Disability and Medicare Costs of Elderly Persons

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RAPIDLY GROWING MEDICARE EXPENDITURES, which are already expected to exceed revenues by the year 2002, are likely to accelerate as a result of the increasing numbers of very old beneficiaries (85+ years), who are particularly at risk of being disabled. The concern for Medicare is that elderly persons with disabilities incur higher than average health care costs because of the underlying causes of their disability, which are usually chronic medical conditions (Manton and Stallard 1992). Such conditions often require long-term care, but they also tend to induce illnesses requiring acute care.

While the Administration and Congress explore ways to control Medicare spending, one option that has received considerable attention is increasing enrollment of Medicare beneficiaries in health maintenance organizations (HMOs). HMOs, which receive a capitated (or all-inclusive) payment for all Medicare-covered services, are believed by proponents to be a cost-effective alternative to the open-ended, fee-for-service system from which most Medicare beneficiaries receive their care. Despite the potential of HMOs to serve elderly persons in general, it is not clear that the needs of disabled persons can adequately be met by HMOs, given the incentives to reduce costs inherent in capitated plans. Moreover, given the higher costs of disabled elderly persons, HMOs themselves

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have disincentives to enroll the very frail and disabled unless payments are adequately risk adjusted.

Currently, Medicare payments to HMOs are risk adjusted to account for variations in costs due to age, sex, Medicaid status, institutional status, employment status, and geographic location. Because this methodology explains less than 1 percent of the variation in Medicare costs, finding ways to improve upon it has been a continuing focus of health services research (Gruenberg, Kaganova, and Hornbrook 1996; Newhouse et al. 1989; Lubitz, Beebe, and Riley 1985). Inclusion of additional health-related characteristics, such as direct measures of disability or diagnoses that are strongly correlated with disability, has been found to be particularly useful in explaining variations in Medicare costs.

Building on prior research that addressed determinants of Medicare costs, we analyzed data from the new Medicare Current Beneficiary Survey to develop additional insight on the relation between disability characteristics and Medicare costs. Although partly motivated by an interest in improving risk adjustment for Medicare capitation payments, we conducted this research primarily to expand perspectives on the relation between disability and Medicare costs among elderly persons. The research presented in this article addresses three issues:

- the relation between levels of disability and prospective Medicare costs
- the effects on Medicare costs of interactions between disability and other personal characteristics of beneficiaries
- changes in the level of disability and Medicare costs

The next section presents a brief background on research that addressed factors behind variations in Medicare costs, with a focus on analyses of disability as an explanatory variable. Data sources, variable construction, and statistical methodology are described in the subsequent sections. Research results on the three topics are presented separately. We conclude with a discussion of the implications of findings from this study for research and policy.

Background

Concern about the projected growth in Medicare expenditures has heightened policy interest in increasing beneficiaries' enrollment in HMOs.

The cost-effectiveness of HMOs in serving Medicare beneficiaries will depend, however, on Medicare payments to HMOs that are adequately risk adjusted. Because the current methodology, referred to as the adjusted average per capita costs (AAPCC), explains such a small proportion of the variance in Medicare costs, refining the AAPCC continues to be an important area for health services research (Gruenberg, Kaganova, and Hornbrook 1996; Manton and Stallard 1992). Work has also been conducted to define payment adjustors specifically for disabled populations in connection with demonstration programs for nursing-home-certifiable patients, such as the Program for All-inclusive Care for the Elderly (PACE). PACE is an integrated acute- and long-term-care services program, which receives Medicare and Medicaid payments on a capitated basis. In such research, which has focused on examining the effects of additional health-related characteristics on costs, measures of disability have been tested and found particularly useful.

Functional disabilities in performing personal care, which result from physical or cognitive impairments, are widely viewed as important dimensions of the health status of elderly persons. Although disabilities in functional tasks have been effective in determining need for long-term care services, research has shown that they are also predictive of acute care use (e.g., Gruenberg, Kaganova, and Hornbrook 1996). Functional disabilities have been measured in many ways, but they have most often been discussed in terms of two sets of activities: activities of daily living (ADLs) and instrumental activities of daily living (IADLs). ADLs refer to self-care and include items of function like dressing, bathing, and eating (Katz et al. 1963), whereas IADLs reflect ability to perform household and social tasks like shopping, preparing meals, and handling money (Lawton and Brody 1969).

ADL and IADL dependency has been useful in predicting health services costs because the specific items of ADLs and IADLs are hierarchically related (e.g., persons who are dependent in eating are also dependent in bathing) and directly associated with amounts of resource requirements. Research has also shown that a simple count of the number of such dependencies (e.g., two or more ADLs) provides a reasonably good proxy for the hierarchical nature of the ADL items and, consequently, of the relative severity of a person's functional disabilities. In addition, because of the relatively more complicated nature of the IADLs relative to ADLs, persons who are dependent in ADLs are also dependent in IADLs. Hence, ADL and IADL depen-

dencies can be employed in various ways to assign relative health care needs of individuals.

Both ADLs and IADLs have been found to be important predictors of Medicare costs in prior research. Thomas et al. (1985) found that IADL impairment was the single best predictor (among measures of health status) of Medicare payments for a sample of Michigan beneficiaries. In more recent work, Gruenberg, Kaganova, and Hornbrook (1996) also showed that adding ADL and IADL impairments to the existing AAPCC factors substantially increased the amount of variance in Medicare costs that could be explained. Further, in research that linked Medicare claims to beneficiary characteristics from the Framingham Study, functional status independently contributed to explaining expenditures, even while taking into account prior utilization and chronic disease risk factors (Schauffler, Howland, and Cobb 1992).

Other researchers have demonstrated that among the subset of persons who typically incur higher expenses—the disabled and the very old—the spending distribution is much less skewed, making spending more predictable. For example, Kronick, Zhou, and Dreyfus (1995) employed various measures, including prior year's expenditures and diagnosis, to explain more than 30 percent of the variation in Medicaid expenditures in a population with disabilities. Disabled persons' health care needs are in many respects ongoing and thus can more easily be anticipated than those of the general population, whose health care needs often emerge at random.

A related issue addressed in this article is the extent to which functional status changes over time and the subsequent effect on health care costs. Lichtenstein and Thomas (1987) studied the stability of functional status over a 12-month period and found that the oldest beneficiaries and those who used the most care experienced the largest decline. For those 65 to 74 years old, 71 percent reported the same level of functioning from year 1 to year 2. In contrast, of those 85 years and older, only 58 percent remained stable. In other research, functional status transitions were monitored over a six-year period using the Longitudinal Study on Aging (Mor et al. 1994). Decline in functioning was much more common than improvement: only 4 percent of men and 2 percent of women improved. The study also found that an increase in utilization of services was more closely associated with the emergence of a new disability in those with no impairment at baseline than with those previously impaired whose status declined further.

Data Source and Methods

The determinants of health care costs for the elderly are extensive, yet most data sources (e.g., claims data files) do not contain the information to test the effects of many of these factors. The Medicare Current Beneficiary Survey (MCBS) provides a new source of data to explore the predictors of health services utilization by aged Medicare beneficiaries. The MCBS is a continuous longitudinal survey of a representative sample of the Medicare population, including the elderly and disabled and those living in the community and in institutions. The sample is approximately 12,000 beneficiaries, of whom 10,000 are elderly (65+).

The MCBS collects a broad range of information, including payments for health care from all sources (Medicare, out-of-pocket, and other insurers), demographic characteristics, and health status indicators. Changes in these variables are monitored annually or more often, with beneficiaries interviewed in person three times a year (rounds of data collection). Once a year, the sample is supplemented with newly eligible beneficiaries and replacements for attrition.

The first round of MCBS interviews was conducted from September through December 1991 to obtain baseline information on the initial sample. The second round (January through April 1992) started the data collection of health care utilization and costs experienced since January 1992. In addition to self-reported health care expenditures, charge and payment data residing in Medicare administrative and claims files are available for the sample and are linked to the interview responses. (See Adler [1994] for additional information on the MCBS.)

In this study, we used the MCBS data on beneficiary characteristics collected in round 4 (September through December 1992) and the Medicare administrative files to derive Medicare payment data related to use in calendar year 1993. Information on the patient characteristics generally refers to the status of sample persons in late 1992, or just before the 1993 observation period for Medicare payments. The exception to this scheme was our measurement of disability status at two points in time for the subset of respondents for whom both 1991 and 1992 disability measures were available.

Medicare Part A and Part B payments for 1993 were aggregated from claims data for each person in the sample to create the dependent variable in our analyses. We measured Medicare payments in 1993 because they represented prospective costs relative to beneficiary characteristics

measured in 1992. Because some members of the sample died during 1993, and would therefore not have exposure to Medicare costs for the entire year, we standardized the costs by dividing total accumulated payments in 1993 by days alive in 1993.

Samples

This study focused on elderly (65+) Medicare beneficiaries. We followed the approach used by Gruenberg, Kaganova, and Hornbrook (1996) to ensure that all elderly persons in the analysis were able to incur both Medicare Part A and B costs (because AAPCC payments cover both Part A and Part B services), did not have extraordinary costs because of end-stage renal disease, and were not in group health plans (which generally do not report Medicare costs). Hence, we excluded from the sample individuals who were not enrolled in Medicare Part B (n = 7), belonged to a group health plan (n = 723), were eligible because of end-stage renal disease (n = 25), or died before 1993 (n = 88) and could not incur costs in that year.

The resulting sample consisted of 9,340 persons, of whom 8,619 were residing in the community and 721 were residents of institutions at the baseline interview in 1992. Not all of the institutional sample was residing in traditional nursing homes; other institutions included mental health facilities, retirement and domiciliary facilities, and homes for the mentally retarded and developmentally disabled. Because of the broad definition of institutions employed by the MCBS (facilities with three or more beds that provide long-term-care assistance), we divided the institutional residents in our analyses between those in nursing homes and those in other facilities.

Explanatory Variables

We examined variables that have been found in prior research to be associated with health care use and costs. These include demographic characteristics like age and marital status, health status indicators, health insurance coverage, and census region of residence. Table 1 lists the explanatory variables that we used and the means of their values. We included ten medical condition variables, derived by the MCBS through questions posed as follows: "Has a physician ever told you that you

TABLE 1
Explanatory Variables

Variable name	Mean
Age	76.40
Female	.61
Married	.50
Hospital use in 1992	.18
Fair/poor health	.27
Myocardial infarction	.15
Stroke	.12
Cancer	.18
Diabetes	.16
Arthritis	.13
Alzheimer's disease	.06
Osteoporosis	.10
Mental disorder	.04
Parkinson's disease	.02
Emphysema, COPD, asthma	.13
IADL only	.22
ADL 1–2	.06
ADL 3+	.03
Nursing home	.07
Other institution	.01
Medicaid	.19
Medigap	.71
Mid-Atlantic	.18
East North Central	.18
West North Central	.06
South Atlantic	.20
East South Central	.06
West South Central	.11
Mountain	.05
Pacific	.11
Puerto Rico	.01

Abbreviations: COPD, chronic obstructive pulmonary disease; ADL, activities of daily living; IADL, instrumental activities of daily living.

had (condition)?" The approach for recording medical conditions in the MCBS is different from that employed in other surveys. Research to test the validity and reliability of responses to these questions remains to be conducted (e.g., comparisons with administrative records). Conse-

quently, we interpreted findings on the effects of these conditions with some caution. We also included responses to a subjective health status question, in which each sample person in the community was asked to rate his or her health on a scale ranging from "excellent" to "poor."

The disability variables that we created are based on dependencies in ADLs and IADLs, which have been used widely in research on disability and long-term care of elderly persons. Although the MCBS asked people about "difficulty" in performing some activities not included in the conventional ADL and IADL measures (e.g., lifting 10 pounds, walking two to three blocks), it did not elicit additional information related to those activities. In contrast, sample persons were asked about difficulty with ADL and IADL items and were questioned in detail about assistance received. The additional questions help to provide less ambiguous indications of need than does a global response of "difficulty."

We considered persons dependent in ADLs or IADLs if they received personal assistance because of those dependencies. For the community residents, five ADLs (bathing, dressing, toileting, transferring, and eating) were examined, as were six IADLs (using the telephone, doing light housework, doing heavy housework, preparing meals, shopping for personal items, and managing money). Beneficiaries were classified by whether they had no disability, one or more IADLs (and no ADL) dependencies, one or two ADL dependencies, and three or more ADL dependencies.

ADL and IADL dependencies were also recorded for persons residing in institutions. Unlike community residents from whom disability information was elicited either directly or through proxies, the disability of institutional residents was collected routinely from staff at the facilities. Because of the possibility that responses for the two groups were not comparable, we did not use community and institutional ADL and IADL dependency variables as a pooled set. For example, in the analysis of the total sample, we included the ADL and IADL variables of the community residents, and we simply coded institutional residents according to whether they were in nursing homes or "other institutions."

We also included a variable indicating whether a person was eligible for Medicaid, as well as a variable indicating whether the person had supplemental health insurance other than Medicaid. We included a variable indicating whether the sample persons had a hospital stay in 1992 to reflect prior use of a relatively costly health service. Finally, we

included census region of residence to control, in part, for geographic variations in Medicare costs.

Proxy Responses

In addition to the institutional population, for whom responses were provided by proxies, about 11 percent of the community-residing sample also had proxy respondents. As with any survey involving proxy respondents, questions arise about the consistency of responses to some questions, such as whether sample persons had been told by a physician that they had a particular medical condition. Although the extent of bias introduced by proxy respondents in the MCBS awaits future testing, it is important to note the possibility of such bias.

Estimation

As we highlighted in the background section, considerable research has been conducted on determinants of Medicare costs. The prior studies have also explored an array of methodological strategies for estimating Medicare costs and, because of that work, some conventional approaches have emerged. In this study, we used ordinary least squares (OLS) regression analyses to estimate the independent effects on costs of explanatory variables, including demographic, health status, functional status, and insurance characteristics of the sample persons. Because of the highly skewed distribution of Medicare payments, with relatively few persons accounting for a large proportion of total costs, researchers have used various techniques to adjust for the skewness (e.g., Newhouse et al. 1989; Schauffler, Howland, and Cobb 1992). We chose to adjust Medicare payments, in the multivariate analyses, by using the natural log of the payment amount plus one cent as the dependent variable. Because the coefficient estimates in log form are difficult to interpret, we also exponentiated the coefficients to present relative payments, which serve as multipliers for comparing the effects of specific characteristics to a reference category.

Findings

The findings from our analysis are separated into three sections, reflecting the three objectives of the research. The first considers the total sample of community and institutional residents. This section examines

the extent to which Medicare costs differ by demographic and health characteristics, particularly disability level, and whether costs of institutionalized persons differ from those of persons in the community. The second examines the interactions of disability and other determinants of costs. In this way, we examine the extent to which predictors of costs for the total sample might have differed for subgroups by disability level. The third section examines Medicare costs as a function of changes in disability status over a one-year period. Hence, it sheds light on whether short-term Medicare costs are affected by chronic versus temporary disability and the extent to which trajectories of disability influence acute-care costs.

Disability and Medicare Costs

Total and per Day Medicare Payments. Table 2 shows that whereas the average payment in 1993 was $4,081 for all persons, those who died in that year incurred costs ($12,319) that were almost three times higher than those of persons who did not die ($3,493). For the total sample, we also estimated that 10 percent of the people accounted for 64 percent of total Medicare payments. Because dying during the year reduces an individual's exposure to Medicare spending for the entire year, the relative costs of deceased and survivors when costs are standardized for exposure are even greater. For example, on a cost per day alive basis, persons who died during 1993 had Medicare payments of $81.87 per day, in contrast to persons who survived the entire year and averaged only $9.57 per day—a ninefold difference.

The other panels in table 2 present information on Medicare costs for subgroups of the total sample, categorized by level of disability if they were community residents (i.e., not disabled, disabled with only IADL dependencies, disabled with one or two ADLs, and disabled with three or more ADLs) and whether they were residing in nursing homes or "other institutions." Among the four groups of community residents, total Medicare payments increased with level of disability. Total payments ranged from $2,982 for persons entering 1993 with no disabilities to $9,957 for persons entering 1993 with three or more ADLs—a threefold difference.

Medicare costs increased with disability level among community residents and were relatively more evenly distributed among more disabled

TABLE 2
Total and per Day Medicare Payments for Subgroups of Enrollees, 1993

Subgroup	*N*	Total Medicare payments	Percent of total payments incurred by top 10% of users	Costs per day
Total sample	9,340	$ 4,081	64%	$ 14.38
Died in 1993	622	12,319	43	81.87
Survived in 1993	8,718	3,493	66	9.57
Community/not disabled	5,756	2,982	72	9.78
Died in 1993	158	18,246	46	108.58
Survived in 1993	5,598	2,551	71	6.99
Community/IADL only	2,046	5,002	59	17.85
Died in 1993	137	13,623	34	99.30
Survived in 1993	1,909	4,383	61	12.01
Community/1–2 ADLs	531	7,481	46	28.52
Died in 1993	73	11,762	43	90.62
Survived in 1993	458	6,798	47	18.63
Community/3+ADLs	286	9,957	40	36.44
Died in 1993	70	11,510	37	68.97
Survived in 1993	216	9,453	41	25.90
Nursing home	624	5,201	50	21.49
Died in 1993	163	6,462	43	45.44
Survived in 1993	461	4,755	53	13.03
Other institutions	97	6,702	51	26.40
Died in 1993	21	9,314	50	62.63
Survived in 1993	76	5,980	55	16.38

persons. For example, whereas 10 percent of persons in the nondisabled subgroup accounted for 72 percent of total costs of that group, the costliest 10 percent of persons in the 3+ ADL subgroup accounted for only 40 percent of total costs. Several factors might contribute to this finding. As noted by other researchers (Kronick, Zhou, and Dreyfus 1995; Gruenberg, Tompkins, and Porell 1989), with increasing frailty and functional limitations, all members of the group are more likely to require extensive health services, including the use of hospital care. Another reason for the more homogeneous costs in the more disabled subgroups is apparently the smaller cost differences between persons who died and survivors in those groups. For example, among the community nondisabled, survivors had average payments of $2,551, whereas deceased persons had payments of $18,246—a sevenfold difference. In contrast, persons with, for example, one or two ADLs who survived the year had average payments of $6,798, whereas persons starting the year with that level of disability who died had costs of $11,762.

The smaller cost differentials between survivors and decedents among increasingly more disabled subgroups are due in large part to the declining costs, with disability, of the decedents. This point is particularly apparent in the cost per day statistics in the last column. For example, persons who were not disabled at the beginning of the year and who died during the year had average costs per day of $108.58. In contrast, persons with three or more ADLs who died in 1993 had costs per day alive of $68.97. There are many possible reasons for these findings, including differences in clinical profiles of more and less disabled persons that require different types and amounts of acute care services. It is also possible that more disabled persons receive long-term-care services that are used as substitutes for acute care services.

The last two panels provide information on the nursing-home and "other institutional" residents among Medicare enrollees. The total Medicare payments for the nursing-home residents came to $5,201, an amount higher than that of nondisabled community residents, but lower than community residents with any ADL disability. Similarly, cost per survival day of nursing-home residents, $21.49, was lower than that of persons in the community with any ADL dependencies. More striking, the nursing-home patients who died during the year had lower costs than community residents who died, both in terms of total Medicare payments and cost per survival day. As with the different subgroups in the community by level of disability, this finding may reflect differences

in age and pattern of medical conditions between nursing-home and community residents who die and, consequently, the medical care requirements of the two groups. Gruenberg, Tompkins, and Porell (1989) also found that, in the last year of life, persons in nursing homes had less than half the Medicare costs of those who resided in their own homes.

Because of the small number of persons in "other institutions" and the diverse types of institutions that are included, it is difficult to make many inferences about this subgroup. In general, their total costs ($6,702) and cost per survival day ($26.40) are slightly higher than those of nursing-home patients, but considerably lower than community residents with any ADL dependencies.

Multivariate Analysis of Predictors of Medicare Payments. Using characteristics of Medicare patients measured just before the beginning of 1993, we estimated the effects of each of those characteristics, while controlling for others, on Medicare costs per day alive in 1993. The regression results are presented in table 3, which contains coefficient estimates, standard errors of the estimates, and the relative payments (*RP*s) associated with significant coefficients. For example, persons who were in "fair or poor health" had 55 percent higher Medicare costs than persons who were in "good or excellent health" ($RP = 1.55$).

Many of the personal characteristics are statistically significant predictors of Medicare costs. Although Medicare costs per day alive increased with age, they were not significantly associated with gender, after controlling for other characteristics listed in table 3. (Note that the relative payment for age, which is the only continuous variable in our analyses, is a per year multiplier.) Many of the reported medical conditions were significantly related to Medicare costs in 1993. For example, persons with diabetes had twice the Medicare costs of those without diabetes. On the other hand, the Medicare costs of people who had had a stroke, Alzheimer's disease, or osteoporosis were not significantly different from those of persons who had not had such conditions, when other factors were controlled.

In contrast to community residents with no disabilities at the beginning of 1993 (the reference category), persons with IADL dependencies had 60 percent higher Medicare costs. Persons with one or two ADLs had two and one-half times the costs of nondisabled persons, while those with three or more ADLs had more than three and one-half times the costs of persons with no disabilities. Persons in nursing homes or "other institutions" incurred more than twice the costs of persons residing in

TABLE 3
Effects of Explanatory Variables on Medicare Payments, 1993[a]

Characteristic	Coefficient	Standard error	Relative payment
Age	.036[b]	.004	1.04
Female	.033	.056	—
Married	.107	.057	—
Hospital use in 1992	1.162[b]	.067	3.20
Fair/poor health	.441[b]	.062	1.55
Myocardial infarction	.445[b]	.071	1.56
Stroke	.008	.081	—
Cancer	.502[b]	.064	1.65
Diabetes	.670[b]	.069	1.95
Arthritis	.248[b]	.076	1.28
Alzheimer's disease	−.088	.130	—
Osteoporosis	−.004	.087	—
Mental disorder	.267[b]	.127	1.31
Parkinson's disease	.128	.172	—
Emphysema, COPD, asthma	.512[b]	.075	1.67
IADL only	.470[b]	.067	1.60
ADL 1–2	.927[b]	.116	2.53
ADL 3+	1.30[b]	.158	3.67
Nursing home	.929[b]	.136	2.53
Other institution	.983[b]	.254	2.67
Medicaid	1.161[b]	.100	3.19
Medigap	1.062[b]	.086	2.89
Mid-Atlantic	.268	.143	—
East North Central	−.031	.144	—
West North Central	.033	.163	—
South Atlantic	.070	.143	—
East South Central	−.149	.167	—
West South Central	−.059	.151	—
Mountain	−.008	.170	—
Pacific	.124	.152	—
Puerto Rico	−.239	.244	—
Intercept	−4.480[b]	.325	—

[a] $N = 9{,}339$; $R^2 = .18$; adjusted $R^2 = .18$.
[b] Significant at a .05 level.
Note: Reference categories are "good/excellent health"; "not disabled"; "New England region."
Abbreviations: See table 1.

the community with no disabilities. Three other factors with large effects on Medicare costs in this model were having a prior hospital stay in 1992 ($RP = 3.20$), being eligible for Medicaid ($RP = 3.19$), and having a supplemental health insurance policy ($RP = 2.89$).

We also included in the model regions of the country in order to control partly for geographic variations in Medicare costs. The New England region served as the reference category for this variable. None of the regional variables was clearly statistically significant after controlling for the other characteristics in the model. Only the Mid-Atlantic region had a positive coefficient ($p = .06$) that approached the .05 level of significance commonly used as a cut-off point.

In general, our findings as described in this section are consistent with prior research. All domains of explanatory variables (e.g., health status, demographic characteristics) represented in the model had individual variables that were significant predictors of Medicare payments in 1993.

Predictors of Medicare Payments for Disability Subgroups

In the analysis of predictors of Medicare payments for the total sample discussed in the preceding section, disability levels were found to have strong effects on Medicare payments, but many other characteristics were also significant predictors of costs. To determine if the effects of other characteristics, like age or health status, had the same or a different impact on Medicare costs across disability subgroups, we estimated models in which disability groups were interacted with such characteristics. Methodological details on these models are discussed in Appendix A.

We included essentially the same explanatory variables that were in the model based on the total sample, but we excluded the regional variables, which did not appear to differentiate Medicare costs when the other characteristics were controlled. We also reduced the number of disability subgroups to four:

1. community nondisabled persons
2. community disabled persons with only IADL dependencies
3. community disabled persons with one or more ADL dependencies
4. residents of nursing homes

Because of sample size considerations, we excluded from this analysis persons in the "other institutional" settings ($n = 97$).

Table 4 presents the findings for the model in which persons who were not disabled served as the reference group, and the set of other personal characteristics was interacted with the IADL, ADL, and nursing-home residency status variables. The interaction terms provide estimates of the extent to which a particular characteristic differentially affects persons with disability relative to persons who are not disabled.

TABLE 4
Effects of Personal Characteristics on Medicare Payments, with Interactions between Disability and other Characteristics

		Nondisabled vs.		
Characteristic	Nondisabled	IADL	ADL	Nursing-home residents
Intercept	−5.83	—	—	—
Age	.05[a]	−.04[b]	−.02	−.03[b]
Female	.07	.14	−.39	−.04
Married	.18[a]	−.11	−.40[b]	−.36
Hospital use in 1992	1.28[a]	−.07	−.29	−.38
Fair/poor health	.53[a]	−.28[b]	.27	−.56[b]
Myocardial infarction	.44[a]	.08	−.30	−.11
Stroke	.05	−.19	.01	−.07
Cancer	.81[a]	−.71[b]	−.71[b]	−.87[b]
Diabetes	.72[a]	−.06	−.39	−.17
Arthritis	.29[a]	−.13	−.17	−.19
Alzheimer's disease	−.16	.48	.20	.03
Osteoporosis	.02	.03	.04	−.36
Mental disorder	.48[a]	−.44	−.83[b]	−.07
Parkinson's disease	.10	.19	.10	−.26
Emphysema	.50[a]	.14	−.29	−.23
Medicaid	1.41[a]	.05	−.74[b]	−.99[b]
Medigap	1.14[a]	.31	−.46	−.81[b]
IADL	—	3.77[b]	—	—
ADL	—	—	3.97[b]	—
Nursing home	—	—	—	5.33[b]

[a]Significantly different at a .05 level from nondisabled persons without the characteristic.
[b]Differences between coefficients of disabled and nondisabled are significant at a .05 level.

Analogous information when other subgroups served as the reference group are presented in Appendix B.

The first column of table 4 presents the estimates for the reference group of nondisabled persons and indicates which of the characteristics has a significant effect relative to the absence of the characteristic among nondisabled persons. As with the estimates for the total sample, presented in table 3, many characteristics were significantly associated with Medicare costs. The next three columns present the coefficient estimates for the interaction terms. A significant coefficient indicates that a particular characteristic has a different effect on Medicare costs for the IADL, ADL, or nursing-home subgroups, respectively, than it has for persons who are nondisabled. In the comparison between persons with IADL dependency and the nondisabled, for example, age, fair or poor health status, and a history of cancer were found to have different effects on the two groups of people. Because all three coefficients are negative, an IADL-disabled person with one of those characteristics has lower Medicare costs than a nondisabled person with the characteristic, when other factors are controlled.

The third column of table 4 presents the estimates for the interaction between ADL disability and the other personal characteristics. Significant differences between ADL-dependent and nondisabled persons were found for being married, having had a history of cancer or mental disorder, and being Medicaid eligible. The negative signs for these variables indicate that those characteristics had a negative effect on Medicare costs for ADL-dependent persons relative to nondisabled persons. The final column presents the interaction of being in a nursing home with the other personal characteristics. As with comparisons between nondisabled persons and the IADL and ADL subgroups, age, fair or poor health status, and a history of cancer significantly differentiated the Medicare costs of nursing-home residents and those of nondisabled persons. In addition, supplemental Medicare insurance (Medigap) was also significant and negative, indicating that among persons with such insurance, nursing-home patients were less costly, all other things being equal.

In general, the significant interaction variables in table 4 were negative, indicating that in the cases where particular characteristics differentiated the costs of disabled and nondisabled persons, disabled persons had lower Medicare costs. This finding is further explored in table 5, which presents the relative payments for the statistically significant

TABLE 5
Relative Payments Associated with Significant Differences in Coefficients between Pairs of Disability Groups

	Nondisabled vs.			IADL vs.		ADL vs. nursing home
	IADL	ADL	Nursing home	ADL	Nursing home	
Age	.96		.97			
Female				.58		
Married		.67				
Hospital use in 1992						
Fair/poor health	.76		.57	1.73		.43
Myocardial infarction						
Stroke						
Cancer	.49	.49	.42			
Diabetes						
Arthritis						
Alzheimer's disease						
Osteoporosis						
Mental disorder		.43				
Parkinson's disease						
Emphysema						
Medicaid		.48	.37	.45	.35	
Medigap			.44	.46	.33	

variables in table 4, as well as for the companion models in which the IADL and the ADL subgroups served as the reference category. Hence, table 5 summarizes the results of the interaction analysis when each subgroup is compared to the other.

The first three columns of table 5 present the comparisons between IADL, ADL, and nursing-home persons and nondisabled persons (reflecting the estimates in table 4). The second, two-column grouping compares the ADL and nursing-home persons to IADL persons, while the final column compares nursing-home residents to ADL-dependent persons in the community. In contrast to nondisabled persons with a history of cancer, for example, the Medicare costs of those with IADL dependencies and a history of cancer were only about one-half (49 percent). ADL-dependent persons (49 percent) and nursing-home residents

(42 percent) with cancer also had about half the costs of nondisabled persons, all else being equal.

In comparisons between persons with IADL dependencies and more severely disabled persons, those with ADL dependencies or residents of nursing homes, we found that more disabled persons tended to have lower Medicare costs on selected characteristics. For example, among persons eligible for Medicaid or for those with supplemental Medicare insurance, persons with ADLs had about one-half (45 to 46 percent) of the costs of those with only IADL dependencies. Similarly, nursing-home patients had about one-third (33 to 35 percent) of the costs of community residents with only IADL dependencies. In the entire analysis, we found only one situation in which more disabled persons had higher costs than less disabled persons: among persons who indicated that their health was fair or poor, those with ADL dependencies had 73 percent ($RP = 1.73$) higher costs than persons who were only IADL dependent. Finally, we found that only subjective health status differentiated costs between nursing-home residents and community residents with ADLs. Among persons who reported fair or poor health status, nursing home-residents had 43 percent of the costs of community residents with ADL dependencies.

In sum, the analysis of interactions between disability and other personal characteristics indicates that the effects of some characteristics on Medicare costs differed by the level of disability of community and nursing-home residents. The most notable finding is that, when significant differences were detected, more disabled persons tended to have lower costs than their less disabled counterparts, a result that applied to any two of the disability categories we created. This general finding may reflect differences in the pattern of comorbidities associated with level of disability. Although we attempted to control for some of those conditions in the regression model, substantial room exists for effects due to conditions that are not listed, severity differences among the conditions that were listed, and interactions of multiple chronic and acute conditions. The finding may also reflect differences in patterns of care provided to persons with different levels of disability.

Transitions in Disability Levels

The prior sections presented findings on the effects of disability levels on Medicare payments when disability was measured at a point in time. Those findings only began to illustrate the potentially complex relations

between disability and acute care costs. For example, the MCBS questions on disability do not include indications of whether the presence of ADL or IADL dependencies reflects a chronic or a temporary disability. The two situations could result in considerable differences in prospective Medicare costs. Beyond determination of whether disability is chronic or temporary, we can gain additional insight by measuring trajectories of disability, such as whether the level of disability increases or decreases over time.

There are few results from prior research to provide expectations for our findings. As we noted in the background section, Mor and his colleagues (1994) found that increases in service use were closely associated with the emergence of a new disability in persons with no previous impairment. Hence, we might expect persons who develop disability to have higher short-term costs than persons with "chronic" disability. On the other hand, we might expect that chronically disabled persons would have a continuing need for services, thereby incurring greater costs than temporarily disabled persons because of the accumulation of service use over time.

To explore the potential effects of temporary versus chronic disability and trends in disability levels on Medicare costs, we employed multiple measurements (i.e., round 1 in 1991 and round 4 in 1992) of disability to classify MCBS respondents by how their disability status changed over the course of a year. Such changes were used to predict 1993 Medicare costs. For this analysis, we selected the sample of 7,685 persons who were in the community in 1991 and for whom follow-up information was available in 1992. By round 4 in 1992, they could have been in the community, in institutions, or deceased. Although we examined transitions for all persons, the analysis of prospective Medicare costs incurred in 1993 excluded perforce persons who had died.

Table 6 presents descriptive information on the sample of MCBS who were residents in the community in the end of 1991 (round 1). The sample was grouped according to whether persons were nondisabled, dependent in one or more IADLs (but not ADLs), or dependent in one or more ADLs. The top panel of table 6 shows the distribution of each of the disability groups in terms of their status at the end of 1992 (round 4). For example, almost 83 percent of persons who were nondisabled in 1991 were also nondisabled in 1992. Among persons who were IADL disabled in 1991, almost one-third (30.0 percent) were nondisabled by 1992; hence, it appears that one-third of those IADL-dependent

TABLE 6
Subgroups by Transitions in Disability Status and Medicare Payments

		1992 (round 4)					
1991 (round 1)	*N*	No disability	IADL only	ADLs	Institutions	Deceased	Total
Percent distribution							
No disability	4,808	82.7%	11.6%	1.9%	0.6%	3.3%	100%
IADL only	2,009	30.0	50.5	9.5	2.5	7.5	100
ADLs	868	7.8	18.8	48.0	6.9	18.4	100
Total	7,685	60.4	22.6	5.9	1.8	6.1	100
Payments per survival day in 1993							
No disability	4,808	$10	$16	$29	$23	—	$11
IADL only	2,009	12	18	31	26	—	16
ADLs	868	12	23	28	35	—	21
Total	7,685	10	18	29	29	—	13

persons were only "temporarily" disabled in 1991. On the other hand, half of that subgroup remained IADL dependent and were likely to have been "chronically" disabled at that level. In addition, the condition of the remaining 20 percent declined over the year and resulted in their having ADL dependencies, being admitted to institutions, or dying. Finally, the panel shows that the more disabled a person is at the initial measurement, the more likely it is that his or her disability level will be different a year later. Moreover, people who are initially more disabled are also more likely to decline further than to improve.

In this analysis, we used the two points-in-time measurements of disability to assign individuals according to whether they were temporarily or chronically disabled. The two points in time are separated by a one-year interval; thus, we recognize that some persons might have had disability-level changes during the year that are not captured here. For example, people who were nondisabled in either round 1 or round 4 might have been IADL or ADL disabled sometime during the year and fully recovered before the round 4 survey. This possibility is suggested by the high proportions of persons who were IADL disabled at round 1 but who improved to become nondisabled by round 4.

The bottom section of table 6 presents the Medicare payments per survival day in 1993 for each of the disability subgroups based on their 1991 and 1992 status. Because the disability measurements were for 1991 and 1992, the 1993 Medicare payments reflect the prospective acute care costs of persons with particular disability trajectories.

Results in this table appear consistent with expectations. First, the largest subgroup, persons who were not disabled in 1991 or in 1992, had the lowest average costs of $10 per survival day in 1993. Persons who were nondisabled in 1991 but became disabled by 1992 had higher levels of Medicare costs, with the payment amounts being directly related to their level of disability in 1992. For example, nondisabled persons who became IADL dependent over the year had average costs of $16 per survival day in 1993, whereas nondisabled persons who became dependent in one or more ADLs had average costs of $29 per day.

Second, persons who were "chronically disabled" at the same level over the course of the year had costs that directly reflected their level of disability. For example, persons who were IADL dependent in both 1991 and 1992 had average Medicare costs of $18 per survival day in 1993, whereas persons who were dependent in ADLs at both time points had average Medicare costs of $28 per survival day. The other set of

"chronically" disabled persons are those who continued to be disabled, but whose level of disability either increased or decreased between 1991 and 1992. In general, initially disabled persons whose level of disability increased (or decreased) tended to have higher (or lower) costs than those whose level of disability remained the same. For example, persons making the transition from IADL dependency to ADL dependency had Medicare costs of $31 per survival day, whereas those who stayed IADL dependent had average costs of $18.

Third, persons who had a "temporary" disability, based on their returning to nondisabled status in 1992, tended to have average Medicare costs that were only slightly higher than those of persons who were not disabled in 1991 and 1992. Those who were only IADL disabled—or dependent in ADLs—in 1991 and returned to being nondisabled in 1992 had costs of $12 per day, in contrast to the $10 average costs of persons who were not disabled in either year.

Multivariate Analysis of Disability Changes. Extending the descriptive analysis, we incorporated the information on sample persons' disability changes in a multivariate analysis. We used essentially the same model of demographic, health status, insurance, and prior hospital use that was presented in preceding sections. The exception is that the point-in-time disability variable was replaced by a new set of variables, reflecting disability changes between 1991 and 1992. The new variable consists of nine categories, each of which is characterized by level of disability at two points in time (round 1 and round 4):

1. nondisabled/nondisabled
2. nondisabled/IADL
3. nondisabled/ADL disabled or institutionalized
4. IADL/nondisabled
5. IADL/IADL
6. IADL/ADL disabled or institutionalized
7. ADL/nondisabled
8. ADL/IADL
9. ADL/ADL or institutionalized

In the multivariate analysis, we used those persons who were not disabled in either round as the reference category; we refer to them as "never disabled" in this discussion.

Initially Nondisabled. Consistent with findings presented above (table 4), in which disability was incorporated as a point-in-time variable, table 7 shows that many of the same demographic, insurance, and health condition variables were significant and had similar effects on Medicare costs. Table 7 also shows that, relative to persons who were nondisabled in either round, nondisabled persons in 1991 who devel-

TABLE 7
Effects of Disability Changes on Medicare Payments per Survival Day[a]

Characteristic	Coefficient	Standard error	Relative payment
Age	.037[b]	.004	1.03
Female	.035	.064	—
Married	.128[b]	.064	1.19
Hospital use in 1992	1.262[b]	.077	3.53
Fair/poor health	.457[b]	.071	1.58
Myocardial infarction	.401[b]	.080	1.49
Stroke	−.022	.094	—
Cancer	.520[b]	.071	1.68
Diabetes	.638[b]	.078	1.89
Arthritis	.224[b]	.082	1.25
Alzheimer's disease	.044	.174	—
Osteoporosis	−.009	.098	—
Mental disorder	.118	.160	—
Parkinson's disease	.189	.208	—
Emphysema, COPD, asthma	.488[b]	.084	1.63
No disability/IADL	.288[b]	.110	1.33
No disability/ADL or institution	.910[b]	.226	2.48
IADL/no disability	.230[b]	.105	1.25
IADL/IADL	.537[b]	.092	1.71
IADL/ADL or institution	.903[b]	.171	2.47
ADL/no disability	.107	.290	—
ADL/IADL	.508[b]	.194	1.66
ADL/ADL or institution	1.005[b]	.135	2.73
Medicaid	1.406[b]	.117	4.07
Medigap	1.275[b]	.101	3.58
Intercept	−4.694[a]	.353	—

[a]N = 7,215; R^2 = .18; adjusted R^2 = .18.
[b]Significant at a .05 level.
Note: Reference categories are "good/excellent health"; "no disability/no disability"; "New England region."
Abbreviations: See table 1.

oped IADL-level disability by 1992 had 33 percent higher costs (*RP* = 1.33). Nondisabled persons who became ADL disabled or were institutionalized had costs that were two and one-half times that of persons who were "never disabled" (*RP* = 2.48).

Initially IADL Disabled. Persons who were "temporarily IADL disabled" (i.e., IADL disabled in 1991 and not disabled in 1992) had 25 percent (*RP* = 1.25) higher 1993 costs than persons who were "never disabled." Despite recovering from a relatively low level of disability, persons who had temporary need for IADL assistance incurred slightly higher Medicare costs than "never disabled" persons. In contrast, persons who were "chronically IADL disabled" (i.e., were IADL dependent at both round 1 and round 4) had 71 percent higher costs than "never disabled" persons. Initially IADL-dependent persons whose severity of disability increased to the ADL level or were institutionalized had Medicare costs that were two and one-half times the level of "never disabled" persons (*RP* = 2.47).

Initially ADL Disabled. Very few persons who had ADL dependencies in 1991 returned to a state of being nondisabled, which probably explains why the coefficient for that category was not significant. On the other hand, initially ADL disabled persons who improved to become only IADL dependent had costs that were 66 percent (*RP* = 1.66) higher than persons who were "never disabled." It is noteworthy that this level is quite comparable to that of persons who were "chronically IADL disabled" (*RP* = 1.71). Finally, persons who were "chronically ADL dependent" (i.e., were ADL dependent at round 1 and still ADL dependent or institutionalized at round 4) had prospective Medicare costs that exceeded those of "never disabled" persons by more than two and one-half times. The prospective costs of this group were close to those of persons who were initially IADL dependent in 1991 but declined to the ADL level or were institutionalized by 1992.

This analysis of disability changes on prospective Medicare costs shows that the round 4 (1992) disability level measured just prior to the measurement of 1993 costs appears to provide an "order of magnitude" prediction of those (1993) costs regardless of the initial measure of disability (i.e., round 1 in 1991). For example, persons who were IADL disabled at the end of 1992, regardless of whether they were not disabled, IADL disabled, or even ADL disabled in 1991, had costs that were between 33 and 71 percent higher than the costs of "never disabled" persons. Similarly, persons who were ADL disabled in 1992,

TABLE 8
Summary of Relative Payments by Disability Transition Groups

	1992 (round 4)		
1991 (round 1)	No disability	IADL	ADL or institution
No disability	1.00	1.33	2.48
IADL	1.25	1.71	2.47
ADL	(1.11)[a]	1.66	2.73

[a]Not significant in the regression model in table 7.

regardless of their 1991 disability level, had 1993 costs that were about two and one-half times those of persons who were "never disabled." These findings, derived from table 7, are highlighted in table 8, which shows the relative costs of the subgroups by disability changes between 1991 and 1992. Statistical tests did not reveal any differences between any pair of coefficients underlying the relative payments in each of the columns in table 8.

Discussion

The research in this paper examined relations between functional disability and Medicare costs among elderly community and institutional residents. Our aim was to provide insights on how disability affects Medicare costs, the interaction of disability with other personal characteristics that affect such costs, and the implications of disability changes for Medicare costs.

Consistent with prior research, we found that disability is an important reason why some elderly persons incur high Medicare costs. The amount of Medicare costs was directly related to the level of disability measured in terms of ADLs and IADLs, when other factors, like demographic characteristics, specific chronic conditions, health insurance, and prior hospital use, were controlled. By disaggregating the elderly population by their level of disability, we derived additional insight on the relation between disability, other personal characteristics, and Medicare costs. First, with increasing disability, the widely noted skewed distribution of Medicare costs diminishes notably. For example, among the nondisabled community residents, 72 percent of Medicare costs for

the group are incurred by 10 percent of the people in the group. In contrast, among the community residents with three or more ADLs, only 40 percent of the total costs are incurred by 10 percent of the people. Hence, the more disabled the Medicare beneficiaries, the more homogeneous are their Medicare costs.

Second, personal characteristics, like age and health status, can have differential effects on Medicare costs among subgroups of elderly persons, by their level of disability. Our analysis of interactions between disability level and other characteristics found that, after controlling for the "fixed" higher costs (because of the larger constants) associated with greater disability levels, more disabled persons with particular characteristics tended to have lower costs than their less disabled counterparts. In the analysis, we found instances where age, sex, and Medicaid status—three of the underwriting factors in the AAPCC—yielded significant interaction terms, suggesting that some refinement in the capitated payment might be achieved by considering such terms in the underwriting formula.

That analysis also found differences in costs of nondisabled and disabled persons with specific clinical characteristics (e.g., cancer). It is possible that nondisabled persons were provided more "high tech" and expensive services than their counterparts who were disabled entering 1993. Because of their relatively good health entering the year, nondisabled persons might have been exposed to more "heroic efforts" by the medical care system. In addition, as suggested by findings of Roos, Montgomery, and Roos (1987), acute care use and costs of disabled elderly persons might be offset, in part, by spending for long-term care.

Third, disabled elderly persons residing in nursing homes had lower Medicare costs than disabled community residents with ADL dependencies in both the descriptive and multivariate analyses. The observed differences may reflect differences in underlying health care needs of nursing-home and community disabled persons and, consequently, in the different types of medical care treatments that are provided to each group. Nursing-home residents may also receive some acute care services under non-Medicare payment sources (e.g., Medicaid) that community residents would receive under Medicare payments.

The last objective of our research was to examine changes in disability and their effects on Medicare costs. Our principal finding was that the level of disability measured just prior to the recording of Medicare costs (i.e., end of 1992 measurement of disability and 1993 Medicare costs)

differentiates elderly persons in terms of "order of magnitude" differences in Medicare costs, regardless of the individual's previous level of disability. For example, persons with IADL dependencies at the end of 1992 had 1993 Medicare costs that ranged from 33 percent to 71 percent higher than persons who were "never disabled," regardless of whether they were nondisabled, ADL disabled, or IADL disabled one year earlier.

Our analysis of the effects on Medicare costs of changes in disability levels provides only preliminary information. Although we assigned "temporary" and "chronically" disabled labels to persons in this study, based on measurements at two points in time, additional analyses are needed to validate our assignments. Such studies might involve employing more detailed medical histories based on both survey and claims records. Identifying the presence of medical conditions that are known clinically to cause chronic disability, for example, would help to differentiate persons with temporary or chronic disability. Additional data points on the same individuals—through the incorporation of future rounds of the MCBS data—would also help to confirm whether sample persons were temporarily or chronically disabled.

Although we found that the point-in-time measurement of disability level at the end of 1992 (regardless of changes between 1991 and 1992) provided a reasonable estimate of effects on costs in 1993, we think that the need to learn more about patterns of disability changes and ways to incorporate information about disability trajectories will have increasingly important policy applications in the future. For example, point-in-time measures of disability could be employed to improve risk adjustment for Medicare HMO payments because such measures could be updated regularly. On the other hand, programs like PACE establish disability level of enrollees only once and effectively "lock in" payment based on that one-time measurement. For such program models, trajectories of disability changes might provide a more accurate long-range forecast of acute care costs than would be achieved by a single point-in-time measure. More generally, information on disability trajectories could be useful in refining actuarial forecasts of health care spending for both managed care and fee-for-service programs.

This study focused on Medicare costs in a single year, but an important topic for future research would be the analysis of multiyear Medicare use and costs data for persons with different levels of disability. That research would provide findings both on the association between

trajectories of Medicare use and costs and on trajectories of changes in disability and other personal characteristics. It would also provide insight on factors that differentiate short-term, high-cost beneficiaries from those who have "chronically" high acute-care costs.

In conclusion, this article presented findings from research that examined functional disabilities and Medicare costs. Although our aim was to develop insight on the relations between disability levels, other characteristics of elderly persons, and Medicare costs, our findings, along with those from prior research in this area, have implications for policies and programs. In particular, with the rapid growth of managed care under capitated payments, rate-setting processes are likely to evolve toward more complex models for establishing payment amounts. The conceptual and empirically demonstrated relation between functional disability and Medicare costs suggests that disability is an important factor for consideration in such models. Finally, the emergence of programs to integrate acute- and long-term-care services under managed care provides an even stronger incentive to elucidate the relation between disability and health care costs.

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Appendix A

The purpose of the interactions analysis was to determine if personal characteristics like age and insurance status have the same effects on Medicare costs for persons with different levels of functional disability. In effect, the question asked was whether the coefficient estimates for a particular characteristic (e.g., age) were significantly different between

persons with two different levels of disability (e.g., not disabled and IADL disabled). Because we had constructed four groups of persons by functional disability—nondisabled, IADL disabled, ADL disabled, and nursing-home resident—we designed the analysis to determine whether differences existed between any two of the four groups. Hence, we developed three separate models. The first used nondisabled persons as the reference category, so that comparisons could be made between nondisabled persons and persons who were IADL disabled, ADL disabled, and residents of nursing homes, respectively. The second model used IADL-disabled persons as the reference category, and they were compared with ADL-disabled and nursing-home residents. The third model used ADL-disabled persons as the reference category for comparisons with nursing-home residents. In this way, differences in coefficients could be tested for all pairs of disability subgroups.

The basic model predicting Medicare costs for each disability group (i = nondisabled, IADL disabled, ADL disabled, nursing-home resident) can be written as:

$$C = \alpha_i + x\beta_i + \varepsilon$$

where costs are equal to the sum of an intercept term, α_i; values of personal characteristics, x; times the estimated coefficient on that characteristic, β_i; and an error term, ε. These models can be estimated using the data for each disability group model.

To test the statistical significance of differences in the estimated coefficients on x of two disability subgroups, the data can be combined in a model with interaction terms. This model can be written for each reference group "r" (e.g., not disabled) and comparison group "a" (e.g., IADL) as follows:

$$C = \alpha_r + x\beta_r + xd_a(\beta_a - \beta_r) + d_a(\alpha_a - \alpha_r)$$

where

C = Medicare costs,

α_r = constant term for the reference disability group,

α_a = constant term for the comparison disability group,

x = personal characteristics,

d_a = dummy variable marking comparison group,

β_r = coefficient estimated for characteristic x in the basic model of the reference disability group, and

β_a = coefficient estimated for characteristic x in the basic model of the comparison disability group.

In this model formulation, the difference between the estimated coefficients of the two disability groups, $\beta_a - \beta_r$, is estimated directly. The accompanying standard error provides a correct test for the significance of the difference.

In table 4, for example, nondisabled persons are the reference category "r," whereas "a" represents persons with (1) IADL disability levels, (2) ADL disability levels, and (3) nursing-home residence. The first column of the table presents the coefficient estimates, β_r, for the reference disability category of nondisabled persons, and the other three columns present the difference in coefficient estimates, $\beta_a - \beta_r$, between nondisabled persons and each of the other disability categories.

Appendix B

	IADL as reference category			ADL as reference category	
Characteristic	IADL	ADL	Nursing home	ADL	Nursing home
Age	.01	.02	.01	.03[a]	−.01
Female	.18	−.54[b]	−.19	−.36	.035
Married	.07	−.29	−.25	−.03	−.04
Hospital use in 1992	1.20[a]	−.21	−.30	.99[a]	−.09
Fair/poor health	.25[a]	.55[b]	−.28	.81[a]	−.84[b]
Myocardial infarction	.53[a]	−.29	.20	.13	.19
Stroke	−.14	−.39	−.12	.07	−.09
Cancer	.10	.21	−.16	.10	−.15
Diabetes	.66[a]	.00	−.11	.33	.21
Arthritis	.17	−.04	−.07	.12	−.02
Alzheimer's disease	.33	−.28	−.45	.05	−.16
Osteoporosis	.06	.01	−.40	.07	−.41
Mental disorder	.03	−.38	.37	−.34	.76
Parkinson's disease	.30	−.08	−.46	.21	−.37

(*continued*)

Appendix B (continued)

Characteristic	IADL as reference category			ADL as reference category	
	IADL	ADL	Nursing home	ADL	Nursing home
Emphysema	.65[a]	−.44	−.38	.20	.06
Medicaid	1.46[a]	−.79[b]	−1.05[b]	.67[a]	−.25
Medigap	1.46[a]	−.77[b]	−1.12[b]	.69[a]	−.35
Not disabled	−3.78[a]	—	—	−3.97[a]	—
IADL	—	—	—	−.19	—
ADL	—	.19	—	—	—
Nursing home	—	—	1.56	—	1.36
Intercept	2.05[a]	—	—	−1.86	—

[a]Significant at a .05 level.
[b]Difference between coefficients of comparison and reference categories are significant at a .05 level.