

**The Rising Cost of Medicare and Improvements in Survival and
Functioning Among the U.S. Elderly, 1985-2000**

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ABSTRACT (97 words)

Medicare expenditures are increasing, raising the question whether increased costs yield commensurate benefits. We compared changes in inflation-adjusted Medicare expenditures to changes in benefits from improved survival and health, 1985-2000, for acute myocardial infarction, stroke, diabetes, and breast cancer. We used data from 1984-99 National Long-Term Care Surveys linked to Medicare claims. Benefits were based on changes in five-year survival, activity limitations, and cognition, net of changes in prescription drug and nursing home costs. Except for breast cancer, five-year Medicare payments following diagnosis increased. But for each condition, the dollar-value of benefits increased more than Medicare payments.

After a period of relative stability, expenditures on personal health care services in general, and for Medicare in particular, began to increase again since 2000. In part, increased cost reflects higher prices for personnel and other inputs, but, historically, the largest part has reflected provision of more services per capita.¹ Mortality among the elderly has declined for several decades.² Rates of disability and cognitive limitations, have declined over at least the past two decades,³⁻¹³ and are expected to continue to decline for at least another decade.¹⁴ Measures of medical inflation may overestimate rates of price change because the price indexes fail to reflect improvements in effectiveness of care.^{15,16}

This study compares changes in inflation-adjusted Medicare payments to changes in benefits, measured in terms of changes in survival and physical and cognitive functioning, during 1985-2000. We focused on treatment of acute myocardial infarction (AMI), stroke, diabetes, and breast cancer.

METHODS

Data

The study population consisted of individuals aged 65+ randomly drawn for selection into the National Long-Term Care Survey (NLTCs). With additions of persons in 1989, 1994, and 1999 to replace decedents, the sample is representative of the US population 65+. The NLTCs included 41,947 individuals over

1982-2000, but most persons were not surveyed for the entire period because of attrition due to death or they were only included in later waves. After removing 2,356 individuals who died before 1984, we matched 38,566 persons to complete Medicare enrollment records and claims data for 1984-2000. Dates of death came from a vital statistics file linked to the Medicare claims. Our study period spanned 1985-2000, further reducing the sample to 30,953.

To select the analysis sample, we searched all Medicare institutional claims (hospital inpatient, outpatient, home health, skilled nursing and hospice) for ICD-9-CM codes specific to each of the four index conditions. We did not use non-institutional claims (e.g., physician supplier) for selecting the sample because they did not contain diagnostic information before 1991. Eliminating repeat hospitalizations within 365 days of a prior admission, persons were selected into the sample based on a hospitalization with a primary diagnosis of AMI (N=2,649) or stroke (N=3,337). For diabetes, persons were selected into the sample at the first occurrence of a primary or secondary diagnosis on an institutional claim (N=5,018). For breast cancer, women were selected based on a primary diagnosis of breast cancer or a related procedure code on either a hospital inpatient or an outpatient claim (N=1,160). We assessed changes over three sub-periods: 1985-89; 1990-94; 1995-2000.

Outcomes

Outcomes common to all four diseases were changes in survival, activities of daily living (ADL) limitations, cognitive status, and placement in a nursing home.

Survival. Survival was measured from the first date of service listed on the claim, used to define the index event, until death or December 31, 2000, whichever occurred first. We estimated survival models for each index condition, implemented as generalized gamma regressions.¹⁷ Using estimated parameters, we predicted monthly survival probabilities for each person for five years following the first date of service on the claim.

Physical and Cognitive Functioning. Changes in having at least one ADL limitation were measured between consecutive NLTCs interviews (1984-89, 1989-94, 1994-99). Changes ranged from -1 (change from no to an ADL limitation), 0 (no change), to +1 (change an ADL to no limitation).

For cognition, we used the number of correct responses to a 10-question module in the NLTCs, the Short Portable Mental Status Questionnaire.¹⁸ We did not measure changes in cognition from 1994-99 because of a change in the instrument in 1999. The outcome measure was the difference in scores between two consecutive waves, with a possible range of -10 (no correct answers followed by all correct answers five years later) to +10. To assess determinants of changes in ADL limitations and

cognition, we performed linear regression analysis, using an individual's observed change as the dependent variable.

Medicare Cost

Medicare cost was real (using the Consumer Price Index - all items), total Medicare payments (2000 dollars) for the first five years following the beneficiary's first date of service on the claim used to define the index event. We used linear regression with the natural logarithm of five-year cost after diagnosis as the dependent variable. Predicted values of cost were later transformed from logarithmic dollars to dollars, using a smearing correction.¹⁹

Other Cost

We also computed changes in the cost of nursing home use and prescription drugs for persons aged 65+. Increases in such cost were treated as a reduction in net benefit.

For nursing home cost, we analyzed transitions between the community and the nursing home between consecutive NLTCs interviews. We calculated the cost of nursing home use using an estimate of annual cost of \$56,478,²⁰ multiplied by a factor of 0.897²¹ to exclude Medicare's share of such cost. Medicare nursing cost was reflected in payments to skilled nursing facilities.

We calculated the cost of prescription drugs using NLTCs community survey responses on the number of prescription drugs

purchased, and either the dollar or percentage cost borne by the beneficiary. We used logistic regression to predict the probability of purchasing any prescription drugs, and used linear regression to predict either the percentage or dollar amount paid for out-of-pocket by those respondents who reported at least one prescription drug purchase. Based on the parameter estimates, we computed the expected value of prescription drug purchases during the five-year period following the index claim.

Explanatory Variables

In the regression analysis, we controlled for gender (male), race (white, nonwhite), age, educational attainment (years); a measure of the person's health status (DxCG score ²²) in the year prior to the first date of service on the claim, and two indicator variables for onset of the condition in 1989-94 and 1994-99.

Valuing Health Benefits

The benefits were gains in survival, and reductions in the increase in ADL limitations and cognitive impairment, net of increases in non-Medicare nursing home and prescription drug cost. To value survival gains, we used a value of \$100,000 per life year without an ADL limitation.²³⁻²⁵ For a life year with an ADL limitation, we used a value of \$50,000.²⁶ For cognitive limitations, we decreased the value of a life year with or

without an ADL limitation by \$2,500 per question answered incorrectly.

For survival, we first predicted mean life expectancy during the five-year period following the first service date on the claim, separately for (1) persons with diagnoses recorded in 1985-89, and (2) an identical cohort in 1990-94, and (3) an identical cohort in 1995-2000. Differences between the predictions ((2)-(1)), and ((3)-(1)) reflected gains in life expectancy, controlling for changes in other covariates.

For ADL limitations, we calculated the prevalence of persons with at least one ADL limitation pre and the probability of onset post recorded diagnosis for each period. We then calculated the expected time that a person lived with and without an ADL limitation during a five-year period after recorded diagnosis. We performed similar predictions for changes in cognition and residence in a nursing home versus community.

Valuing the Cost Increases

We predicted five-year cost after the recorded diagnosis for each person in 1985-89. We also predicted cost for identical cohorts in 1990-94 and 1995-2000. The differences in predicted cost between periods were the net change in real cost controlling for changes in other covariates.

RESULTS

Survival

Survival improved for all persons with each of the four index conditions (Table 1). There were statistically significant improvements ($p < 0.001$ except for stroke ($p = 0.011$) and breast cancer ($p = 0.005$) in 1990-94). The group with the lowest life expectancy was for stroke (Table 2). Persons hospitalized for stroke from 1985-89 had a 0.24 probability of surviving five years, increasing to 0.29 by 1995-2000. Survival probabilities for AMI rose from 0.35 (1985-89) to 0.43 (1995-2000). Survival probabilities for diabetes and breast cancer improved by 0.08 and 0.10 over this decade.

Limitations in Activities of Daily Living

Relative to persons without any of the four conditions (the reference group), persons with a stroke or diabetes had a higher probability of ADL limitation onset in all sub-periods (Table 3). The parameter estimates imply a significant decline in the probability of ADL limitation onset following stroke admission between 1994-99 relative to 1989-94 (0.34, $p = 0.008$) and relative to 1984-89 (0.33, $p = 0.007$), but no change between 1984-89 and 1989-94. For AMI, diabetes, and breast cancer, there were no statistically significant changes in the probability of ADL limitations onset relative to 1984-89, after controlling for the changes over time in the general population. There was a

statistically significant increase in the probability of ADL limitation onset following AMI diagnosis in 1994-99 relative to 1989-94.

Cognition

Relative to persons without any of the study conditions, stroke led to a greater decline in both periods, but the stroke-related decline was smaller in 1989-94, but statistically insignificant ($p=0.110$). There was also greater cognitive decline among persons with diabetes hospitalized in 1989-94, but the difference relative to 1984-89 was also not statistically significant ($p=0.187$). For AMI and breast cancer, there was no differential change in cognition relative to the general population.

Nursing Home Placement

Having a stroke increased the probability of nursing home entry ($p<0.001$), but there were reductions in the probability of nursing home entry following stroke during 1989-94 ($p=0.062$) and 1994-99 ($p=0.012$). The probability of nursing home entry was also elevated for diabetes, but there were no statistically significant changes over time.

Prescription Drugs

Between 1985-99, mean five-year cost increased by \$844 for AMI, \$629 for stroke, \$808 for diabetes, and \$1,013 for breast cancer.

Medicare Cost

Except for breast cancer, there were statistically significant increases in five-year costs following diagnosis ($p < 0.001$, Table 4). The largest increase in real Medicare payments was for AMI, which increased by \$22,354 (76.1%) between 1985-89 and 1994-1999, followed by stroke (\$18,510; 60.6%), diabetes (\$8,752; 19.5%), and breast cancer (-\$988; -3.0%).

Cost-Benefit Analysis

For each condition, benefits exceeded the cost (Table 5). The largest difference in benefit minus cost was for breast cancer (\$17,665), followed by stroke (\$8,867), diabetes (\$5,593), and AMI (\$2,540). Most of the benefit came from improved survival. Breast cancer substantially improved its ranking by having a very low change in treatment cost. AMI and stroke net benefits were reduced by substantial increases in treatment cost. AMI benefits were further reduced by an increase in nursing home costs. Reductions in cost of cognitive limitations raised the benefits for stroke, but were offset by survival gains for diabetes and breast cancer patients. There was no appreciable variation across conditions in changes of prescription drug costs over time.

DISCUSSION

When improvements in survival, functional and cognitive status, and ability to live in the community are quantified, benefits to Medicare beneficiaries accruing over a five-year period exceeded the increase in Medicare payments between 1985 and 2000 (2000\$). The study conditions are among the most common among the elderly with high associated societal costs.

The largest gain was for breast cancer and the smallest gain for AMI, with diabetes and stroke in between. The pattern for breast cancer not only reflects substantial health gains, but also virtually no increase in real Medicare payments for treatment during the first five years following diagnosis. The pattern for payments reflects a massive shift from treatment in hospital inpatient settings to outpatient care. By contrast, for AMI, for which payments increased the most, the elderly increasingly received intensive therapeutic interventions.²⁷

Our estimates are comparable to other studies providing estimates for specific points in time.²⁸⁻³⁰ Our estimates of mortality rates and trends are also consistent with the existing literature. Cutler^{31, 32} reported one-year mortality rates for AMI of 30-40% and reported mortality declines between 1984 and 1991. Our estimates indicate that the five-year breast cancer mortality decreased from 37% to 27% between 1985-90 and 1995-2000, a decline of about one percentage point per year. This

finding is consistent with national estimates that five-year survival rates increased from 77% for whites and 66% for blacks in 1980-82 to 88% for whites and 73% for blacks in 1992-98.

In an analysis of mortality among persons with diabetes in the NHANES, Gu et al.³³ reported five-year survival rates 70% among men and 75% among women, compared with 42 to 50% in our cohort. However, their cohort was much younger (age 65 to 74), and the diagnosis in our cohort was established during a diabetes-related hospitalization, resulting in a higher-risk sample. Our two-year mortality predictions for persons diagnosed with diabetes matched closely those of Bertoni et al.³⁴ with our mortality estimates declining from 18 to 12% between 1985-89 and 1995-00, versus 15% in Bertoni et al. Our estimates of prescription drug cost are similar to those of Tseng et al.,³⁵ but somewhat higher than those of other studies.^{36,37}

At first glance, our observed increase in the prevalence of ADL limitations may appear inconsistent with results from other studies which documented substantial disability declines during the 1980s and 1990s.³⁸⁻⁴⁰ One explanation is greater survival of the sickest persons who live longer, but with more limitations. The most likely explanations for the difference are the use of different measures of disability and the failure of previous studies to control for other covariates. In particular, most studies on disability decline combine IADL with ADL limitations.

When IADL and ADL limitations were analyzed separately, disability declines were limited to changes in IADL limitations. ADL limitations remained constant or increased. In Manton and Gu,⁴¹ prevalence of ADL limitations decreased through 1994 but was nearly unchanged between 1994 and 1999, while IADL limitations continued to decline. That study also did not include multivariate analyses, while we controlled for age, gender, race, education, and a diagnosis-based measure of health status. In Schoeni et al.,⁴² ADL limitations increased from 1993 to 1996, while IADL limitations decreased. A literature review concluded that late-life disability declines have been concentrated among IADL limitations.⁴³

We note several study limitations. Although we documented an association between increased real Medicare payments and benefits for the four study conditions, we have not established a causal link. Chronic diseases leading to acute events such as AMI and stroke extend over many years prior to these acute events. Since our sample started at age 65, we could not document precursors of these events; nor did we know if these were the first such events.

Improved and more widespread use of diagnostic procedures may have lead to diagnoses at earlier stages of the disease, particularly for breast cancer.⁴⁴⁻⁴⁶ If so, we may have underestimated the change in treatment cost, and overestimated

the benefit. In our analysis, we found no trend in incidence in our sample for three of the four study conditions (except for diabetes for which incidence increased), suggesting that the bias is likely to be insubstantial. In sensitivity analysis we evaluated the effect on net benefits of removing the lowest-cost 10% of breast cancer cases between 1990-94, and the lowest-cost 20% of breast cancer cases between 1995-2000. In this analysis, net benefits were reduced to \$29,995 and \$9,071 for the 1990-94 and 1995-2000 periods, respectively. Even with this adjustment, net benefits were highest for breast cancer among the four conditions.

Our estimates of survival gains depended on the functional form of the hazard function. Any parameterized hazard function assumes a specific relationship between time and the baseline hazard of death. We selected a flexible functional form, by implementing the hazard models as generalized gamma. Tests of the appropriateness of this specification indicated that the Weibull did not approximate actual survival patterns as well as the gamma for some study conditions. While the gamma was an improvement over the Weibull, it is not clear what effect using non-parametric specifications would have had on our results.

The analyses of ADL onset, cognition declines, and nursing home entry were conditional on survival to the next interview.

The interviews were separated by five years, resulting in much smaller sample sizes for these analyses.

Medicare payments have risen relative to general inflation. Yet benefits accruing to Medicare beneficiaries have increased at least as much. A physician counseling a patient with any of the four conditions in 2000 could be more optimistic about the patient's outcome than in 1985.

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Table 1. Parameter Estimates from Hazard Models Predicting Survival Time

<u>Explanatory Variables</u>	<u>AMI</u>	<u>Stroke</u>	<u>Diabetes</u>	<u>Breast Cancer</u>
1990 - 1994	0.301 *** (0.091)	0.147 * (0.057)	0.164 *** (0.041)	0.279 ** (0.100)
1995 - 2000	0.752 *** (0.126)	0.379 *** (0.080)	0.367 *** (0.061)	0.483 *** (0.141)
Male	-0.186 * (0.074)	-0.159 ** (0.053)	-0.265 *** (0.038)	
White	0.099 (0.123)	0.018 (0.076)	0.011 (0.053)	0.129 (0.147)
Age	-0.373 *** (0.094)	-0.089 (0.067)	-0.269 *** (0.045)	0.036 (0.117)
Age squared	0.002 ** (0.001)	0.000 (0.000)	0.001 *** (0.000)	-0.001 (0.001)
Education	0.013 (0.014)	-0.006 (0.008)	0.005 (0.006)	0.022 (0.016)
DxCG	-0.565 *** (0.053)	-0.420 *** (0.041)	-0.416 *** (0.037)	-0.590 *** (0.099)
ADLs	-0.227 *** (0.028)	-0.120 *** (0.018)	-0.130 *** (0.013)	-0.221 *** (0.037)

Hazard model estimated as a generalized gamma model with time to failure (death) as the dependent variable.

Estimated standard errors in parentheses.

Statistical significance denoted by * ($p < 0.05$), ** ($p < 0.01$), *** ($p < 0.001$).

Table 2. Survival After Diagnosis in 1985-1989, 1990-1994, and 1995-2000

	AMI			Stroke			Diabetes			Breast Cancer		
	1985 -1989	1990 -1994	1995 -2000									
Survival Probabilities												
30 days	0.84	0.85	0.86	0.86	0.86	0.87	0.97	0.98	0.98	0.99	0.99	0.99
180 days	0.70	0.72	0.73	0.69	0.71	0.72	0.90	0.91	0.92	0.95	0.96	0.97
1 year	0.61	0.64	0.66	0.58	0.60	0.62	0.83	0.85	0.86	0.90	0.93	0.94
2 years	0.51	0.54	0.57	0.45	0.47	0.49	0.72	0.76	0.77	0.82	0.86	0.88
3 years	0.44	0.48	0.51	0.36	0.38	0.41	0.64	0.68	0.70	0.75	0.80	0.83
4 years	0.39	0.43	0.46	0.29	0.32	0.34	0.56	0.61	0.63	0.68	0.75	0.78
5 years	0.35	0.39	0.43	0.24	0.27	0.29	0.50	0.55	0.58	0.63	0.70	0.73
N	2,649			3,337			5,018			1,160		
Sample												
Expected survival (years) ¹	2.52	2.67	2.82	2.19	2.30	2.40	3.48	3.64	3.73	3.96	4.18	4.28
Survival gains (absolute) ²	0.00	0.16	0.30	0.00	0.11	0.21	0.00	0.17	0.25	0.00	0.22	0.32
Survival gains (percent)	0.00	6.18	12.09	0.00	5.10	9.55	0.00	4.80	7.17	0.00	5.43	8.09

¹ during 5 years following diagnosis, only full months counted

² relative to 1985-1989

Table 3. Parameter Estimates from Regressions for Change in ADL Limitation Onset, Cognition Decline, and Nursing Home Status

<u>Explanatory Variables</u>	<u>ADL Onset</u>		<u>Cognition Decline</u>		<u>Nursing Home Status</u>	
1989-94	0.074	***	-0.257	***	0.011	**
	(0.022)		(0.079)		(0.004)	
1994-99	0.166	***			-0.005	
	(0.022)				(0.004)	
AMI 1984-89	0.013		0.094		-0.009	
	(0.093)		(0.276)		(0.015)	
AMI 1989-94	-0.044		-0.072		0.013	
	(0.093)		(0.296)		(0.016)	
AMI 1994-99	0.182	*			0.000	
	(0.088)				(0.015)	
Stroke 1984-89	1.386	***	1.177	***	0.191	***
	(0.083)		(0.248)		(0.013)	
Stroke 1989-94	1.394	***	0.574	*	0.155	***
	(0.089)		(0.285)		(0.015)	
Stroke 1994-99	1.051	***			0.140	***
	(0.093)				(0.015)	
Diabetes 1984-89	0.234	***	0.095		0.032	***
	(0.052)		(0.139)		(0.008)	
Diabetes 1989-94	0.111		0.393	*	0.017	
	(0.062)		(0.179)		(0.010)	
Diabetes 1994-99	0.195	***			0.029	**
	(0.057)				(0.010)	

Breast Cancer 1984-89	0.006		-0.253		-0.005	
	(0.100)		(0.331)		(0.018)	
Breast Cancer 1989-94	-0.170		0.048		-0.023	
	(0.111)		(0.339)		(0.019)	
Breast Cancer 1994-99	0.161				0.007	
	(0.093)				(0.016)	
Male	-0.058	***	-0.026		-0.013	***
	(0.018)		(0.080)		(0.003)	
White	-0.020		0.183		0.014	**
	(0.031)		(0.107)		(0.005)	
Age	0.037	***	0.071	***	0.007	***
	(0.002)		(0.006)		(0.000)	
Education	-0.017	***	-0.026	**	-0.001	*
	(0.004)		(0.010)		(0.001)	
DxCG	0.152	***	0.126		0.020	***
	(0.038)		(0.124)		(0.006)	
Constant	-1.807	***	-4.582	***	-0.462	***
	(0.129)		(0.464)		(0.021)	
N =	21,019		3,563		28,806	
R-squared	0.182		0.063		0.086	

Estimated standard errors in parentheses.

Statistical significance denoted by * ($p < 0.05$), ** ($p < 0.01$), *** ($p < 0.001$).

Table 4. Parameter Estimates from Regression Models Predicting Five-Year Medicare Cost

	<u>Five-Year Log Cost after Diagnosis</u>			
	<u>AMI</u>	<u>Stroke</u>	<u>Diabetes</u>	<u>Breast Cancer</u>
1990 - 1994	0.454 *** (0.047)	0.321 *** (0.042)	0.139 *** (0.020)	-0.093 (0.072)
1995 - 2000	0.592 *** (0.082)	0.466 *** (0.072)	0.196 *** (0.035)	0.003 (0.118)
Male	-0.022 (0.038)	0.005 (0.035)	0.019 (0.016)	
White	-0.108 (0.072)	-0.310 *** (0.051)	-0.090 *** (0.023)	-0.239 * (0.104)
Age	-0.003 (0.050)	0.066 (0.042)	0.018 (0.021)	0.395 *** (0.086)
Age squared	0.000 (0.000)	-0.001 * (0.000)	0.000 (0.000)	-0.002 *** (0.001)
Education	0.010 (0.008)	0.007 (0.006)	0.000 (0.003)	-0.040 ** (0.013)
DxCG	0.026	0.049	0.149 ***	0.292 ***

	(0.034)	(0.030)	(0.020)	(0.082)
ADLs	-0.105 ***	-0.074 ***	-0.025 ***	-0.016
	(0.019)	(0.013)	(0.007)	(0.034)
1996 (1 year missing)	-0.033	-0.039	-0.138 **	-0.192
	(0.104)	(0.095)	(0.046)	(0.154)
1997 (2 years missing)	-0.051	-0.211 *	-0.331 ***	-0.483 **
	(0.106)	(0.096)	(0.046)	(0.160)
1998 (3 years missing)	-0.303 **	-0.305 **	-0.408 ***	-0.767 ***
	(0.112)	(0.097)	(0.045)	(0.158)
1999 (4 years missing)	-0.425 ***	-0.632 ***	-0.561 ***	-1.029 ***
	(0.109)	(0.096)	(0.047)	(0.157)
Constant	10.936 ***	8.654 ***	10.125 ***	-4.908
	(1.998)	(1.680)	(0.835)	(3.367)
N	3,000	3,726	6,603	1,454

Estimated standard errors in parentheses.

Statistical significance denoted by * ($p < 0.05$), ** ($p < 0.01$), *** ($p < 0.001$).

Table 5. Cost-Benefit Analysis

	<u>AMI</u>	<u>Stroke</u>	<u>Diabetes</u>	<u>Breast Cancer</u>
<u>Benefits over Five Years</u>				
(1) Value of additional ADL-adjusted life years				
1990-1994	21,564	7,832	15,233	32,536
1995-2000	28,859	23,135	21,128	26,962
	21,961	10,315	11,565	28,453
(2) Changes in the cost of cognitive limitations				
1990-1994	28,632	24,903	16,930	22,340
	-397	-2,483	3,668	4,083
1995-2000	227	-1,768	4,198	4,621
(3) Cost of additional nursing home use				
1990-1994	4,132	-2,719	-1,448	-3,038
1995-2000	2,894	-3,104	1,777	4,651
(4) Cost of additional prescription drugs				
1990-1994	19	-37	1	3
1995-2000	844	629	808	1,013
(5) Net benefit to beneficiaries (1-2-3-4)				
1990-1994	17,810	13,071	13,011	31,488
1995-2000	24,894	27,377	14,345	16,677
	21,541	10,822	5,009	-6,998

Additional Cost to Medicare

(6) 5-Year Cost	26,092	16,036	11,337	4,676
1990-1994	17,390	13,578	6,456	-3,963
1995-2000	22,354	18,510	8,752	-988

Net Benefit Over Five Years (5-7)

1990-1994	420	-507	6,556	35,451
1995-2000	2,540	8,867	5,593	17,665