Special Article

THE EFFECT OF LONGEVITY ON SPENDING FOR ACUTE AND LONG-TERM CARE

BRENDA C. SPILLMAN, PH.D., AND JAMES LUBITZ, M.P.H.

ABSTRACT

Background The proportion of the population made up of elderly persons in the United States is projected to increase from 13 percent of the population in 2000 to 20 percent by 2030. The implications for health care expenditures may be profound, because elderly persons use health care services at a greater rate than younger persons. We estimated total expenditures for acute and long-term care from the age of 65 years until death and in the last two years of life.

Methods We combined data from Medicare, the National Mortality Followback Survey, and the National Medical Expenditure Survey to estimate total national expenditures for health care according to the age at death. We also simulated expenditures with the use of projected demographic characteristics of two cohorts: people turning 65 in 2000 and those turning 65 in 2015.

Results Total expenditures (in 1996 dollars) from the age of 65 years until death increase substantially with longevity, from $31,181 for persons who die at the age of 65 years to more than $200,000 for those who die at the age of 90, in part because of steep increases in nursing home expenditures for very old persons. Spending in the last two years of life also increases with longevity, but a reduction in Medicare expenditures ($37,000 for persons who die at the age of 75 years and $21,000 for those who die at the age of 95) moderates the effect of the increase in nursing home expenditures ($6,000 for those who die at the age of 75 years and $32,000 for those who die at the age of 95). Health care spending for women is consistently higher than that for men, after adjustment for the increased longevity of women. Simulations show that increased longevity after the age of 65 years has a relatively small effect on the anticipated increase in spending, especially for services covered by Medicare, from 2000 to 2015. The effects of the larger number of people born in 1950 than in 1935 and the larger number of people surviving to the age of 65 years are much more important.

Conclusions In the United States, the effect of longevity on expenditures for acute care differs from its effect on expenditures for long-term care. Acute care expenditures, principally for hospital care and physicians' services, increase at a reduced rate as the age at death increases, whereas expenditures for long-term care increase at an accelerated rate. Increases in longevity after the age of 65 years may result in greater spending for long-term care, but the increase in the number of elderly persons has a more important effect on total spending. (N Engl J Med 2000; 342:1409-15.)

IN the United States, the proportion of the population made up of persons 65 years of age or older is projected to increase from 13 percent of the population in 2000 to 20 percent by 2030 because of the aging of the baby-boom generation and increased longevity.[1] The implications for the delivery and financing of health care will be profound, because elderly persons use health care services at a greater rate than younger persons. The larger number of elderly persons will put greater pressure on the budget for the Medicare program. Increases in the number of persons 85 years of age or older, who are most likely to require nursing home and other long-term care, will exert similar pressure on the Medicaid program, which pays for about half the total costs of nursing home care.[2]

Longitudinal studies of health care use provide a unique perspective on the relation of demographic factors to spending. Previous studies have estimated lifetime Medicare expenses according to the age at death[3,4] and the lifetime use and cost of nursing home care for all elderly persons.[5,6] However, these studies examined two major areas of health care spending in isolation, and the studies of nursing home care did not estimate spending according to the age at death. Studies of health care expenditures at the end of life have shown that expenditures for acute care fall and those for nursing home care rise as the age at death increases.[7-10] We estimated total expenditures for Medicare-covered services, nursing home care, and other services from the age of 65 years until death and in the last two years of life in order to determine the contribution of the aging of the population to health care costs. We also examined differences in expenditures for acute and long-term care according to sex.

METHODS

We used sources of data and methods that have been described elsewhere and are summarized here.[3,5,6,11] We estimated expenditures in three categories. The first category was expenditures for services covered by Medicare, plus estimated cost sharing by beneficiaries. The second category was expenditures for nursing home care, excluding care at a skilled nursing facility that was covered

From the Urban Institute, Washington, D.C. (B.C.S.); and the Office of Analysis, Epidemiology, and Health Promotion, National Center for Health Statistics, Hyattsville, Md., and the Office of Strategic Planning, Health Care Financing Administration, Baltimore (J.L.). Address reprint requests to Dr. Spillman at the Urban Institute, Health Policy Center, 2100 M St., NW, Washington, DC 20037, or at bspillma@ui.urban.org.

by Medicare. The third category was expenditures for other services or items not covered by Medicare, including home care, prescription drugs, vision care, dental care, and durable medical equipment.

Data from the 1987 National Medical Expenditure Survey and the Health Care Financing Administration (HCFA)[12] indicate that these three categories account for nearly all annual health care expenditures for the elderly. Medicare-covered services and nursing home care alone account for about 75 percent of these expenditures.

For each category of spending, we estimated the mean expenditure in constant 1996 dollars for each year of life from the age of 65 years until death and then summed the mean expenditures for each age at the time of death. We then used regression analysis to fit curves to lifetime expenditures for each category. When possible, we estimated expenditures separately according to sex.

Medicare Expenditures

Medicare data are from the Continuous Medicare History Sample, which contains longitudinal information on a 5 percent random sample of beneficiaries. The file contains information from providers' claims and enrollment records and reflects payments only for services covered by Medicare. For beneficiaries covered by both Part A and the optional supplemental medical insurance provided in Part B, Medicare pays for inpatient and outpatient services, up to 100 days in a skilled nursing facility, certain home health care services, services of physicians and other medical providers, and hospice care. Medicare does not pay for prescription drugs, nor does it pay for nursing home care apart from the maximum of 100 days in a skilled nursing facility or home care that does not meet the requirements for coverage. In 1996, Medicare paid for 10 percent of all nursing home care and 42 percent of all home health care.[13]

Our Medicare sample consisted of 73,280 beneficiaries who died in 1996 at the age of 65 years or older. We excluded persons who had ever been enrolled in a health maintenance organization (HMO), because Medicare does not receive complete data on the use of services by such persons. We also excluded persons not continuously covered from the age of 65 by both Part A and Part B of Medicare. These exclusions accounted for about 20 percent of the original sample. This proportion is consistent with the increasing percentage of Medicare beneficiaries enrolled in HMOs, now about 17 percent.

The earliest data in the Continuous Medicare History Sample are from 1974, so payments from the age of 65 years until death were available only for persons who died between the ages of 65 and 87 years. For persons who were older than 87 years when they died, we used a regression analysis to estimate payments for the years before 1974.[3] We estimated Medicare cost sharing (deductibles and coinsurance for Part A and Part B of Medicare, as well as balance billing for Part B) with the use of methods described elsewhere.[14] Cost sharing accounted for 14 percent of total payments for Medicare-covered services in 1996. Estimated and actual Medicare payments were converted to 1996 dollars according to the rate at which per capita Medicare payments increased from the year they were incurred to 1996.

Expenditures for Nursing Home Care

We estimated expenditures for nursing home care on the basis of data on lifetime nursing home use from the 1993 National Mortality Followback Survey,[6] a survey of the next of kin of a national sample of decedents, conducted by the National Center for Health Statistics. Our sample included 6749 decedents who were 65 years of age or older at the time of death; the sample was weighted to obtain nationally representative estimates.

To estimate spending, we multiplied the number of days of nursing home care each year from the age of 65 years until death by the estimated mean charge per day for nursing home care in 1996 (about $118). We estimated the mean daily charge on the basis of 1995 data from the National Nursing Home Survey (conducted by the National Center for Health Statistics) and adjusted the charge for inflation between 1995 and 1996 using HCFA's estimates of the growth in nursing home revenues per day. We excluded estimated expenditures for care in a skilled nursing facility, which were included in the category of Medicare expenditures.

Expenditures for Other Services

We approximated longitudinal data for the third category of spending, using projected annual expenditures for 1996 from the Agency for Health Care Policy and Research. These projections are based on data from the 1987 National Medical Expenditure Survey, adjusted for changes in demographic characteristics and calibrated to the National Health Accounts produced by HCFA.[15] For home care not covered by Medicare, prescription drugs, vision care and eyeglasses, dental care, and durable medical equipment, we estimated mean annual expenditures according to age for decedents and survivors. Mean expenditures for survivors were assigned to each year from the age of 65 years until the next-to-last year of life, and mean annual expenditures for decedents were assigned to the last year of life. Since the samples were too small with single-year estimates, we used the narrowest age ranges possible: 10-year ranges, ending with an age of 85 years or older, for home care and 5-year ranges, ending with an age of 90 or older, for other services.

Simulated Expenditures

To simulate the effects of changes in demographic factors, we reweighted our spending estimates to reflect the mortality rate and cohort size according to sex, on the basis of the Social Security Administration's midrange mortality and population projections for persons turning 65 in 2000 and for those turning 65 in 2015.[16,17] We attributed differences in simulated expenditures between the two cohorts to three demographic factors: the size of the original birth cohort, the proportion of persons surviving to the age of 65 years, and longevity beyond the age of 65. The first two factors were estimated directly from Social Security Administration data. The effect of changes in longevity beyond the age of 65 years was simulated by adjusting the number of deaths at each age to reflect the projected mortality rate for each cohort and calculating a new weighted average (in constant 1996 dollars) for estimated expenditures according to the age at death. These simulations isolated the effect of demographic factors on expenditures, given the current associations between age and use of services, by holding constant all factors except mortality and sex. We did not model the effects of changes in inflation; medical advances; changes in patterns of utilization, disease, or disability; or other factors — all of which would also affect actual health care expenditures for future cohorts.

RESULTS

Expenditures from the Age of 65 Years until Death

The total projected expenditure for all services from the age of 65 years until death (in 1996 dollars) is $164,505. Of this amount, $105,342 is for Medicare plus cost sharing, $34,205 is for nursing home care not covered by Medicare, $11,428 is for home care not covered by Medicare, $9,546 is for prescription drugs, and $3,984 is for vision and dental care and durable medical equipment (Table 1). Total expenditures from the age of 65 years until death rise substantially with longevity, from $31,181 for persons who die at the age of 65 years to over $200,000 for those who die at the age of 90 or older (Fig. 1 and Table 1). This pattern is determined by the substantial increase in nursing home expenditures for very old persons. Consistent with previous findings,[3]

TABLE 1. MEAN CUMULATIVE EXPENDITURES PER PERSON FOR ACUTE AND LONG-TERM CARE FROM THE AGE OF 65 YEARS UNTIL DEATH, ACCORDING TO THE AGE AT DEATH.*

AGE AT DEATH (YR)	MEAN EXPENDITURE					
	ALL SERVICES	MEDICARE-COVERED SERVICES PLUS COST SHARING	NURSING HOME CARE	HOME CARE	PRESCRIPTION DRUGS	OTHER SERVICES
			dollars			
All persons ≥65†	164,505	105,342	34,205	11,428	9,546	3,984
65	31,181	26,161	1,751	2,024	1,073	171
70	87,116	72,302	5,829	3,658	3,564	1,762
75	123,823	96,459	12,168	5,614	6,681	2,901
80	157,903	112,857	22,529	8,909	9,656	3,952
85	193,727	123,722	39,009	13,692	12,335	4,969
90	235,369	130,042	64,665	20,019	14,667	5,976
95	287,980	132,341	104,069	27,948	16,634	6,988
100	358,174	130,910	163,563	37,476	18,214	8,011
>101	407,425	128,617	207,926	43,390	18,913	8,579

*Expenditures are given in 1996 dollars. Medicare data are from the Health Care Financing Administration's Continuous Medicare History Sample, nursing home data were derived from the National Mortality Followback Survey, and data on home care, prescription drugs, and other services (vision and dental care and medical equipment) were derived from the National Medical Expenditure Survey, with projections to 1996. Nursing home care and home care expenditures are for services not covered by Medicare. Expenditures for individual services may not sum to totals because of rounding.

†Means for all persons have been adjusted to reflect the distribution of deaths according to age in 1996 for persons 65 years of age or older, on the basis of 1996 mortality data provided by the National Center for Health Statistics.

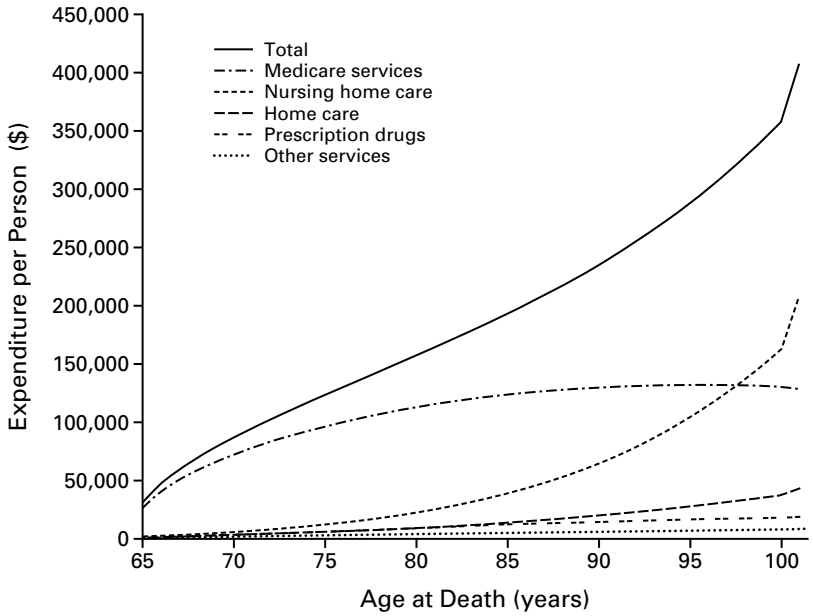

Figure 1. Cumulative Health Care Expenditures from the Age of 65 Years until Death, According to the Type of Health Service and the Age at Death.

Expenditures are in 1996 dollars. Medicare services denotes services covered by Medicare. The other categories of services are those not covered by Medicare. Other services include prescription drugs, vision and dental care, and durable medical equipment.

total Medicare expenditures from the age of 65 years (which in our analysis include estimates of cost sharing and balance billing) rise with age but at a decreasing rate and level off at about $130,000 for persons who die at the age of 90 years or older. For example, the average Medicare-covered expenditure for persons who die at the age of 75 years is $24,157 more than for those who die at the age of 70, whereas the average expenditure for those who die at the age of 95 is $2,299 more than the expenditure for those who die at the age of 90.

Conversely, expenditures for nursing home care not covered by Medicare increase at an accelerated rate, from $1,751 for persons who die at the age of 65 years to $64,665 for those who die at the age of 90 (Table 1). These expenditures surpass Medicare expenditures for persons older than 97 years at the time of death. The average expenditure for nursing home care for persons who die at the age of 75 years is $6,339 more than for those who die at the age of 70, whereas the average expenditure for those who die at the age of 95 is $39,404 more than for those who die at the age of 90. Although expenditures for other categories of care are much smaller, the pattern of spending for home care resembles the pattern for nursing home care — the rate of expenditures increases with longevity — whereas the pattern for prescription drugs, vision and dental care, and medical equipment is more like that for Medicare (Table 1).

Although expenditures for home care, prescription drugs, and the other services not covered by Medicare are important factors, particularly as a potential source of out-of-pocket expenses, Medicare-covered services and nursing home care account for the largest proportion of total expenditures. For persons who die at the age of 70 years, Medicare-covered services account for 83 percent of expenditures, and nursing home care accounts for 7 percent. In contrast, for those who die at the age of 95 years, Medicare-covered services account for 46 percent of expenditures and nursing home care accounts for 36 percent.

Expenditures in the Last Two Years of Life

Expenditures in the last two years of life also increase with the age at death because of steep increases in the costs of nursing home care (Fig. 2), but the rate of increase is lower than that for total expenditures. The reason for this difference is that Medicare expenditures at the end of life decline as the age at death increases, from about $37,000 for persons who die at the age of 75 to about $21,000 for those who die at the age of 95. Conversely, expenditures for nursing home care at the end of life rise from less than $6,000 for those who die at the age of 75 years to about $32,000 for those who die at the age of 95. In the last two years of life, expenditures for nursing home care exceed Medicare expenditures for persons who are more than 90 years old when they die. Expenditures for all the other services account for no more than 8 percent of total expenditures in the last two years of life, whatever the age at death.

Expenditures According to Sex

Combined Medicare and nursing home expenditures from the age of 65 years until death are 17 to 37 percent greater for women than for men, depend-

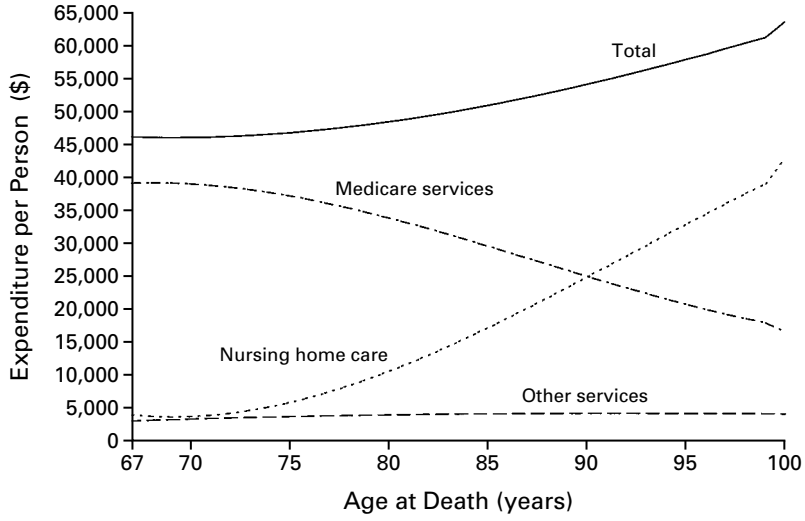

Figure 2. Health Care Expenditures in the Last Two Years of Life, According to the Type of Health Service and the Age at Death.

Expenditures are in 1996 dollars. Medicare services denotes services covered by Medicare. Other services include home care, prescription drugs, vision and dental care, and durable medical equipment.

ing on the age at death. (Samples were too small to estimate expenditures according to sex for other services.) By comparing expenditures for men and women at each age at death, we controlled for the greater longevity of women. Medicare expenditures for women are 7 to 23 percent higher than those for men, whereas nursing home expenditures for women are generally 60 to more than 100 percent higher (Fig. 3).

Among persons who die between the ages of 65 and 82 years, Medicare expenditures in the last two years of life are also higher for women than for men; among persons who die at older ages, the expenditures for women are similar to or slightly lower than those for men (data not shown). Expenditures for nursing home care at the end of life are higher for women than for men at all ages at death. Total expenditures at the end of life are 15 to 27 percent higher for women than for men.

Simulated Expenditures

According to our simulation, combined expenditures for Medicare-covered services and nursing home care from the age of 65 years until death (in constant 1996 dollars) for a cohort of persons born in 1950 and projected to turn 65 in 2015 will be 73 percent greater than the combined expenditures for a cohort of persons born in 1935 and projected to turn 65 in 2000 (Table 2). The most important factor underlying the difference in expenditures is the higher number of persons projected to turn 65 in 2015. This increase is due primarily to the larger number of births in the 2015 cohort (4.27 million, vs. 2.72 million in the 2000 cohort), which accounts for 70 percent of the difference, but also to a higher rate of survival to the age of 65 years (80 percent in the 2015 cohort vs. 74 percent in the 2000 cohort), which accounts for 22 percent of the difference.

Greater longevity after the age of 65 years plays a much smaller part, accounting for only 8 percent of the difference in total spending. Increased longevity has a larger role in nursing home expenditures than in Medicare expenditures. The 3 percent increase in life expectancy at the age of 65 years for the cohort of people born in 1950 is associated with less than a 1 percent increase in the simulated mean Medicare expenditure ($109,352, vs. $108,361 for the cohort of people born in 1935) but with a 6 percent increase in the mean expenditure for nursing home care ($46,168 vs. $43,613).

Persons 85 years of age or older ("the oldest old") are projected to represent an increasing proportion of the elderly population. Forty-four percent of persons turning 65 in 2000 will survive to the age of 85 years, and expenditures for their care will account for 60 percent of total spending for the cohort. Forty-seven percent of persons turning 65 in 2015 will survive to the age of 85 years; expenditures for this group will account for 63 percent of total spending.

DISCUSSION

Longevity has different effects on expenditures for acute care and those for long-term care. The rate

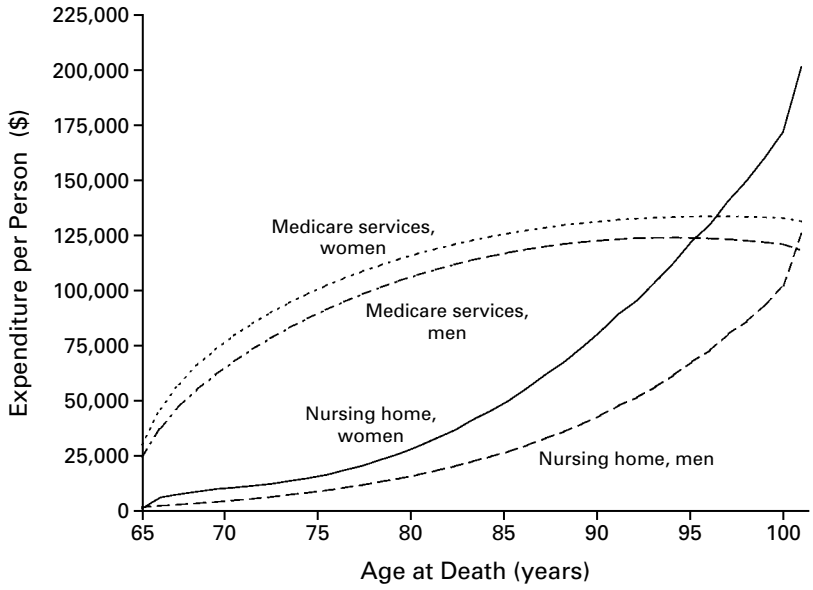

Figure 3. Cumulative Expenditures for Medicare-Covered Services and Nursing Home Care from the Age of 65 Years until Death, According to Sex and the Age at Death.

Expenditures are in 1996 dollars.

TABLE 2. PROJECTED CHARACTERISTICS OF PERSONS TURNING 65 IN 2000 OR 2015.*

CHARACTERISTIC	2000 COHORT	2015 COHORT	CHANGE (%)
Birth year	1935	1950	
Births — no. in millions	2.72	4.27	57
Persons surviving to age 65 — no. in millions (%)	2.01 (74)	3.41 (80)	70 (8)
Life expectancy at age 65 — yr	18.1	18.7	3
Mean cumulative expenditure per person — $†			
Medicare-covered services	108,361	109,352	<1
Nursing home care	43,613	46,168	6
Total	151,974	155,519	2
Total expenditure for cohort — billions of $†			
Medicare-covered services	218	372	71
Nursing home care	88	157	78
Total	306	530	73
Age at death — %‡			
65–74 yr	22	21	−5
75–84 yr	34	33	−3
85–94 yr	34	35	3
≥95 yr	10	12	20
Distribution of expenditures according to age at death — %‡			
65–74 yr	11	10	−9
75–84 yr	30	28	−7
85–94 yr	42	42	0
≥95 yr	18	21	17

*Population and life-expectancy data are from Social Security Administration Alternative II projections and life tables provided by the Office of the Actuary.

†Expenditures (in 1996 dollars) are cumulative totals from the age of 65 until death.

‡Percentages may not sum to 100 because of rounding.

of increase in expenditures for acute care, principally hospital care and physicians' services, declines as the age at the time of death increases, whereas the rate of increase in expenditures for long-term care rises with the age at death. For persons who are very old at the time of death, expenditures for nursing home care from the age of 65 years until death approach or exceed expenditures for Medicare-covered services. The rise in nursing home costs with the age at death is sufficient to counteract the moderating effect of declining Medicare expenditures, so that the rate of increase in total spending from the age of 65 years until death also rises with the age at death. Our simulations show that increased longevity after the age of 65 years may have a small effect on expenditures for acute care, if present conditions continue, but has a larger effect on expenditures for long-term care and, consequently, on total health care spending for the elderly.

These patterns have implications for the financing of health care and the distribution of costs among insurance systems. The demographic factor that has the largest influence on medical expenditures for the elderly is the number of people over the age of 65 years. All other things being equal, longevity after the age of 65 has a larger effect on the costs of nursing home care, which are paid by Medicaid (about half) or out of pocket (about a third), than on the costs of services covered by Medicare.[13] This pattern could result in a greater financial burden for elderly persons and their families and for the Medicaid program as the population ages. Beyond demographic factors, changes in Medicare, Medicaid, and private insurance for long-term care, as well as changes in medicine and social arrangements in caring for the elderly, which we did not account for in our analyses, will help determine who bears the financial burden of long-term care.

We also found that expenditures for nursing home care in the last two years of life increase with the age at death, whereas Medicare expenditures decrease, confirming in a national sample earlier findings in selected populations.[7-10] Concern about costs in the final year of life has focused on the appropriateness of expensive, high-technology care for terminally ill persons. Our findings highlight the costs of long-term care at the end of life, which are less likely to be covered by Medicare or private insurance than are the costs of acute care.

Men and women have different patterns of lifetime expenditures for health care. Women live longer than men and have greater morbidity and disability from nonfatal conditions throughout their lives. It has been hypothesized that the progression of fatal disease in men may be faster than that in women.[18,19] Our data provide some support for this view. Among persons who are 65 to 82 years old at the time of death, Medicare costs in the last two years of life are lower for men than for women, a finding consistent with the idea that fatal disease progresses more rapidly in men than in women. Among persons who are older than 82 years at the time of death, Medicare costs in the last two years of life are slightly lower for women than for men.

Women are more likely than men to receive nursing home care, in part because women tend to live longer, which makes them more likely both to become disabled and to outlive spouses who might otherwise care for them at home. The higher likelihood that women will receive nursing home care persists for all ages at death. More than three quarters of women who survive to the age of 95 years are expected to receive nursing home care, as compared with about half of men.[5]

Our simulation does not account for possible medical advances or for changes in patterns of utilization, disease, or disability or in the Medicare and Medicaid programs. Although the basic associations identified in our analyses are likely to persist in the near future, the level and distribution of spending among

insurance systems could be affected by changes in such factors, particularly changes in the prevalence of disease and disability that may accompany increased longevity. Medicare costs have been shown to differ greatly according to the cause of death for many years before death.[20] If longevity increases because of reduced morbidity and mortality from diseases that are expensive to treat, then Medicare costs may be reduced. If longevity increases as the result of expensive treatments, Medicare costs may rise. The costs of both acute and long-term care increase with the level of disability.[21,22] If increased longevity is accompanied by declines in rates of disability, as suggested by recent studies,[22-24] then the effect of increased longevity on health care expenditures may be moderated.

Changes in the financing and delivery of acute and long-term care may also alter spending patterns and levels. The proportion of Medicare beneficiaries who are enrolled in HMOs, currently about 17 percent, is growing. Payments based on risk-adjusted capitation and other changes in payment are likely. New approaches to the provision of long-term care that emphasize community-based services may reduce the use of nursing home and hospital care, although there is no evidence that in the aggregate such changes will reduce total expenditures for long-term care.[25] Shifts in the location of care without a reduction in costs would be likely to have a greater effect on the distribution of payments among insurers than on actual spending levels. A greater shifting of costs to elderly persons and their families is also possible.

The views expressed in this article are those of the authors and should not be attributed to the Urban Institute, its trustees, or its funders or to the National Center for Health Statistics.

We are indebted to Anne A. Scitovsky, Liliana E. Pezzin, Christopher M. Murtaugh, Marian Gornick, and Jerry Riley for their helpful comments; to James Beebe for statistical advice; to Karen Pinkston of Social and Scientific Systems, Bethesda, Md., for programming assistance; to John Moeller of the Agency for Health Care Policy and Research for providing estimates from the National Medical Expenditure Survey; to Felicitie Bell of the Office of the Actuary, Social Security Administration, for providing cohort life-table data and population estimates; to Bob Anderson of the National Center for Health Statistics for providing 1996 mortality data; and to Judy Sangl for providing other data.

REFERENCES

1. 2000 Annual report of the board of trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds. Baltimore: Social Security Administration, March 30, 2000. (See: www.ssa.gov/OACT/TR.)
2. Long-term budgetary pressures and policy options. Washington, D.C.: Congressional Budget Office, 1997.
3. Lubitz J, Beebe J, Baker C. Longevity and Medicare expenditures. N Engl J Med 1995;332:999-1003.
4. Gornick M, McMillan A, Lubitz J. A longitudinal perspective on patterns of Medicare payments. Health Aff (Millwood) 1993;12(2):140-50.
5. Kemper P, Murtaugh CM. Lifetime use of nursing home care. N Engl J Med 1991;324:595-600.
6. Kemper P, Spillman BC, Murtaugh CM. A lifetime perspective on proposals for financing nursing home care. Inquiry 1991;28:333-44.
7. Scitovsky AA. "The high cost of dying" revisited. Milbank Q 1994;72:561-91.
8. Temkin-Greener H, Meiners MR, Petty EA, Szydlowski JS. The use and cost of health services prior to death: a comparison of the Medicare-only and the Medicare–Medicaid elderly populations. Milbank Q 1991;70:679-701.
9. Scitovsky AA. Medical care in the last twelve months of life: the relation between age, functional status, and medical care expenditures. Milbank Q 1988;66:640-60.
10. Roos NP, Montgomery P, Roos LL. Health care utilization in the years prior to death. Milbank Q 1987;65:231-54.
11. Carlson BL, Kemper P, Murtaugh CM. Constructing a lifetime nursing home use data base from a sample of discharges. J Econ Soc Meas 1995;21:187-211.
12. Waldo DR, Sonnefeld ST, McKusick DR, Arnett RH III. Health expenditures by age group, 1977 and 1987. Health Care Financ Rev 1989;10(4):111-20.
13. Braden BR, Cowan CA, Lazenby HC, et al. National health expenditures, 1997. Health Care Financ Rev 1998;20(1):83-126.
14. Helbing C. Medicare program expenditures. Health Care Financ Rev 1992;Annual Supplement:23-54.
15. Data from the National Medical Expenditure Survey, 1987: household survey projected to 1996-2005: medical expenditures by type of service and payment source, demographics, and poverty and insurance status. Release B (1996-2005). Rockville, Md.: Center for Cost and Financing Studies, Agency for Health Care Policy and Research, 1998. (See: www.meps.ahrq.gov/nmes.htm.)
16. Office of the Actuary. United States life table functions and actuarial functions based on the alternative 2 mortality probabilities used in the 1999 trustees report. Baltimore: Social Security Administration, 1999.
17. Office of the Actuary. Social Security area population under 1999 trustees report alternative II. Baltimore: Social Security Administration, 1999.
18. Verbrugge L. Pathways of health and death. In: Apple RD, ed. Women, health, and medicine in America: a historical handbook. New York: Garland, 1990:41-79.
19. Guralnik JM, Leveille SG, Hirsch R, Ferrucci L, Fried LP. The impact of disability in older women. J Am Med Womens Assoc 1997;52:113-20.
20. Riley GF, Lubitz JD. Longitudinal patterns of Medicare use by cause of death. Health Care Financ Rev 1989;11(1):1-12.
21. Gruenberg L, Kaganova E, Hornbrook MC. Improving the AAPCC (adjusted average per capita cost) with health-status measures from the MCBS (Medicare Current Beneficiary Survey). Health Care Financ Rev 1996;17(3):59-75.
22. Manton KG, Corder L, Stallard E. Chronic disability trends in elderly United States populations: 1982-1994. Proc Natl Acad Sci U S A 1997;94:2593-8.
23. Freedman VA, Martin LG. Understanding trends in functional limitations among older Americans. Am J Public Health 1998;88:1457-62.
24. Waidmann TA, Manton KG. International evidence on trends in disability among the elderly. Washington, D.C.: Office of Aging and Long-Term Care Policy, 1998. (See: http://aspe.hhs.gov/daltcp.)
25. Weissert WG, Hedrick SC. Lessons learned from research on effects of community-based long-term care. J Am Geriatr Soc 1994;42:348-53.