long-term-care prevalence rates for 1984 and 1994 are displayed by age and severity of disability. The rates are age- and sex-standardized to the 1995 U.S. population using tabulation methods described below. The figure shows the overall prevalence of long-term-care disability is composed of a relatively low rate for age 65–74 (12–14%), an intermediate rate for age 75–84 (27–31%), and a high rate for age 85+ (60–67%). The age increase is even steeper for very severe long-term-care disability (defined as institutional or 3+ ADLs), rising from about 3% at age 65–74 to over 32% at age 85+. The steepest age increase is for institutionalization, rising from under 2% at age 65–74 to over 22% at age 85+. In each case the 1994 rate is lower than the 1984 rate.

Data

The National Long-Term-Care Surveys (NLTCS) are a series of four related surveys conducted in 1982, 1984, 1989, and 1994; another edition of the survey is scheduled for 1999. The NLTCS was designed to examine health problems, functional limitations, disability, and use of long-term care among the elderly (age 65+) at multiple

FIGURE 3
LTC STATUS BY YEAR, AGE, AND SEVERITY



Year	1984	1994			1984	1994			1984	1994			1984	1994
0-1 ADLs	14.07	12.61			8.85	8.23			18.3	15.9			27.77	24.84
2 ADLs	1.22	1.16			0.76	0.63			1.53	1.65			2.62	2.34
3-6 ADLs	4.02	3.27			2.28	1.77			4.62	3.63			10.93	9.69
Institutional	5.92	4.98			1.61	1.2			6.57	5.32			25.53	22.79

Source: Data from the 1984 and 1994 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University; age- and sex-standardized to 1995 population estimates (Bell 1997).

points in time. Disability includes IADL and ADL limitations, institutionalization, and cognitive impairment.

The surveys employ a nationally representative longitudinal design with cross-sectional replenishment at age 65–69. This design enhances the overall usefulness of the surveys by permitting both longitudinal and cross-sectional analyses. Both types of analyses are presented in this paper. Cross-sectional analysis of the 1994 NLTCS is used to develop static-component projections of the acute and long-term-care needs of the U.S. elderly population throughout the period 1995–2080. Trends are introduced into these projections by consideration of the sequential cross-sectional analyses of the 1984 and 1994 NLTCS underlying the presentation in Figure 3. Longitudinal analysis is used to evaluate health state transitions between the 1984 and 1989 waves of the NLTCS, and to generate long-term-care incidence and continuance tables based on a Markov chain model.

Sampling Methods

For the 1982 NLTCS approximately 36,000 elderly Medicare enrollees aged 65 and over were selected for initial assessment and future follow-up. Approximately 6,000 were disabled in the community, and 2,000 were institutionalized. All participants were screened to assess their ability to perform nine IADLs and seven ADLs without help. Those disabled and living in the community were given detailed interviews to assess their functional state and the nature of care received. Those disabled and living in institutions (nursing homes or similar facilities with three or more beds that provide nursing care and personal care) were not interviewed in 1982, but they were interviewed in all subsequent surveys.

The 1984 NLTCS was actually the first edition to employ a longitudinal design with "cross-sectional replenishment." This means that the 1984 NLTCS is a longitudinal follow-up of the population sampled in 1982. However, because it was recognized that a pure longitudinal design would not sample persons who had turned age 65 in the interim and, hence, would not provide a complete nationally representative cross-sectional sample of all U.S. elderly aged 65 years and older, the design was modified to include such persons in an additional sample component, the "cross-sectional replenishment." This was accomplished by designating a sample of approximately 5,000 people aged 63–64 in 1982 as new entrants to the sample group. This group, together with a 45% subsample of the nondisabled sample in 1982, was screened to assess their ability to perform nine IADLs and seven ADLs without help. Those found to be disabled or institutionalized in 1984 and those disabled or institutionalized in 1982 were given detailed interviews to assess their functional state and the nature of care received. The sampling and interviewing techniques used in 1984 were similarly employed in 1989 and 1994.

An important design feature of the NLTCS is the relatively large sample size at age 85 and older, a population group that often is only sparsely represented in general population surveys. The NLTCS had over 2,400 people aged 85+ and over 825 people aged 90+ in each of the four surveys. In addition, the 1994 NLTCS had a supplementary sample of 538 people aged 95+, enhancing its suitability for cross-sectional rate estimation at the oldest old-ages.

Individual records in the NLTCS are linked to Medicare expenditure/reimbursement records maintained by the Health Care Financing Administration (HCFA). Currently, Medicare records have been linked to the NLTCS for the period 1982–95. The Medicare data for 1984 and later years contain information on DRGs (Diagnosis Related Groups) for hospital episodes, and also ICD-9-CMs (International Classification of Diseases-9th Revision-Clinical Modification) for hospital, SNF (Skilled Nursing Facility), and HHA (Home Health Agency) episodes. The linkage of the NLTCS data files to the Medicare data system also makes it possible to determine the fact of death, as well as the exact date of death, for NLTCS respondents who died in the period 1982–95.

The linked Medicare data will be updated to reflect the most recently available information during the sample case selection process for the 1999 NLTCS. At that time the NLTCS data will be linked to HCFA's "Denominator Files," which contain enrollment information for prepaid capitated plans. Currently, such information is unavailable, making it necessary to use ad hoc adjustments to the Medicare expenditure/reimbursement data to account for such enrollment.

Medicare cost estimates for calendar year 1995 were derived from tabulations of Medicare program payment records for the one-year period following the 1994 NLTCS. Long-term-care cost estimates for home and community-based care, as well as institutional care, were derived from expenditure data within the 1994 NLTCS. Because the NLTCS survey operations were conducted during August–October 1994, the long-term-care costs were adjusted upward 3.76% to reflect the medical care component of the CPI through mid-1995.

Classification Methods

The NLTCS classifies long-term-care recipients according to whether a person is resident in an institution or in a community setting. The latter are further classified according to the number of basic ADLs for which help is required or, if none, according to the number of more complex IADLs for which help is required. At least one of these activity-limitations must last or be expected to last 90 days or longer in order for the person to be classified as long-term-care disabled in the NLTCS screening interview. Once a community resident is classified as disabled in a screening interview, that person receives the NLTCS detailed interview during that survey and all future surveys. Institutional residents receive a modified version of the NLTCS detailed interview that assesses limitations on basic ADLs and cognitive impairment. Once a person is classified as an institutional resident, that person is scheduled for a detailed interview (community or institutional form, as appropriate) during all future surveys.

Seven basic ADLs are measured in the NLTCS: bathing, dressing, toileting, transferring, eating, continence, and inside mobility. Limitations in ADLs typically include both the use of special equipment and the assistance of another human being in performing designated activities.

Nine IADLs are measured in the NLTCS: light housework, laundry, cooking, grocery shopping, outside mobility, travel, money management, taking medications, and telephoning. Limitations in IADLs generally include only the assistance of another human being in performing designated activities. Two IADLs, outside mobility and telephoning, are based on extended definitions of limitations that include the use of special equipment. In all cases, IADL limitations must be due to a disability or health problem in order to be recognized by the NLTCS. The ADL questions in the NLTCS screening interview probe limitations in both inside and outside mobility, but the questions in the NLTCS detailed community interview treat outside mobility as an IADL, not as a basic ADL.

There are several subtle, but important, differences between the NLTCS definitions for ADL triggers and the definitions used in HIPAA. Tabulations from the NLTCS typically delete continence from the basic ADL list because continence is queried as part of the toileting items (see Manton et al. 1997a). Thus, there is no specific continence trigger in the NLTCS. HIPAA restores continence, but deletes inside mobility, in defining its ADL list; HIPAA also allows insurers to delete one of the remaining six ADLs. The NLTCS's ADL triggers count ADLs whose limitations can be resolved by the use of special equipment without the use of personal assistance; HIPAA excludes such cases.

The NLTCS tabulations in this paper use the HIPAA definitions for ADL Triggers. This is accomplished by separating the continence questions from the toileting questions, by moving inside mobility to the IADL list, and by separately recording those ADLs for which special equipment is used to resolve the respondent's limitations.

The questions in the NLTCS allow one to generate for each ADL a hierarchy of the level of ADL disability:

0. Performs the ADL independently
1. Needs help, but does not get help, with the ADL
2. Performs the ADL with special equipment
3. Gets standby help, no special equipment
4. Gets standby help, also uses special equipment
5. Gets active help, no special equipment
6. Gets active help, also uses special equipment
7. Unable to perform the ADL.

This hierarchy was applied to each of the six ADLs, generating a classification of ADL disability ranging from no deficiency to total inability to perform the ADL.

The definition here of cognitive impairment is based on the error score (CI score) on the Short Portable Mental Status Questionnaire (SPMSQ; Pfeiffer 1975). For those who took the ten-item test, scores of three or four errors were classified as "mild CI," and five or more errors as "moderate/severe CI." In addition, if the interviewer was unable to talk directly to the sampled person because the person had Alzheimer's disease or any other form of dementia, then that person was classified as having severe cognitive impairment (CI score = 100). This accounted for approximately 30% of persons classified as having any level of cognitive impairment in this sample, and approximately 45% of persons having moderate/severe CI.

Tabulation Rules

The NLTCS data were tabulated by age (five-year age groups: 65–69, 70–74, . . ., 95+), gender, and disability status. Disability status was tabulated with either five or six categories using the classification methods for the NLTCS described above.

The five-category tabulations were based on the following groups:

1. Nondisabled
2. Disabled with no ADL limitations
3. One ADL limitation
4. Two ADL limitations
5. Three or more ADL limitations.

Each NLTCS respondent was uniquely assigned to one of these five groups. Groups 2–5 collectively form the disabled subpopulation. Initial assignment to these groups was based on the respondent's satisfying any of the following criteria:

1. Institutionalization
2. Any ADL limitation classified in the range 1–7 on the ADL hierarchy defined above (that is, needs help, uses special equipment, gets help from another person, or unable to perform the activity), applied to the six HIPAA ADLs and inside mobility
3. Any IADL limitation satisfying the NLTCS IADL trigger
4. Any cognitive impairment (CI score indicating three or more errors on the SPMSQ).

Following this initial assignment, an assessment was made of the number of HIPAA ADLs with limitations classified in the range 3–7 (that is, gets help from another person, or unable to perform the activity) on the ADL hierarchy defined above. This count was then used to subclassify the disabled population into one of the four disabled groups (2–5). Persons who were not classified as disabled were assigned to group 1 (that is, nondisabled).

The six-category tabulations were based on the following groups:

1. Community nondisabled
2. Community disabled with no ADL limitations
3. Community resident with 1 ADL limitation
4. Community resident with 2 ADL limitations
5. Community resident with 3+ ADL limitations
6. Institutional resident.

Each NLTCS respondent was uniquely assigned to one of these six groups. Groups 2–6 collectively form the disabled subpopulation. Initial assignment to these groups was based on the respondent's satisfying the four criteria indicated above, the difference being that institutionalized persons were all classified into group 6. Thus, the disability levels represented by groups 2–5 are the same as in the five-category tabulations, but the groups include only disabled community residents.

Six-category tabulations were needed to deal with differences between the community and institutional interviews in the NLTCS. Significantly greater detail on health and functional limitations was provided by the community interview, and it was necessary to exclude institutionalized respondents in processing these measures. The six-category tabulations allowed this to be done.

Methods

Static Component Projections

The static component projection methodology is the simplest method for projecting detailed population characteristics. The method comprises two stages:

1. One must locate or construct a general population projection with sufficient detail to support the calculations in the second stage. This may involve stratification of the projected population by age and gender but also may involve additional stratification by marital status, education, income level, race and ethnic characteristics, or geographic region. Population projections of this type are routinely prepared by agencies of the federal government such as the U.S. Bureau of the Census (for example, Day 1996) or the Social Security Administration (for example, Bell 1997).
2. One must locate or develop estimates of the fractions of each subpopulation included in the first-stage projection that satisfy the criteria used to define the characteristics to be projected to future years. Typically, these estimates are made at the beginning of the population projection interval, and the fractions are assumed to be constant throughout the entire projection interval. Alternatively, trends can be estimated for the fractions, and those trends can be assumed to apply throughout part of or all of the projection interval.

Because the static component method introduces the detailed population characteristics at the second stage, there is no possibility that these characteristics can impact the population projections produced at the first stage. In other words the first-stage projections are assumed to be independent of the characteristics considered at the second stage. It is this independence assumption that accounts for the simplicity and widespread applicability of the method. Indeed, the independence assumption allows various federal agencies to generate population projections without consideration of the specific uses to which they will be put.

Although the independence assumption facilitates the generation of detailed population forecasts under the static component method, it is not clear that the independence assumption is always appropriate to use. For example, in its annual report to Congress the Board of Trustees of Social Security and Medicare uses population projections from its Social Security report as the starting point for its static component projections of Medicare income and expenditures. The Social Security population projections are based on specific assumptions about rates of decline in death rates for ten disease categories, but the Medicare projections take no explicit account of these assumptions—even though they strongly imply continuing improved health for all age groups served by Medicare. In this case it is clear that the methods used for projecting the size and health care costs of the U.S. elderly population are based on independent analyses of mortality and health care data.

One could argue that the simplicity of the static component projection method justifies its usage as a baseline method, even if the independence assumption is wrong or, more importantly, does not provide a reasonably good approximation. Alternatively, if one wished to evaluate the impact of health characteristics on population projections using more elaborate models that take account of various types of dependencies, then the static component projection would provide an appropriate basis for comparison.

In this application the first-stage population projection is the most recent Social Security area population projection available from the Social Security Administration (Bell 1997). This is based on a modification of the standard cohort-component projection method, with the modification introduced to ensure consistent estimates of marital status for men and women. The cohort component projection method is described by Day (1996) and involves a procedure in which a vector of age- and sex-structured population counts for a given year is updated for births, deaths, and net migration to produce a corresponding population vector for the following year. This procedure is repeated for each year in the projection interval, and the accumulated counts are recorded and made available to projection users.

Mathematically the update equation for the cohort component projection method can be represented as

$$L_{t+1} = L_t \cdot P_{t+1} + M_{t+1}, \qquad (1)$$

where L_t is a row vector of age- and sex-structured population counts for year t, P_{i+1} is the one-step projection matrix, M_{t+1} is a row vector of age- and sex-structured net migration counts for year t+1, and L_{t+1} is the updated population vector at year t+1. In this formulation migration is treated as an exogenous factor.

In this application the second stage takes the population vector L_t as given and multiplicatively applies the disability and health service utilization rates estimated from the NLTCS to the elements of that population vector for each year in the interval 1995–2080. As with other projections considered, this assumes that the size and composition of the future U.S. population is independent of their disability and health service utilization parameters. In fact, this is unlikely to be true, but the computation of these static component projections is nonetheless informative. The generation of more detailed population projections that take account of interactions between morbidity, mortality, and disability will be the subject of future reports.

Markov Chain Models

A Markov chain model is the simplest method for projecting population characteristics that accounts for interactions between morbidity, mortality, and disability. This does not mean that this type of model is simple, only that it is simpler than other alternatives. In fact, a fully specified Markov chain model, with time-varying transition rates, designed to yield detailed, accurate, and realistic population projections throughout the interval 1995–2080 would need to be significantly more complex than the Markov chain model considered here—especially if the model transition rates were stratified to reflect effects of marital status, education, income level, race and ethnic characteristics, or geographic region.

We consider a simple Markov chain model designed to generate HCB long-term-care incidence and continuance rates for the U.S. elderly population consistent with the benefit eligibility triggers established by HIPAA. Ideally, to accomplish this goal one would obtain counts of occurrences and exposures and use standard rate-estimation methods to compute the associated incidence and continuance tables. Unfortunately, with currently available data this approach is not feasible. The problem is that there is no nationally representative survey of this population that provides this information. The NLTCS, which targets this population, provides information on disability statuses at the time of each survey but does not record what happens to disability statuses in the time interval between the surveys.

One solution is to use a Markov chain model based on an underlying continuous-time discrete-state Markov process. This type of model employs a conditional (or local) independence assumption for the transition probabilities from each initial disability state (that is, the "states" of the Markov chain) to the disability states observed at the follow-up assessment. For many observation plans this may be unrealistic. Therefore, in specifying a Markov chain model it is important to define the disability states so that the local independence assumption is reasonably plausible.

Following the procedures described in the Society of Actuaries Long-Term-Care Experience Committee Report (Stallard and Yee 1999), we employ a Markov chain model to estimate a complete set of long-term-care disability state transitions between the 1984 and 1989 NLTCS. Further analyses of the corresponding disability state transitions between the 1989 and 1994 NLTCS, and between the 1994 and 1999 NLTCS, are planned. These analyses will establish temporal trends in the transition parameters as a basis for a fully specified set of population projections based on a time-varying Markov chain model.

Five disability states are defined for the model in this paper:

1. Active (1)
2. Mild disability (2–3)
3. HCB long-term care (4–5)
4. Institutional long-term care (6)
5. Dead.

The numbers in parentheses refer to the groups in the six-category tabulations defined in the Data section. The five states form a hierarchy from the lowest level of disability (that is, active or nondisabled) up to the highest levels of disability (that is, institutionalization, followed by death). The first three gradations of disability refer only to community residents. The incidence and continuance tables refer to the transitions into and persistence in the third disability state, HCB long-term care.

With a Markov chain model for a five-year observation interval, we can compute monthly transition rates using the 60th root of the five-year transition matrix. This assumes that monthly transition rates are constant over the five-year interval. More precisely, the transition rates are assumed to be constant over each set of five years of age, using attained age at the start of the five-year observation interval to define the sets of five-year age groups. These assumptions allow us to link data for age groups defined by five-year categories (for example, age 65–69) to the data for the same group five years later (for example, at age 70–74). In this case another matrix would link data for the group initially aged 70–74 to the data for the same group five years later at age 75–79. Similar matrices can be generated for successive five-year age groups up to age 100–104. In addition, because 65 is the youngest age represented in the NLTCS, a special matrix was defined for persons aged

65 that contained their observed transitions over the five-year follow-up interval. Each of these nine matrices can be processed independently to compute monthly transition rates.

A monthly transition matrix was calculated using the 60th root of each five-year transition matrix. The resulting rates were assumed to apply exactly to the single month centered at the midpoint (that is, exact ages 68, 70, 75, 80, 85, 90, 95, 100, and 105 years) of the age and time intervals used to define the transitions. Once the monthly matrices were obtained, linear extrapolations (for ages 65–68) or interpolations between the estimates were used to generate sets of monthly matrices for all months from age 65 to 104. Transition rates for months above age 104 were held constant at the age-104 values.

The fundamental relationship between the observed five-year transition probability matrix and the estimated one-month transition probability matrix is

$$ {}_{60}P_t = [{}_1P_{t+29.5}]^{60}, \tag{2} $$

which states that the five-year matrix is the 60th power of the one-month matrix centered at the midpoint (30th month) of the five-year period. We can solve this equation for the corresponding one-month matrix, using

$$ {}_1P_t = [{}_{60}P_{t-29.5}]^{1/60}. \tag{3} $$

One has to be careful, however, in using Equation 3, or Equation 5 below, because these equations require an iterative solution that is sometimes subject to numerical failure (Singer and Spilerman 1976).

The general process governing the Markov chain model is defined by

$$ l_{t+1} = l_t \cdot {}_1P_t, \tag{4} $$

where l_t is a row vector of initial state counts at the start of the one-month interval indexed by t. The transition hazard-rate matrix is related by a logarithmic transformation to the transition probability matrix. Hence,

$$ {}_1H_t = \ln({}_1P_t). \tag{5} $$

The natural logarithm in Equation 5 is evaluated using a matrix form of the standard Taylor series expansion. A similar application of the Taylor series expansion is used to define the matrix exponential transformation. Hence, the inverse transformation is

$$ {}_1P_t = \exp({}_1H_t). \tag{6} $$

The general solution to Equation 5 yields all 0-values in row 5 of the transition hazard-rate matrix ${}_1H_t$. Equation 4 is parameterized to represent a survival process by setting row 5 of the transition probability matrix ${}_1P_t$ to 0. In this case l_{t5} records the deaths in the interval $(t - 1, t)$.

The methods for generating incidence and continuance tables are similar. In each case the appropriate rows of the transition hazard-rate and probability matrices are set to zeroes and an appropriate multistate life table constructed (for details, see Stallard and Yee 1999).

Results

Static Component Projections

Disability Projections

The first stage of the static component projection method uses the intermediate alternative population projection for 1995–2080 prepared by the Social Security Administration for use by the Board of Trustees of Social Security and Medicare (Bell 1997). The projection for U.S. elderly men and women is summarized in Table 1.

In 1995 there were 34 million elderly Americans aged 65 years or older, composed of 20 million women and 14 million men. These numbers are projected to double over the 40-year period 1995–2035 and to rise at a slower pace thereafter. Male life expectancy at age 65 is projected to increase from 15.6 to 19.0 years, and female life expectancy from 19.0 to 22.5 years, over the projection interval. The Board of Trustees identified this as their preferred projection, making it appropriate for use as the baseline projection in our analyses.

Nonetheless, accepting the Board of Trustees' preferred projection as our baseline is not without risk. Based on the analyses of Lee and Carter (1992), Carter and Lee (1992), and Lee and Tuljapurkar (1994), it is more likely that this projection errs on the low side than on the high side, especially with respect to the number of elderly persons surviving in the more distant future. Lee and Carter (1992) argued that their projection methodology is more appropriate because it involves an unmodified extrapolation of age-specific death rates for the period 1933–87 (this period can be extended in updated applications), whereas the Board of Trustees employs ultimate rates of decline substantially lower than the historic trends. Lee and Carter (1992, Table 4) provided death rate projections for the period 1990–2065 for both sexes combined in which the death rate at age 65–69 declined at a rate of 1.05% per year; age 75–79 declined 1.18% per year; age 85–89 declined 0.96% per year; and

TABLE 1
SSA POPULATION PROJECTION, 1995–2080

Category	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2050	2060	2070	2080
Male 65–69	4,670	4,483	4,784	5,747	7,292	8,434	9,557	9,818	8,942	8,573	9,475	10,390	9,886	10,365
Male 70–74	3,949	3,992	3,861	4,149	5,006	6,370	7,385	8,392	8,644	7,900	7,695	8,885	8,937	9,080
Male 75–79	2,699	3,104	3,168	3,088	3,344	4,058	5,191	6,042	6,895	7,131	6,321	7,094	7,871	7,583
Male 80–84	1,601	1,842	2,136	2,199	2,160	2,365	2,899	3,743	4,387	5,042	4,858	4,855	5,717	5,852
Male 85–89	751	872	1,010	1,178	1,225	1,220	1,361	1,697	2,224	2,635	3,220	2,957	3,452	3,946
Male 90–94	246	292	341	396	466	497	507	581	743	996	1,423	1,451	1,543	1,909
Male 95+	60	69	81	94	111	135	153	164	195	256	451	623	646	816
Female 65–69	5,435	5,109	5,371	6,381	8,004	9,176	10,257	10,451	9,520	9,090	9,906	10,808	10,217	10,662
Female 70–74	5,019	4,967	4,677	4,919	5,843	7,334	8,417	9,422	9,615	8,779	8,401	9,614	9,604	9,690
Female 75–79	3,930	4,342	4,311	4,069	4,292	5,113	6,434	7,400	8,305	8,496	7,461	8,205	9,013	8,588
Female 80–84	2,885	3,098	3,448	3,441	3,263	3,466	4,155	5,257	6,071	6,843	6,471	6,292	7,286	7,360
Female 85–89	1,755	1,934	2,104	2,363	2,379	2,279	2,453	2,974	3,801	4,420	5,193	4,667	5,266	5,897
Female 90–94	767	884	992	1,089	1,241	1,272	1,242	1,367	1,691	2,200	2,984	2,940	2,991	3,588
Female 95+	255	293	342	387	434	511	555	572	646	815	1,351	1,787	1,805	2,157
Male	13,976	14,654	15,381	16,851	19,604	23,079	27,053	30,437	32,030	32,533	33,443	36,255	38,052	39,551
Female	20,046	20,627	21,245	22,649	25,456	29,151	33,513	37,443	39,649	40,643	41,767	44,313	46,182	47,942
Total	34,022	35,281	36,626	39,500	45,060	52,230	60,566	67,880	71,679	73,176	75,210	80,568	84,234	87,493

Source: Bell (1997).

TABLE 2
DISABILITY STATUS PROJECTIONS, 1995–2080

Category	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2050	2060	2070	2080
Constant Disability Rates														
Male	13,976	14,654	15,381	16,851	19,604	23,079	27,053	30,437	32,030	32,533	33,443	36,255	38,052	39,551
Female	20,046	20,627	21,245	22,649	25,456	29,151	33,513	37,443	39,649	40,643	41,767	44,313	46,182	47,942
Ages 65–74	19,073	18,551	18,693	21,196	26,145	31,314	35,616	38,083	36,721	34,342	35,477	39,697	38,644	39,797
Ages 75–84	11,115	12,386	13,063	12,797	13,059	15,002	18,679	22,442	25,658	27,512	25,111	26,446	29,887	29,383
Ages 85+	3,834	4,344	4,870	5,507	5,856	5,914	6,271	7,355	9,300	11,322	14,622	14,425	15,703	18,313
Nondisabled	26,533	27,224	28,049	30,347	35,087	41,109	47,822	53,200	55,163	55,165	55,578	60,085	62,254	63,833
No ADLs	3,488	3,710	3,905	4,151	4,559	5,157	5,974	6,862	7,579	8,057	8,437	8,813	9,449	9,964
1 ADL	995	1,068	1,135	1,204	1,301	1,450	1,668	1,931	2,176	2,365	2,543	2,647	2,853	3,052
2 ADLs	545	588	630	668	719	798	918	1,065	1,208	1,327	1,439	1,496	1,617	1,739
3+ ADLs	2,462	2,689	2,908	3,130	3,394	3,717	4,184	4,821	5,552	6,263	7,213	7,527	8,062	8,906
2+ ADLs	3,007	3,278	3,537	3,798	4,113	4,515	5,102	5,886	6,760	7,589	8,652	9,022	9,679	10,645
1+ ADLs	4,001	4,346	4,672	5,002	5,414	5,965	6,770	7,818	8,937	9,954	11,195	11,670	12,531	13,696
0+ ADLs	7,489	8,057	8,577	9,153	9,973	11,121	12,744	14,680	16,516	18,011	19,632	20,483	21,980	23,660
Total	34,022	35,281	36,626	39,500	45,060	52,230	60,566	67,880	71,679	73,176	75,210	80,568	84,234	87,493
Declining Disability Rates (0.6% per year)														
Male	13,976	14,654	15,381	16,851	19,604	23,079	27,053	30,437	32,030	32,533	33,443	36,255	38,052	39,551
Female	20,046	20,627	21,245	22,649	25,456	29,151	33,513	37,443	39,649	40,643	41,767	44,313	46,182	47,942
Ages 65–74	19,073	18,551	18,693	21,196	26,145	31,314	35,616	38,083	36,721	34,342	35,477	39,697	38,644	39,797
Ages 75–84	11,115	12,386	13,063	12,797	13,059	15,002	18,679	22,442	25,658	27,512	25,111	26,446	29,887	29,383
Ages 85+	3,834	4,344	4,870	5,507	5,856	5,914	6,271	7,355	9,300	11,322	14,622	14,425	15,703	18,313
Nondisabled	26,533	27,463	28,550	31,137	36,218	42,662	49,927	55,989	58,697	59,438	61,110	66,716	70,238	73,307
No ADLs	3,488	3,600	3,677	3,793	4,042	4,437	4,987	5,559	5,958	6,145	6,060	5,960	6,017	5,974
1 ADL	995	1,037	1,069	1,100	1,153	1,247	1,393	1,565	1,711	1,804	1,826	1,790	1,816	1,830
2 ADLs	545	571	593	611	638	686	766	863	949	1,012	1,034	1,012	1,030	1,043
3+ ADLs	2,462	2,610	2,738	2,860	3,009	3,198	3,493	3,905	4,365	4,777	5,180	5,090	5,133	5,340
2+ ADLs	3,007	3,181	3,330	3,470	3,647	3,884	4,259	4,768	5,314	5,789	6,214	6,102	6,163	6,382
1+ ADLs	4,001	4,217	4,399	4,571	4,800	5,131	5,652	6,333	7,025	7,593	8,040	7,892	7,980	8,212
0+ ADLs	7,489	7,818	8,076	8,363	8,842	9,568	10,639	11,892	12,982	13,738	14,100	13,852	13,996	14,186
Total	34,022	35,281	36,626	39,500	45,060	52,230	60,566	67,880	71,679	73,176	75,210	80,568	84,234	87,493
Declining Disability Rates (Age-Specific Declines)														
Male	13,976	14,654	15,381	16,851	19,604	23,079	27,053	30,437	32,030	32,533	33,443	36,255	38,052	39,551
Female	20,046	20,627	21,245	22,649	25,456	29,151	33,513	37,443	39,649	40,643	41,767	44,313	46,182	47,942
Ages 65–74	19,073	18,551	18,693	21,196	26,145	31,314	35,616	38,083	36,721	34,342	35,477	39,697	38,644	39,797
Ages 75–84	11,115	12,386	13,063	12,797	13,059	15,002	18,679	22,442	25,658	27,512	25,111	26,446	29,887	29,383
Ages 85+	3,834	4,344	4,870	5,507	5,856	5,914	6,271	7,355	9,300	11,322	14,622	14,425	15,703	18,313
Nondisabled	26,533	27,594	28,812	31,539	36,792	43,452	50,987	57,340	60,296	61,227	63,155	69,059	72,898	76,189
No ADLs	3,488	3,533	3,544	3,588	3,746	4,026	4,435	4,860	5,143	5,248	5,047	4,787	4,697	4,556
1 ADL	995	1,019	1,034	1,047	1,078	1,144	1,254	1,386	1,499	1,566	1,557	1,482	1,465	1,451
2 ADLs	545	562	574	582	598	631	692	768	835	883	887	844	838	835
3+ ADLs	2,462	2,572	2,662	2,744	2,846	2,977	3,198	3,526	3,905	4,251	4,564	4,395	4,336	4,462
2+ ADLs	3,007	3,134	3,236	3,326	3,443	3,608	3,890	4,293	4,741	5,134	5,451	5,239	5,174	5,297
1+ ADLs	4,001	4,153	4,270	4,373	4,522	4,752	5,143	5,680	6,239	6,700	7,008	6,722	6,640	6,748
0+ ADLs	7,489	7,687	7,814	7,961	8,268	8,778	9,579	10,540	11,383	11,949	12,055	11,509	11,336	11,304
Total	34,022	35,281	36,626	39,500	45,060	52,230	60,566	67,880	71,679	73,176	75,210	80,568	84,234	87,493

Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

age 95–99 declined 0.59% per year. There was some uncertainty about the accuracy of these results above age 85 because the source data grouped all deaths occurring at age 85+ into a single open-ended age-group. The results below age 85, however, can be compared with the ultimate rates of decline at age 65–84 for projections beyond the year 2020 assumed by the Board of Trustees: 0.53% per year for males, 0.50% per year for females (Goss, Wade, and Bell 1998, Table 6). At age 85+ the assumed declines are 0.57% per year for males and 0.63 % per year for females. The assumed overall declines for age 65+ are 0.54% per year for males and 0.55% per year for females.

Because small differences in rates of decline of mortality rates can lead to large differences in projections of the elderly population, the Society of Actuaries undertook a three-phase research project on mortality improvements in Canada, Mexico, and the United States. The second phase of this project included a one-day seminar attended by 79 experts representing different countries, including actuaries, demographers, economists, and medical researchers. These experts were asked to provide numerical values of their best guess for the ultimate annual rate of mortality decline, as well as upper and lower 95% confidence intervals for these values. Of the 41 experts responding, the median best guess for both males and females at age 65+ was a decline of 0.60% per year; the median lower confidence limit was 0.30% per year; and the median upper confidence limit was 1.00% per year (Rosenberg and Luckner 1998, Table 5). One conclusion that can be reached from this analysis is that the Board of Trustees' intermediate assumptions are reasonably close to the consensus of the expert group gathered by the Society of Actuaries. However, there is substantial uncertainty in projecting rates of mortality reduction over the next 75 years, and there is an emerging consensus over the need to develop stochastic models to represent this and other sources of uncertainty in population projections.

The second stage of the static component projection method applies disability prevalence rates estimated from the 1994 NLTCS to the population projection developed in the first stage. These calculations are presented in Table 2 for the five-category disability statuses based on HIPAA's ADL Trigger.

Table 2 employs three sets of trend assumptions in generating the projections:

1. Constant disability rates
2. Declining disability rates with the decline set at 0.6% per year
3. Declining disability rates with age-specific declines of 0.6% per year at age 95+, linearly increasing for younger ages, with a decline of 1.2% per year at age 65–69.

Assumption 1 employs a set of constant disability rates that are multiplicatively applied to the age- and sex-specific population counts projected in Table 1. To gain insight into the impact of constant disability rates, it is useful to consider alternative scenarios and the evidence supporting them.

Assumption 2 reflects the effects of expected continued reductions in age-specific disability prevalence rates among the elderly in future years (Manton et al. 1997a; Freedman and Martin 1998). A decline of 0.6% per year is less than half the rate of the overall disability decline at age 65+ observed in the NLTCS for the period 1984–94 (1.35% per year; Figure 3, comparable to the 1.29% decline estimated for 1982–94 by Manton et al. 1997a). However, it is consistent with the decline at age 65+ of 0.8% per year observed in the NLTCS for the period 1984–89, and it is just below the 0.7% per year decline implied by Crimmins, Saito, and Reynolds's (1997) analysis of the 1982–93 National Health Interview Survey. The 0.6% per year decline is exactly equal to the decline for chronic health conditions calculated by Fogel and Costa (1997, p. 62) for age 65+ for the period 1910–88.

Assumption 3 reflects the effects of larger continued reductions in age-specific disability prevalence rates at the younger parts of the elderly age range. This is more consistent with the age-specific patterns seen in Figure 3, patterns that yield age-specific declines of 1.31% per year at age 65–74; 1.56% per year at age 75–84; and 1.13% per year at age 85+. The decline rate at age 65–74 is actually smaller than at age 75–84, and this is handled in Assumption 3 by setting the maximum decline rate at 1.2% per year at age 65–69. The level and pattern of these decline rates are reasonably close to the mortality decline rates estimated by Lee and Carter (1992) for the period 1933–87. They are also consistent with the age-specific mortality decline rates observed for the period 1968–94 (combining results for both sexes from Bell 1997, Table 6).

To the extent that disability and mortality are linked phenomena, an optimal strategy would be to project them jointly using a dynamic model in which health, disability, and mortality were simultaneously represented as linked processes. Lacking such a model, we rely on available historical data to support the assumption that mortality and disability rates tend to have similar patterns of decline. Robine, Romieu, and Lee (1998) studied secular changes in life expectancy and disability-free or handicap-free life expectancy in six OECD countries (U.S., Japan, U.K., Australia, France, and Canada) over the period 1970–93. They concluded that increases in life expectancy were not accompanied by increases in the time lived with severe disability (p. 21). Furthermore they found positive associations between life expectancy and disability-free life expectancy. The associations were strongest for severe disability, allowing the possibility of increases over the period 1970–93 in life-years spent with light or moderate disability (p. 18). The OECD results for severe disability are most relevant to our analysis of LTC needs and expenditures, and they confirm the results from the NLTCS in Figure 3. The results for light or moderate disability are less consistent with the NLTCS, but this may be because of differences in the national surveys in terms of protocol, questionnaire, or question formulation that make international comparisons more difficult and less reliable (Robine et al. 1998, p. 20). In view of this one can argue that it is reasonable to set the disability decline rates for the baseline model close to the mortality decline rates assumed by the Board of Trustees in generating their intermediate projection. This suggests that Assumption 2 is the best assumption to pair with the trustees' projection.

Assumption 1 represents the worst-case scenario in which mortality improvements in the future occur independently of disability improvements. Assumption 1 implies that the total number of disabled persons (0+ ADLs) would double by 2035 and would more than triple over the total projection interval. This increase is projected to occur for both men and women and for all levels of disability.

Assumption 2 implies that the total number of disabled persons would increase 73.3% by 2035 and 89.4%

TABLE 3
ESTIMATED MEDICARE EXPENDITURES AND EXPENDITURE RATES, 1995

	Expenditures ($ million)								
Category	**Population**	**Parts A + B**	**Part A**	**Inpatient**	**SNF**	**HHA**	**Part B**	**Outpatient**	**Physician**
Male	$13,976	$60,132	$38,908	$31,374	$2,466	$4,193	$21,224	$5,678	$15,539
Female	20,046	80,329	54,047	37,891	4,988	10,285	26,282	7,372	18,888
Ages 65–74	19,073	63,020	38,323	32,043	1,681	4,088	24,697	6,974	17,719
Ages 75–84	11,115	53,355	36,183	26,263	3,157	6,026	17,172	4,585	12,566
Ages 85+	3,834	24,086	18,448	10,960	2,615	4,365	5,638	1,491	4,142
Nondisabled	26,533	82,748	49,536	42,881	1,997	3,939	33,211	8,767	24,444
No ADLs	3,488	18,277	12,593	9,126	1,102	2,087	5,684	1,634	4,043
1 ADL	995	8,993	7,086	4,277	826	1,842	1,907	480	1,422
2 ADLs	545	4,766	3,718	2,032	419	1,174	1,048	279	769
3+ ADLs	2,462	25,678	20,021	10,950	3,109	5,437	5,657	1,890	3,748
2+ ADLs	3,007	30,444	23,739	12,982	3,528	6,611	6,705	2,169	4,517
1+ ADLs	4,001	39,437	30,825	17,259	4,354	8,453	8,612	2,649	5,939
0+ ADLs	7,489	57,713	43,418	26,384	5,457	10,539	14,295	4,283	9,982
Total	34,022	140,461	92,955	69,265	7,454	14,479	47,507	13,051	34,426
	Expenditure Rates (Dollars)								
Male		$4,303	$2,784	$2,245	$176	$300	$1,519	$406	$1,112
Female		4,007	2,696	1,890	249	513	1,311	368	942
Ages 65–74		3,304	2,009	1,680	88	214	1,295	366	929
Ages 75–84		4,800	3,255	2,363	284	542	1,545	413	1,131
Ages 85+		6,282	4,812	2,859	682	1,138	1,470	389	1,080
Nondisabled		3,119	1,867	1,616	75	149	1,252	330	921
No ADLs		5,240	3,611	2,617	316	598	1,630	469	1,159
1 ADL		9,042	7,125	4,300	831	1,852	1,917	483	1,430
2 ADLs		8,752	6,828	3,732	769	2,155	1,924	513	1,412
3+ ADLs		10,428	8,131	4,447	1,263	2,208	2,297	767	1,522
2+ ADLs		10,125	7,895	4,317	1,173	2,199	2,230	721	1,502
1+ ADLs		9,856	7,704	4,313	1,088	2,112	2,152	662	1,484
0+ ADLs		7,706	5,797	3,523	729	1,407	1,909	572	1,333
Total		4,129	2,732	2,036	219	426	1,396	384	1,012

Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

TABLE 4
DETAILED ESTIMATES OF MEDICARE EXPENDITURE RATES, 1995

Age	Disability Status	Population (000's)	Parts A + B	Part A	Inpatient	SNF	HHA	Part B	Out-patient	Physician
					Male					
65–74	Nondisabled	7,772	$2,991	$1,708	$1,592	$30	$73	$1,283	$347	$936
	No ADLs	506	4,508	2,903	2,334	84	347	1,605	512	1,093
	1 ADL	85	10,701	8,808	8,166	0	642	1,893	390	1,502
	2 ADLs	49	8,427	6,355	4,349	763	1,243	2,072	706	1,366
	3+ ADLs	207	10,901	8,285	5,214	832	2,162	2,616	896	1,720
75–84	Nondisabled	3,357	4,718	3,033	2,645	151	178	1,684	403	1,282
	No ADLs	469	6,044	3,881	2,962	200	520	2,163	651	1,513
	1 ADL	116	9,851	7,190	4,687	888	1,149	2,662	826	1,836
	2 ADLs	66	11,723	9,685	4,224	1,812	3,633	2,038	360	1,678
	3+ ADLs	292	12,786	9,953	5,231	1,925	2,213	2,834	1,035	1,774
85+	Nondisabled	580	4,888	3,466	2,448	341	528	1,422	282	1,141
	No ADLs	184	5,633	4,017	2,756	577	435	1,616	410	1,207
	1 ADL	51	9,057	7,287	4,093	969	2,210	1,770	361	1,409
	2 ADLs	40	11,418	9,023	6,665	1,011	1,164	2,395	334	2,061
	3+ ADLs	202	9,442	7,520	4,009	999	2,394	1,922	585	1,337
					Female					
65–74	Nondisabled	9,044	2,499	1,398	1,228	29	123	1,101	305	796
	No ADLs	800	5,295	3,455	2,749	208	455	1,840	593	1,243
	1 ADL	204	8,314	6,091	3,677	1,033	1,297	2,223	586	1,637
	2 ADLs	87	11,308	8,646	5,263	429	1,999	2,662	906	1,756
	3+ ADLs	320	13,737	10,621	6,212	1,629	2,712	3,117	1,036	2,079
75–84	Nondisabled	4,814	3,018	1,837	1,509	110	192	1,181	311	870
	No ADLs	968	4,999	3,578	2,534	341	674	1,421	336	1,083
	1 ADL	303	8,395	6,763	3,676	713	2,215	1,632	448	1,184
	2 ADLs	179	7,974	6,310	2,839	708	2,763	1,664	373	1,291
	3+ ADLs	551	10,342	7,840	4,190	1,035	2,586	2,502	872	1,610
85+	Nondisabled	967	3,830	2,672	1,905	278	448	1,159	306	852
	No ADLs	561	5,438	4,169	2,491	650	1,019	1,269	348	921
	1 ADL	236	9,501	7,808	4,095	1,050	2,572	1,693	329	1,344
	2 ADLs	124	5,744	4,234	2,478	461	1,280	1,509	502	1,007
	3+ ADLs	890	8,633	6,922	3,636	1,216	1,760	1,711	530	1,181
Total		34,022	4,129	2,732	2,036	219	426	1,396	384	1,012

Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

by 2080. The 2080 total under Assumption 2 is only 60.0% of the Assumption 1 value.

Assumption 3 represents disability-decline rates that are somewhat faster than the paired mortality decline rates assumed by the Trustees. By 2035 the disability projections under Assumption 3 are about 12% lower than under Assumption 2. However, because Assumption 2 is more consistent with the assumed mortality decline, we will continue our analysis using Assumption 2.

To determine the burden of long-term care on society, it is necessary to project the growth of severe disability among the elderly because the severely disabled account for most of the care (see Table 13). These results are shown in Table 2 under the category 2+ ADLs, where it can be seen that the 1995 prevalence rate is about 3.0 million persons. Under Assumption 2, this is projected to increase to 5.3 million by 2035, and to 6.4 million by 2080.

Medicare Expenditures

Table 3 displays estimated Medicare expenditures and per capita expenditure rates for 1995. Table 4 provides detailed breakdowns of the expenditure rates by age and gender. These estimates represent only Medicare program payments and do not include beneficiary co-payments. The estimates are based on Medicare payments made in the one-year period following the 1994 NLTCS. The total

TABLE 5
MEDICARE COST PROJECTIONS ($MILLION, 1995 CONSTANT DOLLARS) 1995–2080, ASSUMING DECLINING DISABILITY RATES (0.6% PER YEAR)

Category	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2050	2060	2070	2080
Parts A and B														
Male	$60,132	$64,231	$67,666	$72,737	$82,345	$95,978	$112,922	$128,890	$139,342	$144,500	$147,986	$158,546	$168,656	$175,567
Female	80,329	83,210	85,793	90,380	99,046	111,026	126,221	141,439	152,329	158,813	164,856	171,432	178,193	185,391
65–74	63,020	61,137	61,018	68,495	83,898	100,467	113,901	121,839	117,651	109,336	111,406	124,030	120,212	122,787
75–84	53,355	59,236	62,322	60,845	61,728	70,475	87,286	104,530	119,023	127,237	115,132	120,047	134,597	131,341
85+	24,086	27,068	30,120	33,776	35,765	36,062	37,956	43,960	54,998	66,740	86,304	85,901	92,041	106,830
Nondisabled	82,748	87,121	91,123	98,557	113,129	133,132	156,888	178,343	191,160	196,944	203,948	223,123	238,735	251,510
No ADLs	18,277	18,916	19,379	20,002	21,259	23,264	26,154	29,200	31,415	32,563	32,212	31,616	31,993	31,824
1 ADL	8,993	9,414	9,643	9,878	10,338	11,228	12,546	14,171	15,609	16,410	16,531	16,199	16,468	16,577
2 ADLs	4,767	4,976	5,175	5,349	5,618	6,095	6,861	7,713	8,394	8,852	8,919	8,769	8,948	8,979
3+ ADLs	25,678	27,014	28,140	29,331	31,047	33,285	36,693	40,901	45,094	48,543	51,232	50,271	50,706	52,069
2+ ADLs	30,444	31,990	33,314	34,681	36,665	39,380	43,555	48,614	53,488	57,396	60,151	59,040	59,654	61,047
1+ ADLs	39,437	41,404	42,957	44,558	47,003	50,608	56,101	62,786	69,097	73,806	76,683	75,238	76,122	77,625
0+ ADLs	57,713	60,320	62,336	64,560	68,262	73,872	82,255	91,985	100,512	106,369	108,894	106,855	108,114	109,449
Total	140,461	147,441	153,459	163,117	181,390	207,004	239,143	270,329	291,672	303,313	312,842	329,978	346,850	360,959
SNF														
Male	2,466	2,732	2,917	3,060	3,305	3,736	4,386	5,105	5,830	6,378	6,799	7,166	7,738	8,291
Female	4,988	5,251	5,487	5,744	6,048	6,451	7,132	8,059	9,036	9,848	10,608	10,530	10,941	11,543
65–74	1,681	1,604	1,567	1,722	2,071	2,447	2,732	2,886	2,757	2,522	2,482	2,692	2,544	2,527
75–84	3,157	3,464	3,622	3,507	3,509	3,952	4,839	5,758	6,502	6,910	6,158	6,278	6,932	6,668
85+	2,615	2,915	3,216	3,575	3,773	3,789	3,948	4,520	5,606	6,794	8,767	8,726	9,203	10,639
Nondisabled	1,997	2,216	2,404	2,581	2,836	3,242	3,838	4,539	5,249	5,851	6,545	7,118	7,935	8,828
No ADLs	1,102	1,167	1,216	1,257	1,298	1,370	1,506	1,713	1,939	2,112	2,223	2,132	2,181	2,246
1 ADL	826	873	887	904	949	1,029	1,141	1,283	1,431	1,517	1,550	1,514	1,533	1,554
2 ADLs	419	447	466	471	476	513	589	690	777	823	789	754	795	782
3+ ADLs	3,109	3,281	3,431	3,591	3,795	4,035	4,444	4,940	5,470	5,923	6,300	6,178	6,235	6,424
2+ ADLs	3,528	3,728	3,897	4,062	4,271	4,548	5,033	5,630	6,247	6,747	7,089	6,931	7,030	7,206
1+ ADLs	4,354	4,601	4,785	4,966	5,220	5,576	6,174	6,912	7,677	8,263	8,639	8,445	8,563	8,760
0+ ADLs	5,457	5,768	6,000	6,223	6,518	6,946	7,680	8,625	9,616	10,375	10,862	10,578	10,745	11,006
Total	7,454	7,983	8,404	8,804	9,354	10,188	11,518	13,164	14,865	16,226	17,407	17,696	18,680	19,834
HHA														
Male	4,193	4,563	4,862	5,169	5,637	6,347	7,348	8,491	9,543	10,311	10,984	11,389	12,170	12,959
Female	10,285	10,781	11,190	11,627	12,313	13,375	14,959	16,844	18,613	19,991	21,233	21,538	22,287	23,380
65–74	4,088	3,923	3,840	4,229	5,103	6,068	6,807	7,231	6,948	6,377	6,319	6,912	6,586	6,592
75–84	6,026	6,548	6,824	6,573	6,511	7,262	8,832	10,492	11,795	12,515	11,093	11,165	12,255	11,716
85+	4,365	4,873	5,388	5,995	6,336	6,392	6,669	7,612	9,413	11,411	14,805	14,850	15,616	18,031
Nondisabled	3,939	4,243	4,545	4,950	5,595	6,461	7,556	8,718	9,729	10,567	11,831	12,968	14,157	15,686
No ADLs	2,087	2,178	2,252	2,322	2,411	2,570	2,868	3,242	3,567	3,775	3,778	3,617	3,700	3,707
1 ADL	1,841	1,942	2,016	2,069	2,113	2,224	2,470	2,820	3,180	3,426	3,511	3,358	3,458	3,515
2 ADLs	1,174	1,237	1,272	1,273	1,308	1,426	1,634	1,866	2,051	2,154	2,050	1,998	2,064	2,019
3+ ADLs	5,437	5,745	5,967	6,182	6,522	7,041	7,779	8,689	9,629	10,380	11,046	10,985	11,077	11,411
2+ ADLs	6,611	6,982	7,239	7,456	7,830	8,468	9,413	10,555	11,680	12,534	13,096	12,983	13,141	13,431
1+ ADLs	8,453	8,923	9,255	9,525	9,943	10,691	11,883	13,375	14,860	15,960	16,607	16,341	16,599	16,945
0+ ADLs	10,539	11,101	11,507	11,847	12,354	13,261	14,751	16,617	18,428	19,735	20,385	19,959	20,300	20,653
Total	14,479	15,344	16,052	16,797	17,950	19,722	22,307	25,335	28,157	30,302	32,216	32,927	34,457	36,339

Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

of $140.5 billion compares favorably with HCFA's (1997, Table 16) reported Medicare payments for aged beneficiaries of $138.0 billion for calendar year 1995. The difference (1.8%) is attributable to our use of SSA-level population counts (34.022 million aged 65+) versus HCFA's use of actual Medicare enrollment counts (33.157 million aged 65+; 97.5% of SSA level). Thus, the values in Table 3 are estimates of the health care costs of all U.S. elderly, not just the 97.5% enrolled in Medicare. The differences are small, and the per capita expenditure rates are unaffected.

Together Tables 3 and 4 demonstrate that disabled persons have much higher than average Medicare expenditure rates. Examination of the detailed service costs reveals that skilled nursing facility (SNF) and home health care (HHA) are significantly increased by the presence of ADL disability, confirming the results of Welch, Wennberg, and Welch (1996). Interestingly, Table 4 shows that the highest expenditures for the most severely disabled persons (that is, females with 3+ ADLs) are at age 65–74, not at age 85+ as one might have anticipated from the marginal rates in Table 3.

Table 5 displays the static component projection of total Medicare costs and the component costs for SNF and HHA in constant 1995 dollars. The changes in costs over the projection interval reflect the impact of the aging of the U.S. elderly population, the increase in life expectancy at age 65, and the assumed decline in age-specific disability rates. This projection does not reflect the effects of general inflation or medical inflation, nor does it reflect the continued pressure for expansion of program eligibility for services such as SNF and HHA. In 1995 the total Medicare expenditures for the elderly are estimated to be $140 billion, and these are projected to increase to $292 billion in 2035, and $361 billion in 2080. Thus, this simple projection scenario indicates that Medicare costs could more than double in the next 40 years, assuming the program cost structure was held fixed.

Although the total Medicare cost projection is an estimate only of the combined effect of demographic and disability changes in the elderly population, the relative cost increase of 97.8% for 2000–2035 in Table 5 is almost identical to the 97.3% increase in Medicare costs 2000–2035 as a share of GDP projected in 1999 by the Board of Trustees of Medicare (1999, p. 76). This latter increase contrasts with the 149.8% increase projected in 1997 by the Board of Trustees (1997, p. 70), a difference of 52.5%. The 1999 projection reflects the impact of a range of cost containment procedures in the Balanced Budget Act of 1997 designed to forestall insolvency of the Medicare program. The growth rates in the Trustees' 1999 projection through years prior to 2035 are somewhat larger than in Table 5, while the growth rates through years after 2035 are somewhat smaller (for example, for 2000–2070: 117.2 vs. 135.2%). To the extent that the static component projection approximates a lower bound to expenditure growth, the results in Table 5 suggest that it will be difficult to achieve additional savings comparable to those implemented in the Balanced Budget Act of 1997.

An additional limitation of the static component methodology is the inability to model the effects of cost shifting within the Medicare program. For example, if the 90.7% growth in home health care 1990–95 seen in Figure 1 is the result of more efficient and appropriate health care delivery (for example, subacute care following or in place of hospitalization), then there may be continued growth in the HHA component of Medicare, but not in the total Medicare program. Thus, the HHA projections in Table 5 reflect not just the current Medicare cost structure but also the current structure of the health care delivery system. More accurate projections depend on specification of the dynamics of this process and are beyond the scope of this paper.

Disability Rates

Table 6 provides detailed estimates of the 1995 population distribution of the seven individual ADLs assessed in the NLTCS. The order of the six HIPAA ADLs follows the hierarchy proposed by Katz and Akpom (1976). Except for transferring, the prevalences generally reflect this hierarchy. Among persons with exactly one ADL limitation, bathing is the cause in 76% of the cases. Among those with exactly two ADL limitations, bathing is a cause in 90% of the cases, followed by dressing in 39%.

The detailed information on ADL prevalences can be used to assess the impact of dropping any one of the six ADLs from the HIPAA list. For example, Table 6 indicates that there are 3.0 million persons with two or more ADL limitations and that 545 thousand persons have exactly two ADL limitations, based on the six ADL list used in HIPAA. Thus, the maximum impact of dropping any single ADL must be less than 545,000 persons. The two ADL distribution is given in Table 6 and corresponds to reductions of 490, 214, 101, 175, 55, and 28 thousand persons, respectively, for each of the six ADLs. Expressed as a percentage of the overall 2+ ADL count of 3.0 million persons, these reductions are equal to 16.3%, 7.1%, 3.4%, 5.8%, 1.8%, and 0.9%, respectively.

Table 6
Estimated Prevalences of ADL Limitations, 1995

Category		Population (000's)	Bathing	Dressing	Toileting	Transferring	Continence	Eating	Inside Mobility
Male									
65–74	Nondisabled	7,772	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	No ADLs	506	0.00	0.00	0.00	0.00	0.00	0.00	1.67
	1 ADL	85	59.05	12.47	3.28	20.35	4.87	0.00	22.01
	2 ADLs	49	79.79	59.34	22.48	17.86	0.00	20.51	34.13
	3+ ADLs	207	88.42	77.98	65.49	88.45	50.71	46.20	82.21
75–84	Nondisabled	3,357	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	No ADLs	469	0.00	0.00	0.00	0.00	0.00	0.00	1.69
	1 ADL	116	64.73	8.61	4.78	9.94	10.07	1.87	23.60
	2 ADLs	66	98.94	26.26	20.37	37.76	12.15	3.30	36.86
	3+ ADLs	292	91.16	81.56	70.22	83.06	65.49	52.44	76.90
85+	Nondisabled	580	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	No ADLs	184	0.00	0.00	0.00	0.00	0.00	0.00	7.58
	1 ADL	51	70.07	6.64	0.00	13.88	9.41	0.00	34.88
	2 ADLs	40	83.38	42.95	19.96	26.36	18.57	0.00	29.26
	3+ ADLs	202	89.93	75.28	72.08	83.81	65.83	54.30	82.85
Female									
65–74	Nondisabled	9,044	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	No ADLs	800	0.00	0.00	0.00	0.00	0.00	0.00	1.48
	1 ADL	204	70.39	8.30	7.84	9.68	2.59	1.20	12.35
	2 ADLs	87	88.35	47.61	14.92	40.63	8.49	0.00	56.13
	3+ ADLs	320	88.64	82.73	76.11	87.69	50.43	49.30	79.80
75–84	Nondisabled	4,814	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	No ADLs	968	0.00	0.00	0.00	0.00	0.00	0.00	3.59
	1 ADL	303	79.62	4.12	2.16	8.98	2.91	1.69	15.51
	2 ADLs	179	95.00	38.29	21.75	29.88	11.17	2.06	46.76
	3+ ADLs	551	91.69	80.31	73.32	88.20	62.14	58.01	83.86
85+	Nondisabled	967	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	No ADLs	561	0.00	0.00	0.00	0.00	0.00	0.00	4.98
	1 ADL	236	90.60	0.00	1.70	5.58	1.15	0.00	25.19
	2 ADLs	124	85.18	32.48	13.55	33.79	9.76	9.63	47.91
	3+ ADLs	890	89.16	79.63	70.66	88.52	64.90	55.05	85.74
Both Sexes									
65+	Nondisabled	26,533	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	No ADLs	3,488	0.00	0.00	0.00	0.00	0.00	0.00	3.01
	1 ADL	995	76.34	5.37	3.51	9.66	3.76	0.98	19.65
	2 ADLs	545	89.97	39.23	18.56	32.10	10.09	5.10	44.88
	3+ ADLs	2,462	89.92	79.92	71.59	87.30	61.35	53.85	82.97
	0–1 ADL	4,482	16.94	1.19	0.78	2.14	0.83	0.22	6.70
	2+ ADLs	3,007	89.93	72.55	61.99	77.30	52.07	45.02	76.07
Total		34,022	10.18	6.57	5.58	7.11	4.71	4.01	7.61

Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

Clearly, bathing has the largest impact, reducing the number that satisfy the HIPAA 2+ ADL Trigger from 3.0 to 2.5 million persons aged 65+.

Table 7 provides detailed estimates of the distribution of community and institutional residents by age, disability (five-category definition), and gender. Overall the number of persons with two or more ADL limitations is split almost evenly between community and institutional residence (50.1% vs. 49.9%). In contrast, only 4.3% of persons with 0–1 ADL limitations are institutionalized, but this accounts for 11.4% of the institutionalized population.

TABLE 7
ESTIMATES OF COMMUNITY AND INSTITUTIONAL RESIDENTS, AND INSTITUTIONAL PAYMENTS, 1995

Category		Population (000's) Total	Population (000's) Community	Population (000's) Institutional	Percentage Community	Percentage Institutional	Institutional Payment Total ($million)	Institutional Payment $ Per Resident
Male								
65–74	Nondisabled	7,772	7,772	0	100.00%	0.00%	$0	$0
	No ADLs	506	499	7	98.66	1.34	0	0
	1 ADL	85	81	5	94.64	5.36	104	22,668
	2 ADLs	49	42	7	86.35	13.65	123	18,542
	3+ ADLs	207	125	83	60.03	39.97	2,540	30,635
75–84	Nondisabled	3,357	3,357	0	100.00	0.00	0	0
	No ADLs	469	461	8	98.31	1.69	89	11,271
	1 ADL	116	101	15	87.01	12.99	212	14,019
	2 ADLs	66	51	15	76.87	23.13	346	22,600
	3+ ADLs	292	156	136	53.54	46.46	4,598	33,934
85+	Nondisabled	580	580	0	100.00	0.00	0	0
	No ADLs	184	172	12	93.46	6.54	252	20,916
	1 ADL	51	41	9	81.55	18.45	216	23,038
	2 ADLs	40	23	17	57.66	42.34	367	21,420
	3+ ADLs	202	87	114	43.31	56.69	3,891	34,020
Female								
65–74	Nondisabled	9,044	9,044	0	100.00%	0.00%	$0	$0
	No ADLs	800	794	5	99.33	0.67	100	18,677
	1 ADL	204	196	8	96.14	3.86	267	33,926
	2 ADLs	87	79	8	90.46	9.54	176	21,252
	3+ ADLs	320	213	107	66.49	33.51	3,410	31,797
75–84	Nondisabled	4,814	4,814	0	100.00	0.00	0	0
	No ADLs	968	950	18	98.13	1.87	387	21,333
	1 ADL	303	254	48	84.08	15.92	880	18,260
	2 ADLs	179	132	47	73.87	26.13	1,283	27,473
	3+ ADLs	551	247	304	44.82	55.18	10,815	35,560
85+	Nondisabled	967	967	0	100.00	0.00	0	0
	No ADLs	561	549	12	97.87	2.13	194	16,293
	1 ADL	236	190	46	80.62	19.38	1,038	22,718
	2 ADLs	124	66	57	53.71	46.29	1,734	30,300
	3+ ADLs	890	284	606	31.92	68.08	23,880	39,405
Both Sexes								
65+	Nondisabled	26,533	26,533	0	100.00%	0.00%	$0	$0
	No ADLs	3,488	3,426	62	98.22	1.78	1,022	16,450
	1 ADL	995	864	131	86.85	13.15	2,716	20,766
	2 ADLs	545	393	151	72.22	27.78	4,029	26,629
	3+ ADLs	2,462	1,112	1,350	45.16	54.84	49,135	36,391
	0–1 ADLs	4,482	4,289	193	95.70	4.30	3,738	19,376
	2+ ADLs	3,007	1,505	1,502	50.06	49.94	53,165	35,407
Total		34,022	32,328	1,694	95.02	4.98	56,902	33,582

Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

About 1.69 million elderly persons resided in institutions on a typical day in 1995. The estimated total annual cost of their care was $56.9 billion, with $53.2 billion for residents with two or more ADL limitations. The costs for individual disability categories tend to increase with increasing ADL count, reaching a maximum of $39,405 per year for females aged 85+ with three or more ADLs. The annual $33,583 cost per resident converts to a per diem cost of $92, about 9.5% above the $84 U.S. average nursing home per diem cost for Medicaid in 1995

(American Association of Retired Persons 1998). The NLTCS estimates are based on monthly cost data obtained from an institutional staff member (70.6%) or a knowledgeable family member (25.7%). Part of the between-category variation in cost per institutional resident is due to a lack of credible sample sizes in some cells: The average sample weight in the 1994 NLTCS institutional survey was 1,280, meaning that some estimates in Table 7 are based on as few as four survey respondents.

These estimates can be compared with estimates from two other sources. First, detailed estimates were generated by the National Center for Health Statistics (NCHS 1998, Table 127) that imply an overall average nursing home cost rate of $37,068 per elderly person per year in 1995 ($102 per day), and a total nursing home expenditure amount of either $52.3 or $62.8 billion, depending on whether the annual rate is applied to NCHS's estimate of elderly nursing home residents (1.39 million; Dey 1997, Table 1) or the NLTCS estimate (1.69 million; Table 7). The NLTCS annual cost estimate of $56.9 billion is near the midpoint ($57.6 million) of these two estimates.

Second, estimates based on the National Health Accounts (NHA; Figure 1) yield a nursing home cost rate of $127 per day in 1995, equivalent to an annual cost rate of $46,355 (Levit et al. 1996, p. 189). The NHA estimate includes all payments to freestanding nursing homes, not just payments by elderly persons with disabilities. Removing the nonelderly from the NHA estimate reduces the total cost in Figure 1 from $77.9 to $69.4 billion (using an estimate of 89.1% elderly nursing home residents, from the 1995 National Nursing Home Survey; Strahan 1997, Table 6). An additional adjustment of $3.1 billion can be developed by comparing the distributions of short-stay nursing home episodes between HCFA's SNF reports (HCFA 1997, Table 40) and those in the NLTCS. Thus, the NHA estimate can be reduced to $66.3 billion, or, alternatively, the NLTCS estimate can be increased to $60.0 billion to capture these SNF costs. With this latter change, the adjusted NLTCS cost estimate is near the midpoint ($60.9 billion) of the NCHS low estimate ($52.3 billion) and the NHA estimate ($69.4 billion).

The average annual cost rate varies greatly with the type of certification held by the facility—ranging from $26,028 for Medicaid only (that is, not Medicare certified) to $50,532 for Medicare only (that is, not Medicaid certified). The average for facilities holding both Medicaid and Medicare certification was $39,804 per person per year in 1995, while the average for facilities holding neither Medicaid nor Medicare certification was $27,876 (NCHS 1998, Table 127). These estimates encompass our unadjusted estimated annual cost of $33,583 per elderly resident.

Table 8 provides detailed estimates of the distribution of cognitive impairment using benefit triggers based on two cuts of the CI-score measure based on the SPMSQ, one representing mild to severe impairment (3+ CI), the other representing moderate to severe impairment (5+ CI) (Pfeiffer 1975). The difference between the two criteria is almost 1 million persons (7.8% vs. 5.0% of 34 million), suggesting that HIPAA's Cognitive Impairment Trigger may be problematic and may yield large numbers of "borderline" cases.

The percentages in Table 8 are computed separately for the total population and for the community versus institutional residence. Under the 3+ CI criterion, 7.8% of the total population aged 65+ is cognitively impaired. This breaks down into 5.1% of community residents and 59.9% of institutional residents. Among those with 0–1 ADLs, 26.3% (1.18 million persons) is cognitively impaired, suggesting that these persons may satisfy HIPAA's CI Trigger, in which case the number satisfying both the ADL and CI Triggers would be 4.18 million persons, 39.2% higher than for the ADL Trigger alone.

The fact that reasonable interpretations of HIPAA's benefit triggers using data in Table 6 and 8 can yield a range of 2.5–4.2 million eligible persons illustrates the difficulty of implementing any set of criteria with sharp bounds in eligibility. One mitigating factor may be that lower levels of disability are associated with lower levels of need for long-term care. In addition, most of the uncertainty involves community residents, not institutionalized persons. Table 8 shows that 42.5% of institutional residents with 0–1 ADLs satisfied the 3+ CI criterion, leaving only 111,000 (6.6%) institutional residents who fail to satisfy either HIPAA criterion. Alternatively, the fact that 93.4% of institutional residents satisfy at least one HIPAA criterion suggests that the institutional classification in the NLTCS is a sensitive indicator of long-term-care disability.

The tables in the rest of this section use the six-category disability classification in which institutional residents are separated from other disability categories. This allows us to exploit the greater detail of the NLTCS community interview.

Table 9 displays the estimated frequencies of 13 selected medical conditions for 1995 for the six-category disability statuses based on HIPAA's ADL Trigger. The medical conditions are identified with abbreviated titles. Arthritis-rheumatism includes other permanent numbness or stiffness. CNS (central nervous system) diseases include paralysis, multiple sclerosis, cerebral

TABLE 8
ESTIMATED PREVALENCES OF COGNITIVE IMPAIRMENT, 1995

		Population (000's)			3 + CI			5 + CI		
		Total	Community	Institutional	Total	Community	Institutional	Total	Community	Institutional
Male										
65–74	Nondisabled	7,772	7,772	0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	No ADLs	506	499	7	20.51	20.13	48.60	7.87	7.32	48.60
	1 ADL	85	81	5	30.74	29.63	50.26	18.86	17.08	50.26
	2 ADLs	49	42	7	10.56	7.68	28.78	3.93	0.00	28.78
	3+ ADLs	207	125	83	32.20	24.99	43.03	25.80	17.26	38.61
75–84	Nondisabled	3,357	3,357	0	0.00	0.00	0.00	0.00	0.00	0.00
	No ADLs	469	461	8	30.86	30.75	37.05	10.22	9.76	37.07
	1 ADL	116	101	15	30.26	26.03	58.55	16.74	13.24	40.18
	2 ADLs	66	51	15	38.10	37.50	40.11	22.78	20.30	31.02
	3+ ADLs	292	156	136	48.21	37.21	60.88	43.13	35.68	51.71
85+	Nondisabled	580	580	0	0.00	0.00	0.00	0.00	0.00	0.00
	No ADLs	184	172	12	26.36	26.73	21.04	16.24	15.91	21.04
	1 ADL	51	41	9	29.24	28.61	32.05	19.68	20.47	16.18
	2 ADLs	40	23	17	54.09	58.45	48.14	45.56	54.08	33.97
	3+ ADLs	202	87	114	56.89	44.73	66.18	48.39	29.59	62.75
Female										
65–74	Nondisabled	9,044	9,044	0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	No ADLs	800	794	5	23.41	23.57	0.00	6.41	6.45	0.00
	1 ADL	204	196	8	10.74	10.54	15.56	4.56	4.12	15.54
	2 ADLs	87	79	8	19.79	14.32	71.71	0.00	0.00	0.00
	3+ ADLs	320	213	107	36.02	24.86	58.17	30.22	18.14	54.18
75–84	Nondisabled	4,814	4,814	0	0.00	0.00	0.00	0.00	0.00	0.00
	No ADLs	968	950	18	24.83	24.49	42.72	7.34	6.66	42.71
	1 ADL	303	254	48	32.56	27.55	59.05	18.41	13.03	46.85
	2 ADLs	179	132	47	37.43	31.32	54.70	23.18	17.85	38.25
	3+ ADLs	551	247	304	53.83	43.76	62.01	42.96	30.70	52.92
85+	Nondisabled	967	967	0	0.00	0.00	0.00	0.00	0.00	0.00
	No ADLs	561	549	12	28.61	29.11	5.54	10.93	11.17	0.00
	1 ADL	236	190	46	40.22	38.83	46.00	24.76	23.39	30.43
	2 ADLs	124	66	57	49.53	40.95	59.47	36.62	30.02	44.27
	3+ ADLs	890	284	606	61.71	50.56	66.94	55.40	42.82	61.29
Both Sexes										
65+	Nondisabled	26,533	26,533	0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	No ADLs	3,488	3,426	62	25.38	25.34	27.63	8.64	8.31	26.56
	1 ADL	995	864	131	29.31	26.24	49.58	16.98	14.05	36.39
	2 ADLs	545	393	151	36.27	29.42	54.08	22.42	16.89	36.80
	3+ ADLs	2,462	1,112	1,350	52.13	38.93	62.99	44.82	30.50	56.61
	0–1 ADLs	4,482	4,289	193	26.25	25.52	42.51	10.49	9.47	33.22
	2+ ADLs	3,007	1,505	1,502	49.26	36.45	62.10	40.76	26.94	54.62
Total		34,022	32,328	1,694	7.81	5.08	59.86	4.98	2.51	52.18

Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

palsy, epilepsy, and Parkinson's disease. Discomfort includes frequent constipation, frequent trouble sleeping, and frequent severe headaches. Overweight includes obesity. Circulatory disease includes arteriosclerosis, heart attack, any other heart problem, hypertension, stroke, and circulation trouble in the arms or legs. Chronic lung diseases include bronchitis, emphysema, and asthma. Broken bones include hip fractures. Dementia includes Alzheimer's disease and senility. Mental retardation is generally a condition with lifelong consequences. It is not

TABLE 9
ESTIMATED PREVALENCES OF SELECTED MEDICAL CONDITIONS, 1995

Male

Category		Population (000's)	Arthritis-Rheumatism	CNS	Glaucoma	Diabetes	Cancer	Discomfort	Overweight	Circulatory Disease	Influenza-Pneumonia	Chronic Lung Disease	Broken Bones	Dementia	Mental Retardation
65–74	Non-disabled	7,772	45.26%	1.91%	3.29%	15.08%	6.87%	23.51%	20.51%	51.44%	11.44%	14.57%	2.40%	0.00%	0.00%
	No ADLs	499	68.48	10.29	9.57	20.52	9.13	45.58	24.68	70.22	18.40	27.92	6.83	2.92	1.20
	1 ADL	81	81.33	18.49	17.33	21.84	4.47	47.66	31.05	94.93	21.96	31.63	3.46	4.14	4.02
	2 ADLs	42	86.63	27.21	0.00	16.59	5.02	59.72	10.91	84.92	34.09	42.01	0.00	0.00	0.00
	3+ ADLs	125	69.38	46.70	1.41	43.66	19.01	46.91	19.86	89.41	22.94	23.90	5.28	15.19	3.43
	Institutional	101	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75–84	Non-disabled	3,357	53.48	3.08	11.00	11.07	8.38	29.44	12.79	57.30	11.60	14.61	2.12	0.00	0.00
	No ADLs	461	70.77	9.10	11.49	18.74	11.21	44.65	17.19	73.33	16.05	21.85	5.25	5.21	0.00
	1 ADL	101	66.32	10.86	11.97	16.16	18.97	45.58	12.04	82.65	18.86	29.58	9.47	10.68	0.00
	2 ADLs	51	72.66	31.29	7.67	23.54	16.51	41.59	13.15	82.52	26.08	33.57	8.05	11.63	0.00
	3+ ADLs	156	80.44	39.43	12.55	24.28	12.55	55.34	8.59	77.78	22.06	26.40	8.52	25.33	1.70
	Institutional	174	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
85+	Non-disabled	580	56.73	0.00	8.04	17.04	0.00	31.03	0.00	61.91	17.36	13.60	5.79	0.00	0.00
	No ADLs	172	65.61	6.27	16.93	10.08	10.72	45.91	10.01	59.16	8.04	12.60	4.36	4.92	0.00
	1 ADL	41	72.02	13.30	4.60	6.78	11.18	50.17	0.00	83.31	17.38	10.18	8.98	11.87	0.00
	2 ADLs	23	65.17	16.22	22.95	19.41	4.11	17.14	0.00	54.23	12.38	6.94	9.33	25.45	0.00
	3+ ADLs	87	68.27	33.69	16.81	13.28	9.31	52.90	13.90	81.38	25.18	27.15	9.17	31.02	2.83
	Institutional	153	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

								Female							
65–74	Non-disabled	9,044	58.21	1.70	5.10	11.96	3.21	29.80	29.46	55.67	14.18	18.36	5.07	0.00	0.00
	No ADLs	794	84.35	4.52	6.69	29.95	9.12	50.27	52.19	73.64	20.67	25.72	6.31	0.84	0.20
	1 ADL	196	85.47	16.14	8.35	16.59	12.24	63.58	32.32	80.94	28.94	41.56	12.54	0.85	2.52
	2 ADLs	79	77.02	31.99	5.17	32.57	3.52	56.53	37.65	86.90	38.96	35.62	7.32	0.00	4.54
	3+ ADLs	213	86.69	30.59	7.67	36.77	6.19	58.65	39.06	79.39	25.17	28.71	10.94	13.52	3.93
	Institutional	129	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75–84	Non-disabled	4,814	60.37	1.54	8.33	10.00	4.30	29.87	19.48	59.10	9.87	15.51	5.61	0.00	0.00
	No ADLs	950	78.72	4.78	11.69	18.29	6.37	48.32	29.42	72.72	17.39	21.14	8.72	1.70	0.22
	1 ADL	254	79.86	10.38	8.69	15.60	6.52	52.22	25.12	71.70	23.40	25.73	14.81	8.70	0.89
	2 ADLs	132	79.68	14.53	8.88	21.66	6.54	61.07	24.77	75.59	12.60	18.12	17.65	13.38	4.32
	3+ ADLs	247	74.97	23.19	10.49	30.06	8.53	63.72	14.59	78.09	20.83	26.41	8.35	25.68	1.12
	Institutional	417	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
85+	Non-disabled	967	58.22	2.88	7.66	8.23	1.37	33.67	3.67	51.10	10.74	15.09	13.11	0.00	0.00
	No ADLs	549	72.76	3.25	13.58	8.07	4.12	46.18	11.24	66.90	13.95	12.06	11.80	2.90	0.00
	1 ADL	190	78.19	8.96	13.57	10.48	7.15	41.29	7.61	77.70	15.15	16.78	8.07	10.30	0.50
	2 ADLs	66	83.98	9.78	20.46	3.03	6.68	36.46	15.43	78.68	19.19	16.46	8.57	23.93	0.00
	3+ ADLs	284	70.60	16.34	19.78	14.65	5.95	57.69	9.46	82.41	22.15	13.98	10.77	41.48	3.08
	Institutional	721	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(continued)

TABLE 9 (CONTINUED)
ESTIMATED PREVALENCES OF SELECTED MEDICAL CONDITIONS, 1995

		Both sexes													
Category		Population (000's)	Arthritis-Rheumatism	CNS	Glaucoma	Diabetes	Cancer	Discomfort	Overweight	Circulatory Disease	Influenza-Pneumonia	Chronic Lung Disease	Broken Bones	Dementia	Mental Retardation
65+	Nondisabled	26,533	54.18	1.92	6.06	12.38	4.99	28.09	21.34	55.23	12.21	16.03	4.32	0.00	0.00
	No ADLs	3,426	75.85	5.93	10.76	18.63	7.92	47.42	28.47	71.04	17.10	21.40	7.69	2.50	0.28
	1 ADL	864	78.95	12.33	10.68	14.92	9.45	51.09	20.72	79.12	21.89	27.61	10.84	7.23	1.32
	2 ADLs	393	78.85	20.85	9.82	20.27	6.94	50.74	21.31	79.00	23.01	25.23	10.43	11.57	2.36
	3+ ADLs	1,112	75.71	28.59	12.09	26.80	9.22	57.30	17.66	80.93	22.75	23.45	9.21	26.58	2.63
	Institutional	1,694	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
65+	0–1 ADLs	4,289	76.48	7.22	10.75	17.89	8.23	48.16	26.91	72.67	18.06	22.65	8.33	3.46	0.49
	2+ ADLs	1,505	76.53	26.57	11.50	25.09	8.63	55.59	18.61	80.42	22.82	23.92	9.53	22.66	2.56
Total Community		32,328	58.18	3.77	6.94	13.70	5.59	32.03	21.95	58.72	13.48	17.28	5.09	1.51	0.18

Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

included with either dementia or cognitive impairment. The dementia prevalence estimate of 1.5% (489,000 persons) represents cases of dementia severe enough to require the use of a proxy respondent. A better estimate of the total number of people suffering from dementia is provided in Table 8 by the cognitive impairment score with cut-points at either 3+ or 5+ errors on the SPMSQ.

Two categories in Table 9 require explanation. In the NLTCS medical conditions were evaluated only in the detailed community interview. Therefore, the counts in Table 9 for institutionalized persons are zero. The counts for nondisabled persons reflect a mixture of medical conditions for a supplementary sample of "healthy" persons who "screened out" but were given an abbreviated form of the detailed community interview, and elderly persons who "screened in" to the NLTCS detailed community interview but were then determined to be nondisabled. The supplementary sample represented about 57.5% of the combined group.

In general, the prevalence of these 13 conditions increases with increasing disability. The one exception is being overweight, which averages 22.0%, but increases to 28.5% for the 0 ADL disabled and drops to 17.7% for the 3+ ADL group. This may be explained in part by increased difficulty eating in the 3+ ADL group. Three conditions, CNS, dementia, and mental retardation, exhibit large relative increases between the 0–1 ADL and 2+ ADL groups. Large absolute increases occur for diabetes, discomfort, and circulatory disease. Arthritis-rheumatism and circulatory disease are highly prevalent in both the disabled and nondisabled subpopulations (54–81% at age 65+ for both sexes). These rates are high enough that it would be useful to have these medical conditions classified by severity.

Marital Status and Family Support

Table 10 presents the distribution of disabled elderly persons by marital status (married vs. unmarried) and provides the percentage of persons in each of these categories with paid helpers, by gender. Overall, 84.2% of institutional residents are not married, and, by definition, all of them use paid helpers. Among community residents there are large differences in the marital status rates by age and gender. One interesting reversal is the increase in the percent married, moving from 0–1 ADL to 2+ ADLs. This may reflect the importance of a spouse in maintaining community-residence status for severely disabled persons. Even so, 44.0% of married persons with 2+ ADLs used paid help, and among elderly women aged 85+ this rate rises to 73.8%. Among unmarried disabled community residents, the use of paid help is high (above 43%) beginning with one ADL limitation. Even among those with no ADL limitations (restricted to IADL or CI limitations), 25.4% used paid help. Among nondisabled persons, a small fraction reported using paid help.

Table 11 presents the distribution of disabled elderly persons by family structure, that is, living arrangements in which (1) a spouse is present, (2) a spouse is not present, but either children, other relatives, or other persons are co-resident with the disabled person living in the community, or (3) the disabled person lives alone. There is a high utilization of paid help among disabled persons living alone. As in Table 9, the estimates for institutionalized persons are zero, and the estimates for nondisabled persons are based on a reweighting of the detailed interview responses to represent the entire nondisabled sample. The fact that the percentage of nondisabled living with a spouse is almost identical to the percentage married in Table 10 (where reweighting was not used) suggests that the reweighting procedure is unbiased. This suggests that the estimate that 0.8–3.4% of the nondisabled use paid help is reasonable.

The estimates for community residents living with their spouse are comparable to the estimates for married persons in Table 10. The estimates for the other two groups in Table 11 are breakouts of the estimates for unmarrieds in Table 10.

Table 11 does not fully reveal the role of children in providing care for disabled elderly parents. Among those disabled living with their spouse, about 14.0% are co-resident with children. Among those disabled living with children, relatives, or others, about 64.4% actually live with children, and another 25.5% live with other relatives; only 10.0% live with nonrelatives. The role of children increases with increasing disability so that 72.3% of those with 3+ ADLs living with children, relatives, or others actually live with children. The NLTCS contains detailed information on caregiving that permits in-depth study of the roles of children and others in providing care for disabled elderly.

Helper Hours and Payments

Table 12 presents the distribution of helper hours and helper payments for disabled elderly community residents in 1995, by gender. Estimates of the number of disabled persons with paid or unpaid help, and the total number of hours of help, are provided. The estimates indicate that 1,548 hours of help per person per year (PPPY) were provided to 5.3 million community residents

TABLE 10
ESTIMATED DISABILITY PREVALENCES BY MARITAL STATUS, 1995

Category		Population (000's)	Married	Unmarried	Percentage of Category with Paid Helpers: Married	Percentage of Category with Paid Helpers: Unmarried
Male						
65–74	Nondisabled	7,772	81.12%	18.88%	0.05%	0.13%
	No ADLs	499	68.80	31.20	5.97	24.92
	1 ADL	81	69.90	30.10	5.92	40.44
	2 ADLs	42	100.00	0.00	29.60	0.00
	3+ ADLs	125	71.18	28.82	61.58	50.51
	Institutional	101	30.12	69.88	100.00	100.00
75–84	Nondisabled	3,357	74.64	25.36	0.14	0.68
	No ADLs	461	67.77	32.23	7.25	23.97
	1 ADL	101	72.42	27.58	13.32	51.39
	2 ADLs	51	75.76	24.24	22.58	40.81
	3+ ADLs	156	82.67	17.33	36.28	54.64
	Institutional	174	43.73	56.27	100.00	100.00
85+	Nondisabled	580	58.00	42.00	0.00	1.00
	No ADLs	172	51.90	48.10	22.58	25.77
	1 ADL	41	46.07	53.93	42.23	47.06
	2 ADLs	23	64.63	35.37	11.19	87.64
	3+ ADLs	87	62.80	37.20	57.55	50.17
	Institutional	153	34.97	65.03	100.00	100.00
Female						
65–74	Nondisabled	9,044	54.85%	45.15%	0.17%	0.38%
	No ADLs	794	39.52	60.48	11.68	19.65
	1 ADL	196	41.17	58.83	7.72	41.47
	2 ADLs	79	47.65	52.35	25.38	46.03
	3+ ADLs	213	51.51	48.49	41.85	36.59
	Institutional	129	21.85	78.15	100.00	100.00
75–84	Nondisabled	4,814	35.28	64.72	0.21	0.52
	No ADLs	950	21.67	78.33	19.98	26.07
	1 ADL	254	29.43	70.57	34.76	41.56
	2 ADLs	132	35.38	64.61	33.25	56.25
	3+ ADLs	247	44.24	55.76	51.55	51.73
	Institutional	417	9.90	90.10	100.00	100.00
85+	Nondisabled	967	14.30	85.70	0.00	0.53
	No ADLs	549	9.01	90.99	43.96	30.29
	1 ADL	190	6.02	93.98	45.24	45.43
	2 ADLs	66	21.65	78.35	73.75	34.62
	3+ ADLs	284	9.84	90.16	73.77	64.21
	Institutional	721	5.34	94.66	100.00	100.00
Both Sexes						
65+	Nondisabled	26,533	60.09%	39.91%	0.11%	0.44%
	No ADLs	3,426	38.38	61.62	12.39	25.36
	1 ADL	864	36.55	63.45	18.55	43.48
	2 ADLs	393	49.39	50.61	30.11	48.83
	3+ ADLs	1,112	46.71	53.29	49.25	54.46
	Institutional	1,694	15.80	84.20	100.00	100.00
	0–1 ADL	4,289	38.01	61.99	13.58	29.10
	2+ ADLs	1,505	47.41	52.59	44.04	53.05
Total		34,022	54.54	45.46	4.43	17.24
Total Community		32,328	56.57	43.43	3.03	8.83

Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

TABLE 11
ESTIMATED DISABILITY PREVALENCES BY FAMILY STRUCTURE AND PAY STATUS, 1995

Category		Population (000's)	Percentage Living with			Percentage of Category with Paid Helpers		
			Spouse	Child/Rel/Other	Alone	Spouse	Child/Rel/Other	Alone
Male								
65–74	Nondisabled	7,772	81.45%	8.37%	10.18%	0.36%	0.00%	1.89%
	No ADLs	499	69.72	11.12	19.16	5.79	23.06	26.68
	1 ADL	81	67.99	15.60	16.41	3.28	41.32	46.53
	2 ADLs	42	100.00	0.00	0.00	29.60	0.00	0.00
	3+ ADLs	125	74.47	17.57	7.97	58.86	57.01	57.02
	Institutional	101	0.00	0.00	0.00	0.00	0.00	0.00
75–84	Nondisabled	3,357	75.46	6.08	18.45	1.13	0.00	5.04
	No ADLs	461	67.58	10.06	22.36	7.11	18.85	27.31
	1 ADL	101	71.08	13.86	15.06	11.35	39.95	73.16
	2 ADLs	51	74.59	14.24	11.18	22.93	35.05	57.66
	3+ ADLs	156	82.67	11.47	5.86	36.93	33.87	92.21
	Institutional	174	0.00	0.00	0.00	0.00	0.00	0.00
85+	Nondisabled	580	44.89	12.40	42.71	0.00	0.00	8.25
	No ADLs	172	53.04	16.52	30.44	22.99	3.10	36.79
	1 ADL	41	38.22	38.05	23.73	30.54	41.33	70.07
	2 ADLs	23	64.63	19.52	15.84	11.19	77.64	100.00
	3+ ADLs	87	57.77	27.61	14.63	57.69	38.03	67.82
	Institutional	153	0.00	0.00	0.00	0.00	0.00	0.00
Female								
65–74	Nondisabled	9,044	55.98%	13.93%	30.08%	1.22%	3.00%	3.00%
	No ADLs	794	41.13	17.93	40.94	12.56	10.69	22.02
	1 ADL	196	41.20	31.83	26.97	9.37	21.64	60.19
	2 ADLs	79	50.59	35.54	13.87	29.72	20.50	100.00
	3+ ADLs	213	48.84	45.34	5.83	40.13	36.06	43.87
	Institutional	129	0.00	0.00	0.00	0.00	0.00	0.00
75–84	Nondisabled	4,814	33.94	16.18	49.87	0.95	6.07	3.13
	No ADLs	950	24.60	21.69	53.72	23.61	12.40	30.13
	1 ADL	254	32.00	28.14	39.85	35.49	22.94	53.97
	2 ADLs	132	37.14	32.05	30.82	31.68	28.96	87.83
	3+ ADLs	247	45.62	33.19	21.19	50.40	44.11	64.66
	Institutional	417	0.00	0.00	0.00	0.00	0.00	0.00
85+	Nondisabled	967	17.33	23.86	58.81	0.00	2.71	4.43
	No ADLs	549	10.82	25.57	63.61	40.65	14.51	36.31
	1 ADL	190	6.07	41.39	52.54	42.25	18.50	69.25
	2 ADLs	66	20.89	57.54	21.57	72.79	30.70	47.40
	3+ ADLs	284	14.16	56.51	29.33	76.51	51.94	87.81
	Institutional	721	0.00	0.00	0.00	0.00	0.00	0.00
Both Sexes								
65+	Nondisabled	26,533	60.26%	12.05%	27.70%	0.80%	2.86%	3.38%
	No ADLs	3,426	40.02	18.07	41.91	13.40	13.50	29.61
	1 ADL	864	36.62	29.53	33.86	17.74	24.23	61.51
	2 ADLs	393	50.29	30.57	19.14	30.48	29.76	80.22
	3+ ADLs	1,112	47.58	36.24	16.18	49.26	45.18	75.15
	Institutional	1,694	0.00	0.00	0.00	0.00	0.00	0.00
	0–1 ADL	4,289	39.33	20.38	40.29	14.21	16.63	35.01
	2+ ADLs	1,505	48.29	34.76	24.43	44.15	41.64	65.34
Total Community		32,328	56.92	14.21	28.87	3.75	9.90	11.24

Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

TABLE 12
ESTIMATED HELPER HOURS AND PAYMENTS FOR DISABLED COMMUNITY RESIDENTS, 1995

Category		Population (000's)	Paid or Unpaid Help: Percentage with Helpers	Paid or Unpaid Help: Helper Hours (Hr. PPPY)	Paid Help Only: Percentage with Paid Helpers	Paid Help Only: Amount Paid (PPPY)	Paid Help Only: Average Pay Out-of-Pocket (PPPY)	Paid Help Only: Helper Hours (Hr. PPPY)	Paid Help Only: Total Paid Helper Hours (Hr. PPPY)
Male									
65–74	Nondisabled	7,772	1.44%	730	0.06%	$ 3,255	$ 224	1,092	780
	No ADLs	499	75.68	871	11.72	6,561	415	765	529
	1 ADL	81	95.21	1,104	16.31	1,917	92	1,179	235
	2 ADLs	42	100.00	1,996	29.60	991	50	3,564	116
	3+ ADLs	125	100.00	3,686	58.39	13,729	3,220	4,634	1,532
	Institutional	101	0.00	0	0.00	0	0	0	0
75–84	Nondisabled	3,357	2.78	700	0.27	945	268	218	114
	No ADLs	461	73.71	976	12.81	3,127	298	760	451
	1 ADL	101	97.12	1,354	24.63	2,141	152	888	292
	2 ADLs	51	100.00	1,961	28.54	4,662	852	1,378	660
	3+ ADLs	156	100.00	3,631	39.82	11,446	1,728	4,135	1,368
	Institutional	174	0.00	0	0.00	0	0	0	0
85+	Nondisabled	580	3.91	592	0.37	10,755	2,490	1,664	1,456
	No ADLs	172	82.55	899	23.91	2,784	1,159	884	394
	1 ADL	41	100.00	1,367	44.03	2,685	1,861	723	364
	2 ADLs	23	100.00	1,465	38.23	3,215	612	1,463	482
	3+ ADLs	87	100.00	5,560	53.74	18,316	4,029	6,605	2,890
	Institutional	153	0.00	0	0.00	0	0	0	0
Female									
65–74	Nondisabled	9,044	1.05	682	0.26	3,091	230	472	430
	No ADLs	794	61.28	577	16.10	2,222	443	721	336
	1 ADL	196	89.78	1,300	26.98	6,089	2,081	1,259	981
	2 ADLs	79	97.20	1,212	36.19	6,290	632	1,071	901
	3+ ADLs	213	100.00	3,553	38.50	16,802	2,100	4,339	2,316
	Institutional	129	0.00	0	0.00	0	0	0	0
75–84	Nondisabled	4,814	1.57	245	0.40	990	203	277	109
	No ADLs	950	72.74	578	24.68	2,420	690	583	325
	1 ADL	254	97.31	1,156	39.32	3,469	738	1,011	505
	2 ADLs	132	100.00	2,080	48.11	11,610	5,883	2,266	1,621
	3+ ADLs	247	100.00	3,337	51.33	12,592	4,688	3,664	1,551
	Institutional	417	0.00	0	0.00	0	0	0	0
85+	Nondisabled	967	2.81	283	0.43	2,713	1,311	520	520
	No ADLs	549	84.39	649	31.21	2,299	1,226	476	325
	1 ADL	190	99.44	1,078	46.61	3,593	1,529	834	497
	2 ADLs	66	100.00	1,760	43.09	5,179	1,012	2,125	668
	3+ ADLs	284	100.00	4,685	65.94	21,300	6,390	4,877	3,020
	Institutional	721	0.00	0	0.00	0	0	0	0

Estimated Helper Hours and Payments for Disabled Community Residents, 1995

Both Sexes									
			Paid or Unpaid Help		Paid Help Only				
Category		Population (000's)	Percentage with Helpers	Helper Hours (Hr. PPPY)	Percentage with Paid Helpers	Amount Paid (PPPY)	Average Pay Out-of-Pocket (PPPY)	Helper Hours (Hr. PPPY)	Total Paid Helper Hours (Hr. PPPY)
65+	Nondisabled	26,533	1.60	591	0.24	2,391	377	467	354
	No ADLs	3,426	73.00	707	20.21	2,785	748	630	359
	1 ADL	864	95.98	1,198	34.48	3,744	1,203	982	549
	2 ADLs	393	99.44	1,795	39.78	7,498	2,805	1,998	1,042
	3+ ADLs	1,112	100.00	3,978	51.97	16,497	4,316	4,565	2,222
	Institutional	1,694	0.00	0	0.00	0	0	0	0
	0–1 ADL	4,289	77.63	830	23.08	3,073	885	736	416
	2+ ADLs	1,505	99.85	3,410	48.79	14,580	3,994	4,018	1,971
Total Community		32,328	16.27	1,548	5.53	7,778	2,145	2,075	1,053

Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

(16.3%). This corresponds to 29.8 hours per week per person receiving help and implies a total of 8.1 billion hours of help per year.

Corresponding estimates are provided for the 1.8 million elderly community residents (5.5%) who received any amount of paid care. Approximately 2,075 hours of care were provided per person per year to these people, of which 1,053 hours were paid for, at a cost of $7,778 each. These estimates imply that 1.9 billion hours of paid care were provided in 1995, at a cost of $13.9 billion. Of the 8.1 billion hours of help in 1995, 76.9% was unpaid.

The average cost of paid care in 1995 was $7.39 per hour. If we assumed that this rate also applied to unpaid care in 1995, then the value of unpaid care for community residents would be $46.2 billion, the value of all care for community residents would be $60.1 billion (including $13.9 billion paid care), and the value of all care for institutional and community residents would be $117.0 billion (including $56.9 billion for institutional care; see Table 7). This assumption is similar to that used by Arno, Levine, and Memmott (1999) in evaluating the economic value of all types of informal caregiving, not just long-term care for the disabled elderly population. Their preferred estimate for 1997 was based on an hourly rate of $8.18 (which deflates to $7.77 in 1995; 5.1% higher than our $7.39 rate), but they also used low-high values of $5.15 and $11.20 per hour to reflect a range of costs that might be incurred if informal caregiving had to be replaced by paid workers.

Approximately 27.6% ($2,145) of the total cost was paid out-of-pocket by long-term-care recipients in 1995. This compares with NHA-based estimates of 21.0% for home health care and 32.5% for all types of long-term care in 1995 (Levitt et al. 1996, p. 204).

Table 12 provides detailed estimates of helper utilization rates and costs that can inform a range of issues relating to program design. For example, the percentage of the 2+ ADL group with helpers is 99.9%. This drops to 77.6% for the 0–1 ADL group, a group that fails to satisfy HIPAA's ADL Trigger. Table 8 indicates that about 25.5% of the 0–1 ADL group has 3+ CI scores, which could satisfy HIPAA's CI Trigger. If we assumed that all of the 3+ CI group used helpers, then it follows that the remaining 52.1% (77.6% – 25.5%) of the 0–1 ADL group who currently use help with ADL or IADL activities would not satisfy either HIPAA trigger.

One might argue that the assistance needs of the 0–1 ADL group are minor. However, Table 12 shows that about 23.1% of the 0–1 ADL group use paid help at a cost of $3,073 per year each, with $885 paid out-of-pocket on average. This is a nontrivial expenditure, especially considering the finding in Table 11 that the highest utilization rates for paid care are among those living alone (35% overall for 0–1 ADLs). It is also noteworthy that these expenditures would not qualify for reimbursement under a long-term-care insurance policy that met HIPAA's qualification requirements for tax-favored treatment.

Long-Term-Care Expenditures

Table 13 displays the static component projection of total long-term-care expenditures and the component projections for institutional and community care for the period 1995–2080. The institutional cost projection is based on the estimates in Table 7; the home and community-based (HCB) cost projection is based on the estimates in Table 12. The total long-term-care costs are based on summation of the institutional and HCB costs.

The total long-term-care cost for the elderly in 1995 is estimated to be $71 billion, and this is projected to increase to $126 billion in 2035 and $163 billion in 2080. This projection does not reflect the effects of general inflation and medical inflation, nor does it reflect changes in the mix of institutional and HCB care, nor changes in the relative amount of informal versus paid care in the community. Changes in any of these factors could significantly impact the projection. For example, Lakdawalla and Philipson (1998) argue that increasing longevity could increase the availability of elderly males who could act as caregivers for disabled female spouses, thereby lowering the demand for paid long-term care both in the community and institutions.

The total long-term-care cost in 1995 is 50.4% of the corresponding total Medicare cost in Table 5. This ratio drops to 43.2% in 2035 and increases slightly to 45.2% in 2080.

Comparison of Tables 3 and 13 suggests that Medicare's HHA costs are not particularly good indicators of HCB long-term-care costs. For example, the 1995 HHA cost for community residents with 3+ ADLs was $5.4 billion, whereas their 1995 HCB long-term-care cost was $9.5 billion (75.4% higher). However, the 1995 HHA cost for nondisabled elderly was $3.9 billion versus $150 million HCB long-term-care costs (96.2% lower). Nonetheless, since it is likely that HHA costs would be reported as part of the HCB long-term-care costs for disabled community residents with paid care, there is some potential for double counting, and this should be considered in evaluating these projections.

TABLE 13
LTC COST PROJECTIONS ($ MILLION, 1995 CONSTANT DOLLARS) 1995–2080, ASSUMING DECLINING DISABILITY RATES (0.6% PER YEAR)

Category	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2050	2060	2070	2080
Total														
Total	$70,802	$75,760	$80,072	$83,689	$87,427	$91,630	$98,799	$110,853	$126,127	$141,045	$156,975	$153,422	$154,743	$163,100
Male	16,275	17,605	18,809	19,973	21,369	23,348	26,290	29,996	33,781	36,949	40,115	40,259	41,503	43,606
Female	54,528	58,155	61,263	63,716	66,058	68,282	72,509	80,857	92,345	104,096	116,860	113,163	113,240	119,494
65–74	10,389	9,883	9,487	10,229	12,131	14,316	15,863	16,723	15,953	14,373	13,685	14,544	13,462	12,991
75–84	22,903	24,527	25,561	24,460	23,678	25,789	30,826	36,529	40,662	43,019	37,440	36,221	38,878	36,333
85+	37,510	41,350	45,024	49,000	51,618	51,525	52,110	57,602	69,512	83,653	105,849	102,657	102,403	113,776
Nondisabled	150	160	165	179	208	247	282	326	368	397	457	496	534	605
No ADLs	2,950	3,095	3,226	3,351	3,529	3,789	4,208	4,726	5,208	5,599	5,843	5,701	5,795	5,941
1 ADL	3,830	4,033	4,226	4,397	4,531	4,744	5,223	5,907	6,625	7,195	7,553	7,231	7,399	7,579
2 ADLs	5,202	5,544	5,828	5,985	6,064	6,360	7,055	8,065	9,197	10,115	10,753	10,540	10,829	11,187
3+ ADLs	58,670	62,928	66,627	69,777	73,095	76,490	82,031	91,829	104,729	117,739	132,369	129,455	130,186	137,787
2+ ADLs	63,872	68,472	72,455	75,763	79,159	82,850	89,086	99,894	113,926	127,854	143,122	139,994	37,256	148,974
1+ ADLs	67,703	72,505	76,681	80,159	83,689	87,594	94,309	105,801	120,551	135,049	150,675	147,225	148,414	156,553
0+ ADLs	70,653	75,600	79,907	83,511	87,219	91,383	98,517	110,527	125,759	140,648	156,518	152,926	154,209	162,495
Institutional LTC														
Total	56,902	61,138	64,791	67,688	70,498	73,599	79,170	88,944	101,804	114,572	128,299	125,316	126,457	133,623
Male	12,738	13,873	14,828	15,672	16,674	18,200	20,535	23,531	26,720	29,356	31,871	31,992	33,063	34,743
Female	44,164	47,265	49,964	52,015	53,824	55,399	58,635	65,413	75,084	85,216	96,428	93,324	93,394	98,879
65–74	6,720	6,400	6,128	6,586	7,799	9,225	10,226	10,807	10,340	9,301	8,821	9,381	8,689	8,371
75–84	18,610	19,934	20,768	19,874	19,248	20,974	25,077	29,704	33,064	34,964	30,416	29,441	31,590	29,511
85+	31,572	34,804	37,895	41,228	43,451	43,399	43,867	48,433	58,400	70,307	89,061	86,493	86,178	95,741
Nondisabled	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No ADLs	1,022	1,102	1,160	1,196	1,235	1,302	1,438	1,653	1,911	2,135	2,295	2,202	2,276	2,385
1 ADL	2,715	2,876	3,043	3,179	3,261	3,375	3,704	4,198	4,746	5,220	5,531	5,245	5,386	5,540
2 ADLs	4,029	4,316	4,567	4,732	4,788	4,972	5,461	6,260	7,231	8,054	8,790	8,599	8,835	9,245
3+ ADLs	49,135	52,841	56,021	58,580	61,214	63,950	68,568	76,834	87,916	99,163	111,682	109,269	109,960	116,453
2+ ADLs	53,165	57,159	60,587	63,312	66,002	68,922	74,029	83,094	95,147	107,218	120,473	117,868	15,034	125,698
1+ ADLs	55,880	60,035	63,631	66,491	69,263	72,297	77,732	87,292	99,893	112,438	126,004	123,113	124,180	131,238
0+ ADLs	56,902	61,138	64,791	67,688	70,498	73,599	79,170	88,944	101,804	114,572	128,299	125,316	126,457	133,623
Home and Community-Based LTC														
Total	13,900	14,622	15,281	16,002	16,929	18,032	19,629	21,909	24,323	26,473	28,676	28,106	28,286	29,477
Male	3,537	3,732	3,981	4,301	4,695	5,148	5,755	6,466	7,062	7,593	8,244	8,267	8,440	8,863
Female	10,364	10,890	11,299	11,701	12,234	12,883	13,874	15,443	17,261	18,880	20,432	19,839	19,846	20,614
65–74	3,669	3,483	3,359	3,642	4,332	5,090	5,637	5,916	5,612	5,072	4,864	5,183	4,773	4,621
75–84	4,293	4,593	4,793	4,587	4,431	4,815	5,749	6,825	7,598	8,055	7,024	6,779	7,288	6,822
85+	5,938	6,546	7,129	7,773	8,167	8,126	8,243	9,169	11,112	13,346	16,788	16,164	16,225	18,035
Nondisabled	150	160	165	179	208	247	282	326	368	397	457	496	534	605
No ADLs	1,928	1,992	2,065	2,155	2,295	2,487	2,770	3,073	3,297	3,464	3,548	3,498	3,518	3,557
1 ADL	1,115	1,157	1,183	1,218	1,270	1,369	1,520	1,709	1,878	1,975	2,022	1,986	2,013	2,039
2 ADLs	1,173	1,226	1,261	1,253	1,276	1,388	1,595	1,805	1,966	2,060	1,963	1,940	1,995	1,943
3+ ADLs	9,535	10,087	10,607	11,197	11,881	12,540	13,463	14,995	16,813	18,576	20,687	20,185	20,227	21,334
2+ ADLs	10,708	11,313	11,868	12,450	13,157	13,928	15,057	16,800	18,779	20,636	22,649	22,126	22,221	23,277
1+ ADLs	11,823	12,470	13,051	13,668	14,426	15,298	16,577	18,509	20,658	22,611	24,672	24,112	24,234	25,315
0+ ADLs	13,751	14,462	15,116	15,823	16,721	17,785	19,347	21,583	23,955	26,075	28,220	27,610	27,752	28,872

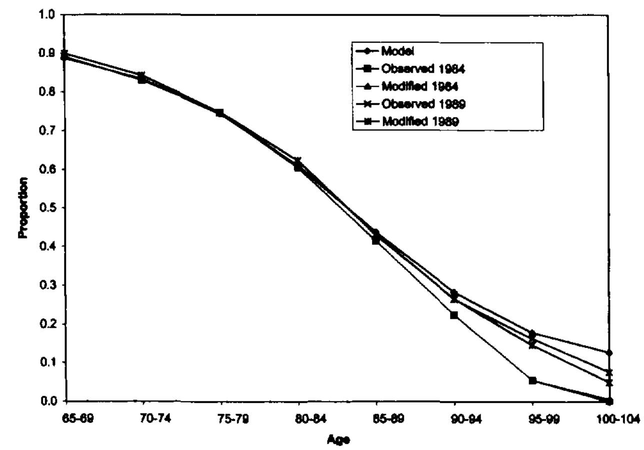
Source: Data from the 1994 National Long-Term-Care Survey, tabulated at the Center for Demographic Studies, Duke University.

Markov Chain Models

Projections based on a Markov chain model are fundamentally different from static component projections. Whereas a static component projection requires good estimates of the prevalence rates for various population characteristics (such as those in Tables 2–13), a Markov chain projection requires good estimates of the transition rates between the various dynamic states of the model. Any population characteristic that is not included in the dynamic part of the model can be represented by using appropriately defined conditional prevalence rates or conditional probabilities, in a manner similar to the second stage of the static component projection method. Thus, a Markov chain projection neither needs nor uses the general population projection developed in the first stage of the static component projection. Indeed, the dynamic part of the Markov chain projection may be viewed as an alternative to the general population projection, albeit one that may have significantly greater detail on health status and other characteristics of the population. Thus, the most critical step in the development of such a projection is the successful validation of the dynamic Markov chain model-based results.

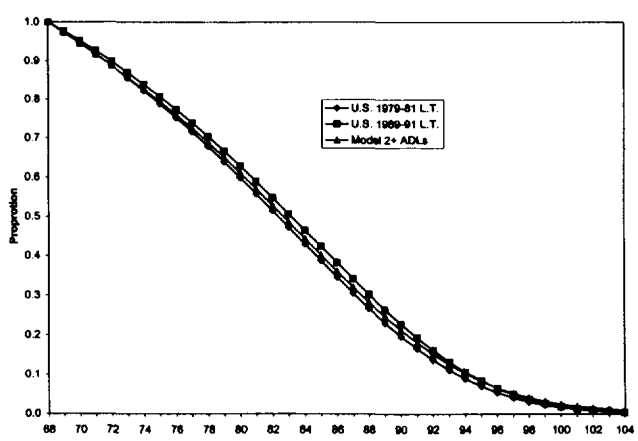
Because projected future values are currently unknown, it is impossible to have 100% confidence in any projection model. What can be done, however, is to compare projection outputs with currently available data, examining the pattern of residuals for clues that might reveal structural flaws in the model. When structural flaws are identified, then one must respecify the flawed part of the model, reestimate any affected parameters, recalculate the projection, and revalidate the

FIGURE 5
OBSERVED AND PREDICTED PREVALENCE OF NONDISABLED PERSONS, BOTH SEXES



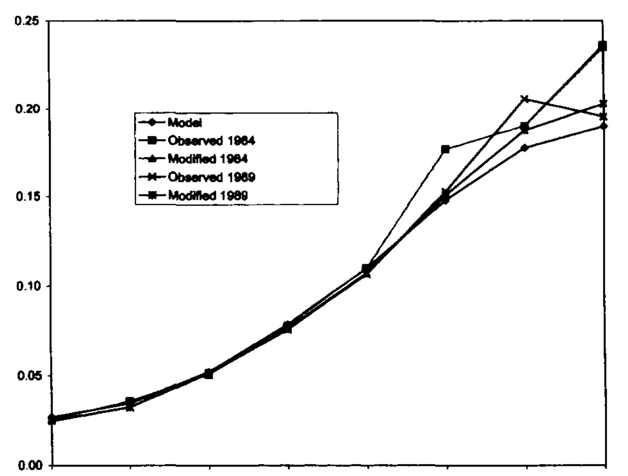
Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

FIGURE 4
OBSERVED AND PREDICTED RELATIVE SURVIVAL, BOTH SEXES: AGE 68+



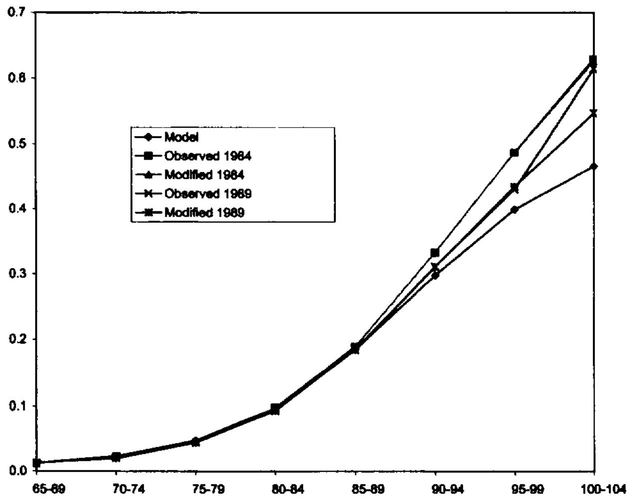
Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

FIGURE 6
OBSERVED AND PREDICTED PREVALENCE OF HCB LONG-TERM CARE, BOTH SEXES



Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

FIGURE 7
OBSERVED AND PREDICTED PREVALENCE OF INSTITUTIONAL LONG-TERM CARE, BOTH SEXES



Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

projection outputs. The broader the range of projection outputs that are evaluated this way, the greater one's confidence in the projection model.

This section presents a simple Markov chain model designed to generate HCB long-term-care incidence and continuance rates for the U.S. elderly population based on HIPAA's 2+ ADL Trigger. The model was validated by comparing the projection results for a broad range of benefit triggers with known patterns of mortality and disability prevalence rates (Stallard and Yee 1999).

For all model variations the predicted mortality survival curves were matched to the survival values reported from age 68 to 95 in the 1979–81 and 1989–91 U.S. decennial life tables (NCHS 1985, 1997). This is illustrated in Figure 4 for the 2+ ADL trigger for both sexes combined for age 68+. The figure clearly shows that the model-based survival curve falls between the survival curves for the U.S. population at the start and end of the 1980s. Given that the model-based mortality rates reflect the experience of the period 1984–89, this part of the model appears quite satisfactory.

In assessing the fit of the model to the observed data in Figure 4, it is worthwhile to remember that the only point that is forced to match is the first point at age 68. Thus, the close fit at age 98 reflects the results of the Markov chain model after 30 annual iteration cycles. This differs, for example, from the goodness-of-fit plots in a regression analysis where the observed and predicted values are forced to match at the mean of the observed values.

Each model variation was also validated by comparing cross-sectional estimates of the prevalence rates from the 1984 and 1989 NLTCS with corresponding prevalence rates derived from the model. This is illustrated in Figures 5–7 for the 2+ ADL trigger for both sexes combined for age 65–69 and above.

In addition to the observed NLTCS data for 1984 and 1989, Figures 5–7 also display plots of "modified" NLTCS data for 1984 and 1989. The modifications are small and generally restricted to the two oldest age groups, and reflect pooling of transition counts to deal with credibility issues relating to small sample sizes at these ages (Stallard and Yee 1999).

Figure 5 shows that about 89% of the population is nondisabled at age 65–69, but that this rate declines to below 18% at age 95–99. At each age there is a higher percentage of nondisabled persons in 1989 than in 1984—consistent with the long-term trends displayed in Figure 3. The model-based results track the 1984 and 1989 observed values from age 65–69 to 80–84, after which there is a higher percentage of nondisabled persons in the model than in either of the NLTCS surveys. These higher model-based values at age 85+ are consistent with temporal declines in age-specific disability rates. Again, it is worth emphasizing that the only point at which the model is forced to match observed data is the first point at age 65–69. The close match between the model and the observed data at all older ages is evidence of the validity of the model structure.

Figure 6 shows that about 2.6% of the population satisfies HIPAA's 2+ ADL Trigger at age 65–69 and that this rate increases to about 11.0% at age 85–89, after which the model-based results diverge downward from the two NLTCS surveys reaching 19.0% at age 100–104. Figure 7 shows that about 1.2% of the population is institutionalized at age 65–69 and that this rate increases to about 18.4% at age 85–89, after which the model-based results again diverge downward from the two NLTCS surveys reaching 46.5% at age 100–104. The lower model-based values at age 85+ in Figures 6 and 7 are consistent with the declines in age-specific disability rates seen in Figures 3 and 5.

The incidence rates for HCB long-term care using the HIPAA 2+ ADL Trigger to define the benefit eligibility state are presented in Tables 14 and 15 for men and women, respectively, and are graphically displayed in Figures 8 and 9. The continuance rates are presented in

Table 14
Incidence Rates for HCB Long-Term Care: Males, 2+ ADLs

Attained Age	Age at Selection[a]											
	Ultimate		Age 65.0		Age 70.0		Age 75.0		Age 80.0		Age 85.0	
	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute
65	0.00772	6395	0.00619	4902								
66	0.00832	6660	0.00667	5123								
67	0.00910	7033	0.00736	5470								
68	0.00963	7172	0.00779	5589								
69	0.01000	7163	0.00809	5595								
70	0.01082	7446	0.00908	6051	0.00504	3198						
71	0.01181	7787	0.01036	6634	0.00709	4350						
72	0.01272	8003	0.01152	7044	0.00884	5204						
73	0.01358	8111	0.01257	7311	0.01036	5820						
74	0.01438	8126	0.01353	7455	0.01170	6242						
75	0.01590	8467	0.01511	7851	0.01342	6769	0.00833	3932				
76	0.01819	9071	0.01740	8476	0.01573	7454	0.01079	4818				
77	0.02065	9575	0.01989	9014	0.01828	8076	0.01360	5699				
78	0.02329	9957	0.02257	9439	0.02104	8600	0.01670	6509				
79	0.02609	10202	0.02542	9732	0.02400	8995	0.02002	7198				
80	0.02918	10350	0.02856	9930	0.02729	9301	0.02374	7802	0.01257	3763		
81	0.03289	10481	0.03234	10109	0.03122	9582	0.02814	8359	0.01870	5134		
82	0.03723	10535	0.03675	10206	0.03577	9765	0.03309	8775	0.02509	6222		
83	0.04213	10456	0.04171	10164	0.04085	9796	0.03853	9001	0.03174	6995		
84	0.04753	10210	0.04716	9951	0.04641	9646	0.04440	9010	0.03860	7445		
85	0.05122	9396	0.05090	9175	0.05026	8927	0.04851	8432	0.04356	7238	0.01948	2682
86	0.05351	8295	0.05323	8112	0.05268	7916	0.05118	7538	0.04700	6651	0.02797	3381
87	0.05612	7293	0.05589	7140	0.05542	6985	0.05415	6700	0.05063	6045	0.03551	3711
88	0.05892	6355	0.05872	6228	0.05831	6106	0.05724	5890	0.05428	5410	0.04217	3749
89	0.06177	5471	0.06160	5366	0.06126	5270	0.06035	5108	0.05786	4757	0.04805	3578
90	0.06511	4681	0.06497	4594	0.06468	4519	0.06391	4397	0.06183	4142	0.05387	3307
91	0.06851	3962	0.06839	3891	0.06814	3831	0.06749	3739	0.06572	3553	0.05915	2954
92	0.07141	3305	0.07130	3247	0.07109	3199	0.07053	3129	0.06900	2991	0.06344	2556
93	0.07396	2728	0.07386	2681	0.07368	2643	0.07318	2589	0.07185	2486	0.06706	2166
94	0.07624	2234	0.07616	2195	0.07599	2166	0.07555	2124	0.07438	2047	0.07020	1809
95	0.07817	1814	0.07810	1784	0.07795	1760	0.07756	1728	0.07652	1669	0.07284	1492
96	0.07977	1464	0.07971	1440	0.07958	1421	0.07923	1396	0.07830	1352	0.07504	1218
97	0.08119	1178	0.08113	1158	0.08101	1143	0.08070	1124	0.07987	1090	0.07697	989
98	0.08245	944	0.08239	929	0.08229	917	0.08201	902	0.08126	876	0.07867	800
99	0.08357	756	0.08352	743	0.08343	734	0.08318	722	0.08251	702	0.08018	644
100	0.08458	603	0.08454	593	0.08445	586	0.08423	577	0.08362	562	0.08152	517
101	0.08549	481	0.08545	473	0.08537	467	0.08517	460	0.08462	449	0.08273	414
102	0.08631	383	0.08627	377	0.08620	372	0.08602	367	0.08552	358	0.08381	331
103	0.08705	305	0.08701	300	0.08695	296	0.08678	292	0.08633	285	0.08479	264
104	0.08771	242	0.08768	238	0.08763	235	0.08747	232	0.08707	226	0.08567	211
105	0.08832	192	0.08829	189	0.08824	187	0.08810	184	0.08773	180	0.08647	168
106	0.08887	152	0.08884	150	0.08880	148	0.08867	146	0.08834	143	0.08719	133
107	0.08937	121	0.08934	119	0.08930	117	0.08919	116	0.08888	113	0.08784	106
108	0.08982	96	0.08980	94	0.08976	93	0.08966	92	0.08938	90	0.08844	84
109	0.09023	76	0.09021	74	0.09017	74	0.09008	73	0.08983	71	0.08897	67

Note: Age-specific relative and absolute annual incidence rate of HCB long-term care among community residents active or mildly disabled at the start of the year, by ultimate and selected subpopulations. Includes transfers to and from institutional long-term care occurring within the year.

Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

[a] Includes only persons who are active at that age.

TABLE 15
INCIDENCE RATES FOR HCB LONG-TERM CARE: FEMALES, 2+ ADLS

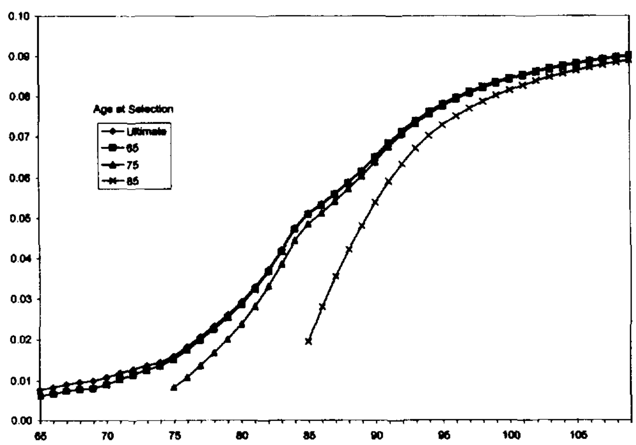
Attained Age	Ultimate		Age at Selection[a] Age 65.0		Age 70.0		Age 75.0		Age 80.0		Age 85.0	
	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute
65	0.00923	8745	0.00574	5026								
66	0.00955	8863	0.00643	5538								
67	0.00985	8950	0.00707	5978								
68	0.00979	8689	0.00738	6119								
69	0.00940	8149	0.00738	5986								
70	0.00971	8204	0.00779	6180	0.00498	3763						
71	0.01076	8846	0.00879	6801	0.00593	4376						
72	0.01203	9599	0.01006	7568	0.00720	5192						
73	0.01353	10451	0.01160	8462	0.00880	6174						
74	0.01527	11381	0.01340	9452	0.01070	7283						
75	0.01732	12404	0.01561	10606	0.01317	8658	0.00596	3580				
76	0.01952	13377	0.01803	11750	0.01593	10071	0.00989	5765				
77	0.02172	14168	0.02044	12693	0.01863	11254	0.01354	7611				
78	0.02392	14754	0.02280	13417	0.02124	12190	0.01695	9119				
79	0.02607	15124	0.02511	13914	0.02377	12872	0.02014	10293				
80	0.02818	15269	0.02738	14194	0.02628	13343	0.02335	11253	0.01338	5482		
81	0.03013	15139	0.02950	14201	0.02865	13529	0.02640	11894	0.01904	7439		
82	0.03189	14729	0.03141	13911	0.03076	13384	0.02905	12113	0.02365	8687		
83	0.03339	14045	0.03302	13334	0.03253	12924	0.03126	11945	0.02735	9322		
84	0.03456	13118	0.03429	12505	0.03393	12189	0.03302	11440	0.03024	9447		
85	0.03762	12767	0.03741	12204	0.03712	11940	0.03639	11321	0.03421	9678	0.02659	5723
86	0.04247	12720	0.04228	12180	0.04202	11947	0.04136	11401	0.03942	9957	0.03296	6515
87	0.04725	12304	0.04707	11800	0.04684	11597	0.04624	11126	0.04452	9881	0.03898	6936
88	0.05196	11593	0.05180	11132	0.05159	10959	0.05105	10560	0.04952	9507	0.04473	7031
89	0.05661	10663	0.05647	10250	0.05628	10105	0.05579	9774	0.05442	8900	0.05026	6853
90	0.06097	9552	0.06082	9187	0.06062	9065	0.06012	8787	0.05871	8052	0.05452	6337
91	0.06536	8405	0.06519	8088	0.06497	7984	0.06441	7750	0.06284	7131	0.05829	5691
92	0.06993	7297	0.06975	7025	0.06952	6940	0.06892	6748	0.06727	6241	0.06256	5064
93	0.07465	6246	0.07447	6016	0.07422	5948	0.07361	5794	0.07192	5389	0.06720	4450
94	0.07947	5269	0.07928	5078	0.07903	5024	0.07842	4904	0.07673	4587	0.07210	3855
95	0.08233	4274	0.08215	4122	0.08192	4082	0.08134	3993	0.07977	3757	0.07553	3216
96	0.08337	3369	0.08321	3251	0.08301	3222	0.08249	3158	0.08109	2989	0.07737	2603
97	0.08435	2650	0.08421	2559	0.08402	2538	0.08356	2492	0.08231	2370	0.07902	2093
98	0.08528	2081	0.08515	2010	0.08498	1995	0.08456	1962	0.08344	1874	0.08050	1674
99	0.08615	1631	0.08604	1576	0.08588	1565	0.08550	1541	0.08448	1477	0.08185	1333
100	0.08687	1275	0.08677	1233	0.08663	1224	0.08628	1207	0.08536	1161	0.08299	1056
101	0.08745	994	0.08736	961	0.08723	955	0.08691	943	0.08608	909	0.08395	833
102	0.08799	774	0.08790	749	0.08779	744	0.08750	735	0.08674	711	0.08482	656
103	0.08849	602	0.08841	583	0.08830	579	0.08804	573	0.08735	555	0.08560	515
104	0.08896	468	0.08888	453	0.08878	451	0.08855	446	0.08791	432	0.08632	403
105	0.08939	363	0.08932	352	0.08923	350	0.08901	346	0.08843	337	0.08698	315
106	0.08979	282	0.08973	273	0.08964	271	0.08944	269	0.08891	262	0.08757	246
107	0.09016	218	0.09010	211	0.09003	210	0.08984	209	0.08935	203	0.08812	192
108	0.09051	169	0.09045	164	0.09038	163	0.09021	162	0.08976	158	0.08863	149
109	0.09083	131	0.09078	127	0.09071	126	0.09055	125	0.09013	122	0.08910	116

Note: Age-specific relative and absolute annual incidence rate of HCB long-term care among community residents active or mildly disabled at the start of the year, by ultimate and selected subpopulations. Includes transfers to and from institutional long-term care occurring within the year.

Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

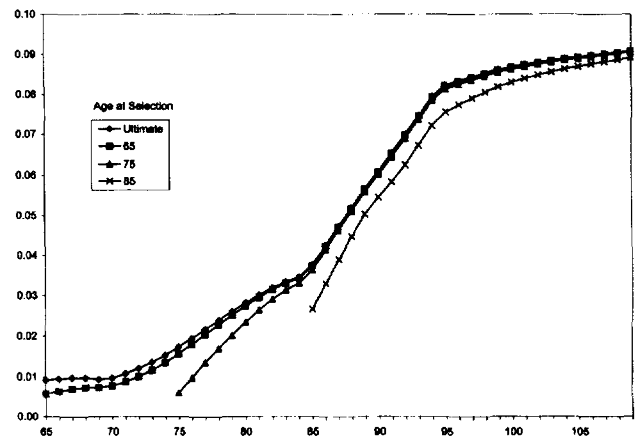
[a] Includes only persons who are active at that age.

FIGURE 8
AGE-SPECIFIC RELATIVE INCIDENCE OF HCB LONG-TERM CARE, MALES



Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

FIGURE 9
AGE-SPECIFIC RELATIVE INCIDENCE OF HCB LONG-TERM CARE, FEMALES

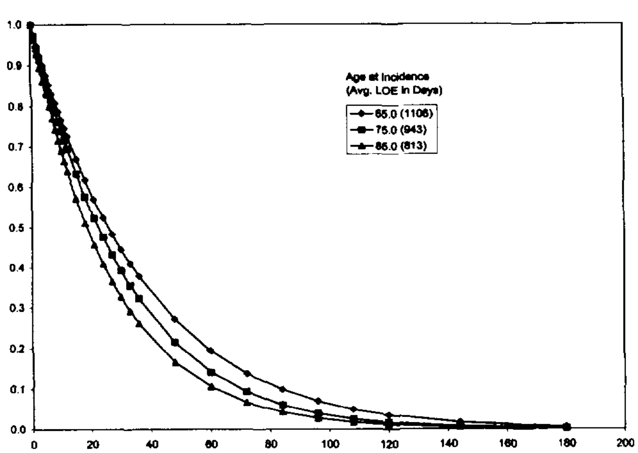


Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

Tables 16 and 17 and are graphically displayed in Figures 10 and 11.

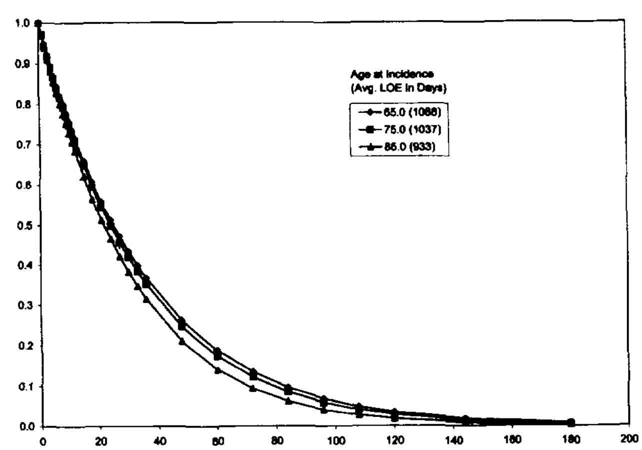
Each age-specific incidence rate is defined as the probability that a community resident classified as active or mildly disabled who reaches the indicated exact age at the start of the year will exceed the 2+ ADL threshold for HCB long-term care at some time during the year, while retaining his or her status as a community resident. Four sets of incidence rates are presented, three based on risk selection at ages 65, 75, or 85, and an ultimate set with no risk selection. Under this model "risk selection" is restricted to classifying the individual

FIGURE 10
DURATION-SPECIFIC CONTINUANCE RATES OF HCB LONG-TERM CARE, MALES



Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

FIGURE 11
DURATION-SPECIFIC CONTINUANCE RATES OF HCB LONG-TERM CARE, FEMALES



Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

TABLE 16
CONTINUANCE RATES FOR HCB LONG-TERM CARE: MALES, 2+ ADLS

Months since Incidence	Age 65.5		Age 70.5		Age 75.5		Age 80.5		Age 85.5		Age 90.5	
	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute
Relative and Absolute Persistence, by Age at Incidence												
0	1.00000	6395	1.00000	7446	1.00000	8467	1.00000	10350	1.00000	9396	1.00000	4681
1	0.97379	6227	0.97228	7239	0.97057	8217	0.96559	9993	0.96351	9053	0.96293	4507
2	0.94824	6064	0.94530	7038	0.94192	7975	0.93234	9649	0.92834	8723	0.92723	4340
3	0.92333	5904	0.91906	6843	0.91403	7739	0.90019	9317	0.89444	8404	0.89286	4179
4	0.89906	5749	0.89352	6653	0.88689	7509	0.86911	8995	0.86177	8097	0.85976	4024
5	0.87540	5598	0.86868	6468	0.86047	7285	0.83908	8684	0.83028	7801	0.82788	3875
6	0.85234	5450	0.84451	6288	0.83476	7068	0.81005	8384	0.79994	7516	0.79719	3732
7	0.82987	5307	0.82099	6113	0.80975	6856	0.78200	8093	0.77070	7242	0.76763	3593
8	0.80797	5167	0.79811	5942	0.78542	6650	0.75488	7813	0.74251	6977	0.73916	3460
9	0.78662	5030	0.77586	5777	0.76174	6449	0.72868	7542	0.71535	6722	0.71175	3332
10	0.76582	4897	0.75420	5616	0.73871	6254	0.70336	7279	0.68918	6476	0.68536	3208
11	0.74555	4767	0.73314	5459	0.71632	6065	0.67890	7026	0.66396	6239	0.65994	3089
12	0.72579	4641	0.71265	5306	0.69453	5880	0.65525	6782	0.63965	6010	0.63547	2975
15	0.66951	4281	0.65447	4873	0.63273	5357	0.58902	6096	0.57190	5374	0.56735	2656
18	0.61744	3948	0.60093	4474	0.57595	4876	0.52929	5478	0.51127	4804	0.50652	2371
21	0.56928	3640	0.55166	4107	0.52384	4435	0.47545	4921	0.45703	4294	0.45221	2117
24	0.52474	3355	0.50634	3770	0.47604	4030	0.42693	4419	0.40850	3838	0.40372	1890
27	0.48357	3092	0.46465	3460	0.43225	3660	0.38323	3966	0.36508	3430	0.36042	1687
30	0.44552	2849	0.42631	3174	0.39217	3320	0.34388	3559	0.32625	3066	0.32176	1506
33	0.41037	2624	0.39106	2912	0.35551	3010	0.30846	3192	0.29152	2739	0.28724	1345
36	0.37790	2416	0.35866	2670	0.32201	2726	0.27659	2863	0.26046	2447	0.25643	1200
48	0.27113	1734	0.25329	1886	0.21495	1820	0.17818	1844	0.16581	1558	0.16283	762
60	0.19382	1239	0.17807	1326	0.14176	1200	0.11420	1182	0.10541	990	0.10338	484
72	0.13812	883	0.12368	921	0.09289	786	0.07305	756	0.06698	629	0.06563	307
84	0.09814	628	0.08477	631	0.06052	512	0.04665	483	0.04255	400	0.04167	195
96	0.06952	445	0.05734	427	0.03921	332	0.02975	308	0.02703	254	0.02645	124
108	0.04909	314	0.03828	285	0.02526	214	0.01894	196	0.01716	161	0.01679	79
120	0.03451	221	0.02524	188	0.01619	137	0.01204	125	0.01090	102	0.01066	50
144	0.01643	105	0.01078	80	0.00661	56	0.00486	50	0.00439	41	0.00430	20
180	0.00489	31	0.00288	21	0.00171	14	0.00124	13	0.00112	11	0.00110	5
Proportion of Disability Days and Average Length of Episode, by Age, at Incidence												
0	1.00000	1106	1.00000	1043	1.00000	943	1.00000	847	1.00000	813	1.00000	805
1	0.97284	1105	0.97123	1042	0.96820	941	0.96466	846	0.96325	813	0.96289	805
2	0.94639	1104	0.94326	1041	0.93734	938	0.93054	845	0.92785	813	0.92715	805
3	0.92064	1103	0.91607	1040	0.90739	936	0.89759	844	0.89373	813	0.89274	805
4	0.89556	1102	0.88963	1039	0.87832	934	0.86579	843	0.86086	812	0.85961	805
5	0.87115	1101	0.86392	1038	0.85012	932	0.83507	842	0.82920	812	0.82770	805
6	0.84737	1100	0.83893	1036	0.82277	929	0.80543	842	0.79869	812	0.79697	805
7	0.82422	1098	0.81464	1035	0.79623	927	0.77680	841	0.76929	812	0.76739	805
8	0.80169	1097	0.79102	1034	0.77049	925	0.74917	840	0.74097	811	0.73890	805
9	0.77975	1096	0.76806	1033	0.74552	923	0.72250	839	0.71369	811	0.71147	805
10	0.75838	1095	0.74575	1032	0.72130	921	0.69676	839	0.68740	811	0.68506	805
11	0.73759	1094	0.72405	1030	0.69782	919	0.67190	838	0.66208	811	0.65962	805
12	0.71434	1093	0.70296	1029	0.67505	917	0.64792	837	0.63768	811	0.63513	805

(continued)

Table 16 (Continued)
Continuance Rates for HCB Long-Term Care: Males, 2+ ADLs

Months since Incidence	Age 65.5 Relative	Age 65.5 Absolute	Age 70.5 Relative	Age 70.5 Absolute	Age 75.5 Relative	Age 75.5 Absolute	Age 80.5 Relative	Age 80.5 Absolute	Age 85.5 Relative	Age 85.5 Absolute	Age 90.5 Relative	Age 90.5 Absolute
	Proportion of Disability Days and Average Length of Episode, by Age, at Incidence											
15	0.65977	1090	0.64317	1025	0.61083	910	0.58056	835	0.56972	810	0.56697	804
18	0.60667	1087	0.58826	1021	0.55235	904	0.52060	833	0.50896	809	0.50612	804
21	0.55770	1084	0.53785	1017	0.49914	899	0.46645	830	0.45464	809	0.45180	804
24	0.51256	1080	0.49158	1013	0.45076	893	0.41782	828	0.40609	808	0.40329	804
27	0.47096	1077	0.44911	1008	0.40682	888	0.37416	826	0.36270	808	0.35999	804
30	0.43262	1074	0.41015	1004	0.36693	882	0.33498	825	0.32392	807	0.32134	804
33	0.39731	1071	0.37440	999	0.33076	877	0.29983	823	0.28927	807	0.28683	804
36	0.36478	1068	0.34161	994	0.29798	873	0.26830	821	0.25831	806	0.25602	804
48	0.25855	1055	0.23553	970	0.19526	857	0.17168	816	0.16414	805	0.16249	803
60	0.18246	1041	0.16074	942	0.12711	846	0.10960	812	0.10424	804	0.10311	803
72	0.12815	1026	0.10844	915	0.08231	836	0.06985	809	0.06617	803	0.06540	802
84	0.08951	1009	0.07234	890	0.05303	826	0.04444	806	0.04198	802	0.04147	801
96	0.06208	988	0.04775	869	0.03400	818	0.02823	803	0.02661	801	0.02627	800
108	0.04269	962	0.03121	851	0.02171	810	0.01790	800	0.01685	798	0.01663	797
120	0.02901	930	0.02024	837	0.01381	804	0.01132	796	0.01066	795	0.01050	793
144	0.01285	865	0.00832	806	0.00552	787	0.00449	783	0.00423	782	0.00415	777
180	0.00333	752	0.00201	727	0.00130	720	0.00106	719	0.00099	719	0.00095	698

Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

TABLE 17
CONTINUANCE RATES FOR HCB LONG-TERM CARE: FEMALE, 2 + ADLS

Months since Incidence	Age 65.5		Age 70.5		Age 75.5		Age 80.5		Age 85.5		Age 90.5	
	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute
Relative and Absolute Persistence, by Age at Incidence												
0	1.00000	8745	1.00000	8204	1.00000	12404	1.00000	15269	1.00000	12767	1.00000	9552
1	0.97268	8506	0.97256	7978	0.97153	12051	0.97081	14824	0.96903	12372	0.96665	9234
2	0.94609	8274	0.94586	7759	0.94386	11707	0.94244	14391	0.93897	11988	0.93438	8925
3	0.92022	8048	0.91988	7546	0.91697	11374	0.91488	13970	0.90982	11616	0.90316	8627
4	0.89505	7827	0.89459	7339	0.89084	11050	0.88810	13561	0.88153	11254	0.87294	8338
5	0.87056	7613	0.86998	7137	0.86544	10735	0.86207	13163	0.85408	10904	0.84371	8059
6	0.84672	7405	0.84603	6940	0.84076	10429	0.83679	12777	0.82746	10564	0.81542	7789
7	0.82353	7202	0.82273	6749	0.81678	10131	0.81222	12402	0.80163	10234	0.78806	7528
8	0.80097	7005	0.80005	6563	0.79347	9842	0.78835	12038	0.77657	9915	0.76159	7275
9	0.77902	6813	0.77798	6382	0.77082	9561	0.76516	11683	0.75227	9604	0.73598	7030
10	0.75766	6626	0.75651	6206	0.74880	9288	0.74263	11339	0.72870	9303	0.71120	6793
11	0.73688	6444	0.73562	6035	0.72741	9023	0.72074	11005	0.70583	9011	0.68724	6565
12	0.71666	6267	0.71529	5868	0.70662	8765	0.69948	10681	0.68366	8728	0.66405	6343
15	0.65923	5765	0.65753	5394	0.64772	8034	0.63927	9761	0.62108	7929	0.59896	5721
18	0.60634	5303	0.60434	4958	0.59367	7364	0.58409	8919	0.56401	7201	0.54008	5159
21	0.55763	4877	0.55536	4556	0.54408	6749	0.53353	8147	0.51199	6537	0.48683	4650
24	0.51279	4485	0.51026	4186	0.49859	6184	0.48722	7439	0.46460	5932	0.43868	4190
27	0.47151	4123	0.46874	3845	0.45686	5667	0.44481	6792	0.42144	5381	0.39517	3775
30	0.43351	3791	0.43053	3532	0.41858	5192	0.40599	6199	0.38215	4879	0.35586	3399
33	0.39859	3486	0.39537	3243	0.38348	4757	0.37046	5657	0.34638	4422	0.32035	3060
36	0.36653	3205	0.36302	2978	0.35129	4357	0.33795	5160	0.31385	4007	0.28829	2754
48	0.26241	2295	0.25757	2113	0.24714	3065	0.23342	3564	0.21075	2691	0.18848	1800
60	0.18811	1645	0.18230	1495	0.17355	2153	0.16051	2451	0.14069	1796	0.12268	1172
72	0.13455	1177	0.12882	1057	0.12139	1506	0.10973	1676	0.09343	1193	0.07980	762
84	0.09599	839	0.09089	746	0.08456	1049	0.07457	1139	0.06172	788	0.05190	496
96	0.06829	597	0.06404	525	0.05865	727	0.05038	769	0.04056	518	0.03375	322
108	0.04845	424	0.04505	370	0.04051	502	0.03383	517	0.02652	339	0.02195	210
120	0.03429	300	0.03164	260	0.02786	346	0.02258	345	0.01726	220	0.01427	136
144	0.01710	150	0.01541	126	0.01294	161	0.00991	151	0.00730	93	0.00603	58
180	0.00595	52	0.00508	42	0.00392	49	0.00277	42	0.00201	26	0.00166	16
Proportion of Disability Days and Average Length of Episode, by Age at Incidence												
0	1.00000	1088	1.00000	1070	1.00000	1037	1.00000	995	1.00000	933	1.00000	875
1	0.97241	1088	0.97196	1070	0.97106	1036	0.96984	994	0.96787	932	0.96580	874
2	0.94558	1088	0.94468	1069	0.94294	1036	0.94057	993	0.93674	930	0.93275	874
3	0.91948	1087	0.91816	1068	0.91563	1035	0.91215	992	0.90657	929	0.90080	873
4	0.89409	1087	0.89236	1068	0.88909	1035	0.88456	991	0.87734	928	0.86991	872
5	0.86940	1087	0.86728	1067	0.86331	1034	0.85779	990	0.84901	927	0.84006	871
6	0.84538	1086	0.84288	1067	0.83826	1034	0.83179	989	0.82158	926	0.81121	871
7	0.82202	1086	0.81916	1066	0.81393	1033	0.80656	988	0.79499	925	0.78333	870
8	0.79930	1086	0.79609	1065	0.79030	1033	0.78207	987	0.76924	924	0.75638	869
9	0.77721	1086	0.77365	1065	0.76733	1032	0.75830	986	0.74429	923	0.73034	869
10	0.75572	1085	0.75184	1064	0.74503	1032	0.73523	985	0.72013	922	0.70518	868
11	0.73481	1085	0.73063	1063	0.72336	1031	0.71284	984	0.69672	921	0.68086	867
12	0.71449	1085	0.71000	1063	0.70231	1030	0.69111	983	0.67404	920	0.65737	866

(*continued*)

TABLE 17 (CONTINUED)
CONTINUANCE RATES FOR HCB LONG-TERM CARE: FEMALE, 2 + ADLS

	Proportion of Disability Days and Average Length of Episode, by Age at Incidence											
	Age 65.5		Age 70.5		Age 75.5		Age 80.5		Age 85.5		Age 90.5	
Months since Incidence	**Relative**	**Absolute**	**Relative**	**Absolute**	**Relative**	**Absolute**	**Relative**	**Absolute**	**Relative**	**Absolute**	**Relative**	**Absolute**
15	0.65679	1084	0.65148	1061	0.64270	1029	0.62969	980	0.61021	916	0.59153	864
18	0.60372	1084	0.59769	1059	0.58806	1027	0.57357	977	0.55224	913	0.53216	862
21	0.55491	1083	0.54825	1057	0.53798	1025	0.52230	974	0.49960	910	0.47863	860
24	0.51002	1082	0.50283	1055	0.49209	1023	0.47547	971	0.45182	907	0.43039	859
27	0.46875	1082	0.46109	1053	0.45004	1021	0.43271	968	0.40848	904	0.38692	857
30	0.43080	1081	0.42276	1051	0.41151	1019	0.39368	964	0.36916	901	0.34778	855
33	0.39590	1081	0.38755	1049	0.37621	1017	0.35806	961	0.33352	898	0.31253	854
36	0.36382	1080	0.35523	1048	0.34387	1015	0.32556	958	0.30123	895	0.28081	852
48	0.25925	1075	0.25035	1040	0.23951	1005	0.22179	945	0.19978	884	0.18274	849
60	0.18433	1066	0.17603	1034	0.16614	993	0.15026	931	0.13184	874	0.11877	847
72	0.13066	1057	0.12347	1026	0.11471	980	0.10120	917	0.08661	865	0.07716	846
84	0.09233	1047	0.08636	1017	0.07881	966	0.06775	904	0.05664	856	0.05009	845
96	0.06501	1036	0.06019	1006	0.05385	952	0.04509	890	0.03689	848	0.03249	843
108	0.04560	1024	0.04176	992	0.03657	936	0.02982	877	0.02394	842	0.02104	839
120	0.03185	1011	0.02881	975	0.02466	918	0.01960	863	0.01550	837	0.01360	834
144	0.01526	971	0.01339	930	0.01093	875	0.00828	831	0.00643	821	0.00561	814
180	0.00461	843	0.00383	808	0.00291	769	0.00208	749	0.00161	748	0.00137	724

Source: Data from the 1984 and 1989 National Long-Term-Care Surveys, tabulated at the Center for Demographic Studies, Duke University, following procedures described in Stallard and Yee (1999).

as being "active" at the time of selection; mildly disabled individuals are excluded. Figures 8 and 9 show that the impact of risk selection persists for 10–15 years and that the effect is larger at older ages of selection. The convergence of the select and ultimate incidence curves is due to the accumulation of increasing proportions of mildly disabled persons in the select population over time. The relative smoothness of the incidence curves results from applying linear interpolation to the monthly transition probability matrices of the Markov chain model.

Figures 10 and 11 show that the length-of-episode (LOE) declines substantially with increasing age at incidence. For incidence at age 65, the average length of a HCB long-term-care episode is 1,106 days (3.0 years) for men and 1,088 days (also 3.0 years) for women. This drops to 813 days (2.2 years) and 933 days (2.6 years), respectively, at age 85.

In interpreting these incidence and continuance rates, it should be remembered that these rates reflect the experience of a noninsured population so that additional adjustments may be required if one wished to apply them to an insured population. Furthermore, these rates are based on one interpretation of the rules for the HIPAA ADL Trigger. Alternative interpretations can yield incidence and continuance rates that differ significantly (Stallard and Yee 1999).

Discussion

The purpose of this paper is twofold: to introduce the reader to issues related to the relatively predictable decline of health in the elderly population during retirement, and to provide health-related estimates and statistics sufficiently detailed to be useful in financial calculations related to retirement planning.

The analyses in this paper are based on an underlying theoretical perspective that views health as a complex lifelong biological process that begins prior to birth, establishes an identifiable pattern during the developmental period, evolves further during reproductive and postreproductive years, and is manifest in a range of medical conditions, diseases, disabilities, and functional limitations during the retirement years. This perspective provides a paradigm through which one can build credible models of the future health of the elderly. This perspective allows consistent and integrated approaches to issues related to heterogeneity of the population with respect to susceptibility to disease and disability; persistency of individual health statuses, especially those involving chronic conditions; and population momentum with respect to measures of life expectancy, active life expectancy, and disability-free life expectancy.

A fundamental step in this direction was provided by Verbrugge and Jette (1994), who described a sociomedical model of disability, the "disablement process." Under this model the disablement process initiates with some type of pathology (disease, injury, or congenital condition), which leads to an impairment (dysfunction or significant structural abnormality in affected body systems), which leads to functional limitations (restrictions in performing fundamental physical and mental actions required in daily life), which lead to disability (difficulty doing activities in any domain of life; for example, ADL, IADL, and job activities). Verbrugge and Jette stressed the importance of clearly distinguishing functional limitations from disability, emphasizing that rather than being a personal characteristic, disability is a gap between personal capability and environmental demand. Multiple disablement processes can occur in a given individual, and the impairments within each process can be affected by social, lifestyle, behavioral, psychological, environmental, and biological risk factors. Functional limitations are affected by extra-individual factors including medical care, rehabilitation, medications, therapy, external support, and physical and social environment; and by intra-individual factors including lifestyle, behavior, psychosocial factors, and activity accommodations. The disability phase of the process responds to interventions (for example, personal assistance and special equipment) and exacerbators (for example, side effects of medications, self-destructive behaviors, and external impediments). Prevention efforts can be directed toward averting the onset of pathology, detecting and managing pathology, reducing disease impacts, and maintaining and restoring function.

The conceptualization of the disablement process proposed by Verbrugge and Jette (1994) builds on earlier work by Nagi (1965, 1976) and by the World Health Organization (1980) in formulating the International Classification of Impairments, Disability, and Handicaps (ICIDH). Lawrence and Jette (1996) evaluated the hypothesis of the model that functional limitations are intermediary stages between risk factors and IADL disability. Additional supporting evidence was provided by Fuchs et al. (1998), who evaluated the impact of chronic conditions on the development of disability and found significant roles for stroke, hip fracture, diabetes, osteoporosis, anemia, heart attack, urinary/kidney disease, respiratory disease, and Parkinson's disease. However, there is uncertainty in the mechanisms connecting disease and disability. For example, Hogan, Ebly, and Fung (1999) evaluated the association of disease and disability among two groups of cognitively intact persons aged 65–84 and 85+ and found that disability occurred among the older group even in those without explanatory disease. In contrast, depression, stroke, and respiratory problems were significant risk factors for disability in the younger age group.

The extension of the time frame of the disablement process to the entire lifespan follows naturally from research connecting adult onset diseases to genetic predispositions, prenatal and postnatal environments, and childhood diseases. For example, Elo and Preston (1992) reviewed the epidemiologic literature on childhood health conditions that influence adult mortality and found significant impacts for respiratory tuberculosis, hepatitis B, cirrhosis/liver cancer, rheumatic heart disease, respiratory infection and bronchitis, persistent viruses, and dietary practices. They concluded that an individual's height was an excellent indicator of nutritional and disease environment in childhood and was also an excellent predictor of adult mortality, especially for death due to cardiovascular disease.

Mosley and Gray (1993) extended the analysis of Elo and Preston (1992), with a greater focus on maintaining and expanding programs to promote child health in the developing world. They identified childhood conditions in a range of areas including perinatal conditions, infectious diseases, nutritional deficiencies, and environmental hazards, all of which have significant health consequences in adults. Barker (1997) evaluated the relationships between maternal nutrition, fetal nutrition, and diseases developing in adult life and concluded that human fetuses adapt to limited supplies of nutrients in a way that permanently changes their physiology and metabolisn. They linked these changes to persistent changes in blood pressure, cholesterol metabolism, insulin-glucose response, and other metabolic, endocrine, and immune functions. Barker argued that the role of the intrauterine environment is essentially independent of genetic factors, based on half-sib birthweight correlations equal to 0.58 when the mother is the shared parent versus 0.10 when the father is the shared parent.

Genetic factors are important, but not dominant, in determining longevity. Ljungquist et al. (1998) estimated that a maximum of one-third of the variance in longevity was attributable to genetic factors in the Swedish Twin Registry data. However, genetic factors may be more important in determining the onset of specific diseases. For example, Gatz et al. (1997) found a concordance rate of 67% for Alzheimer's disease among monozygotic twins in the same data. Marenberg et al. (1994) evaluated the relative hazard of death from coronary heart disease and found strong genetic effects at younger ages (that is, for men below age 55; for women below age 65), but these effects dissipated by age 85. Neel (1997) discussed the role of genetic and epigenetic factors in a disease complex involving non-insulin-dependent diabetes mellitus, essential hypertension, and obesity and the difficulties in untangling the causal pathways in this complex array of conditions. These difficulties are exemplified in a paper by Cooper and Rotimi (1994) that reviewed evidence for and against a genetic basis of hypertension in persons of African origin.

The role of genetic factors in human health and longevity opens several avenues of investigation that might help us better understand the limits to longevity and the potential for improvement in health at older ages. First, recent efforts at interdisciplinary approaches to evolutionary biology provide a theoretical basis for understanding the transmission of longevity characteristics from one generation to the next, the role of reproductive fitness in that transmission, and the biological trade-offs that may affect the trajectories of morbidity, disability, and mortality in the post-reproductive years (Wachter and Finch 1997).

Second, the payoff for fundamental research in genetics, molecular biology, and cell biology will include a better understanding of the genetic variability of existing human populations and improved capacity for the treatment and prevention of disease and disability. Schwartz (1998) argued that improved understanding of the role of genes in human health will ultimately lead to life without disease, and that significant progress in this regard will be accomplished by 2050. Singer and Manton (1998) argued that appropriate public health and biomedical research investments could be implemented to yield a sustained decline in disability of 1.5% per year through 2070.

Third, Fogel and Costa (1997) argued for an expansion of the evolutionary approach to encompass a "technophysio-evolution" based on a synergism between technological and physiological improvements in human biological fitness. This theory is supported by evidence that profound changes in human physiology have occurred over the past 300 years, resulting in greatly improved robustness and capacity of vital organs systems, and average body sizes that have increased by over 50%. Factors associated with increases in height and weight jointly explained about 90% of the decline in French mortality rates between 1785 and 1870, and about 50% thereafter (Fogel and Costa 1997, p. 54).

Fogel and Costa (p. 61) presented data indicating continued increases in mean final height of native-born white American males, through birth years as late as 1970. Given the established correlation between height and life expectancy (Elo and Preston 1992), it can be argued that significant improvements in life expectancy will be seen through at least 2035.

Costa (1998) compared a range of health indicators obtained from Union Army veterans in 1900 and 1910 with more recent U.S. data from the National Health and Nutrition Examination Surveys from 1971–80 and 1988–94. The shift from manual to white-collar occupations and reduced exposure to infectious diseases were cited as important factors in explaining declines of 70% for respiratory conditions; 90% for irregular pulse rates, heart murmurs, and valvular diseases; 60% for atherosclerosis; and 30% for joint/back problems.

Quantification of the impact of various causitive factors is extremely difficult, and the numerical values obtained are, at best, just ballpark estimates. Manton, Stallard, and Corder (1997b) reviewed a range of factors potentially affecting cohort health back to 1880 and discussed how those factors might affect the current and future mortality risks of major chronic diseases. Factors considered include

- Maternal and fetal malnutrition and their impact on adult coronary heart disease and stroke
- Micro-nutrients, including vitamins A, B-6, C, D, and E, cod liver oil, irradiated milk, and red meats, and their impacts on iron absorption, osteoporosis, arterial lesions, human growth hormone, and circulatory disease
- Potential impacts of viral or bacterial infections and of commercial food processing, salt, nitrates, and agricultural fertilizers on coronary heart disease, atherosclerosis, autoimmune and inflammatory processes, stomach cancer, liver cancer, stomach ulcer, duodenal ulcer, and blood pressure.

The identification of cohort effects is particularly important in forecasting. This is because the lifespan of a cohort extends up to a century or more so that factors affecting a cohort's health early in life can have consequences up to a century later. This generates a type of population momentum, with respect to life expectancy, active life expectancy, and disability-free life expectancy, that can be used as a theoretical basis for forecasting models. The need for a theoretical basis was stressed by Gutterman and Vanderhoof (1998), who pointed out that standard forecasting methods, including those used by Lee and Carter (1992) and Bell (1997), contain no theory or structural model for mortality. Gutterman and Vanderhoof (1998) called for research to produce a comprehensive theory of mortality that would improve our understanding of the underlying processes and enhance our ability to adequately produce forecasts.

An understanding of the underlying processes would serve two purposes. First, it would allow us to better understand the unprecedented gains in life expectancy and health that have been attained in the U.S. over the past century, especially over the past 60 years. For example, life expectancy at age 65 for females increased from 13.2 years in 1935 to 19.0 years in 1995, a 44% relative increase (Bell 1997). These life expectancy increases can be linked to declines in major causes of death. Mortality data for 1950–95 indicate a 55.0% decline for heart disease and a 70.3% decline for stroke (NCHS 1998, p. 203, both sexes). Even the death rate for cancer, which increased 3.6% over the same period, has been declining since 1990, with a cumulative decline of 3.8% for the period 1990–95. Thus, an understanding of gains in life expectancy is intimately linked to an understanding of mortality reductions in major chronic diseases.

Second, an understanding of these processes would allow us to better anticipate the types and levels of gains in health and life expectancy that might be attained in the U.S. over the next century. For example, the relatively large declines in disability rates observed between the 1982 and 1994 NLTCS should alert us to the possibility of continued significant improvement in the health of the U.S. elderly population (Manton et al. 1997a; Singer and Manton 1998).

Those responsible for retirement planning are mainly concerned with the cost consequences of the outcomes of this health process, especially costs that have to be borne by individual retirees. These costs are often separated into acute-care versus long-term care costs, and then considered independently. From a financing perspective this may make sense because acute care for the elderly is primarily covered by the Medicare program, and even this is supplemented with private Medigap insurance for nearly two-thirds of the elderly (Eppig and Chulis 1997). However, long-term-care costs for the elderly appear to be largely ignored in financial planning for retirement, as evidenced by Wiener et al.'s (1996) finding that about 40% of patients admitted to nursing homes are eligible for Medicaid assistance at the time of admission. From the perspective of financial planning, this is an area that should be given greater consideration.

With respect to long-term care, two issues need to be addressed relatively quickly. First, the extent to which long-term-care insurance is a reasonable potential solution for financing the care needed to address the problems of the frail elderly needs to be determined. About 6–7% of the elderly currently owns long-term-care policies, and this rate is the result of substantial growth over the past decade. Concern about the cost of these policies may be a deterrent to purchase at older ages, but not at younger ages. The high cost of these policies at older ages reflects the high risk at these ages, and one might expect this to be a motivator, rather than a deterrent, for the purchase of such policies.

Second, the extent to which new rules imposed by HIPAA are based on a model of the disablement process that incompletely describes the health status, impairments, functional limitations, and disabilities of the elderly needs to be determined. In particular, it needs to be established whether HIPAA imposes rules that will prevent or obfuscate attempts of innovative long-term-care insurers to provide appropriate and necessary care for the frail elderly.

With respect to acute health care, the projected insolvency of Part A of the Medicare program should be an area of continuing concern. Given current financial strains on the Medicare program, it is unlikely that there will be a major expansion of benefits anytime in the near future, and it is quite possible that there will be benefit cutbacks. The inability of the National Bipartisan Commission on the Future of Medicare to reach a consensus on recommendations for reform suggests that it will continue to be very difficult to deal with the insolvency issue. Thus, it may be important for those planning the financing of retirement to consider the potential impact of various reform proposals on specific clients.

It should be stressed that health is not independent of life expectancy and that different persons reach retirement in different states of health. Thus, for someone in extremely good or extremely poor health it may be inappropriate to perform financial calculations related to their survival and health using population-based life tables or population-based health expenditure distributions. In such cases, it may be necessary to develop customized life tables and expenditure distributions appropriate to the health status of the given client.

Furthermore, Lubitz and Riley (1993) found that about 52% of Medicare payments between 1976 and 1988 were made for care provided during the last 60 days of life and that this expenditure rate held steady throughout the entire study period. Lubitz, Beebe, and Barker (1995) evaluated the effect on Medicare spending of increased longevity and found that estimated undiscounted lifetime Medicare payments increased only modestly for persons whose deaths occurred after age 80. With appropriate discounting the lifetime costs at age 65 could actually be stable or declining for persons whose deaths occur above age 80. These findings led Lubitz to the conclusion that increased longevity among the elderly may have only a modest impact on Medicare expenditures. To the extent that individual retiree expenditures are correlated with Medicare expenditures this conclusion would also apply to them.

Finally, it should be recognized that rapid increases in longevity associated with improved health and reduced disability could significantly impact the life tables used to plan for retirement income. The impact would be larger for younger clients because of the longer time until they reach high-mortality ages. One way to deal with this would be to perform financial calculations using life tables whose mortality rates declined 0.5% per year faster than in standard tables, equivalent to an additional increase in life expectancy at age 65 of about 0.6 years each calendar decade. Based on the distributions reported by Rosenberg and Luckner (1998), this could provide sufficient margin in the calculations to guard against this risk.

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See the discussion of this paper by Ron Solomon (p. 210).