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Disability Declines and Trends in Medicare Expenditures

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Abstract

Forecasts of disability and Medicare expenditures ignore heterogeneity in the prevalence of disability, and associated health costs, in the U.S. elderly population. Understanding how people, and their health costs, are distributed over differences in individual health and function may identify further savings for the Medicare Trust Fund. In this paper we: (i) construct multivariate functional status profiles graded by severity of disability to make cross-temporal comparisons, (ii) analyze changes in the distribution of the age 65+ population across disability groups 1982 to 1999; (iii) document inflation adjusted Medicare costs, and their 1982 to 1999 changes, in these disability groups and for the U.S. elderly population.

Introduction

A number of factors drive changes in Medicare costs for the U.S. elderly population. One is population aging, i.e., the growth of the number of persons aged 65+. A second are changes in the health and function of elderly individuals. A third is the level of medical and health services necessary to sustain, or change, the health of individuals.

Unfortunately, in the models used to make official forecasts of U.S. Medicare expenditures, and the resulting Medicare Trust Fund status, there is no explicit relation between the level of expenditures on Medicare services and the health status and longevity of individuals. This is problematic since we expect there is a strong correlation of the level of Medicare expenditures and beneficiary's health status (the rationale of is Medicare spending in to maintain and improve the health of the elderly). Those relations should be used in identifying how changes in benefits (e.g., the introduction of Medicare Part D, prescription drug benefits, in 2006) will affect the future health status and longevity of the U.S. elderly population, its need for medical services, and how human capital will be created in the U.S. elderly population and how it will affect U.S. future economic growth (Tolley *et al*, 2004a).

To ascertain the nature and strength of the current expenditure-health relation, we examined changes in per capita Medicare expenditures 1982 to 1999 for persons who have particular health traits and disability. One plausible model would suggest that, to preserve health and increase human capital, per capita health expenditures should increase, i.e., that health problems continue to be treated to be eliminated or modified. Another perspective suggests expenditures will decrease: health costs, on an inflation adjusted per capita basis, should decline over time because elderly persons received improved health care at earlier ages, will have improved health at later ages. We will test which of these hypotheses is correct using data from the 1982 to 1999 National Long Term Care Survey (NLTCS) linked to Medicare health cost records for the same period.

From 1982 to 1999 the U.S. population aged 65+ increased from 26.9 million persons in 1982 to 35.2 million in 1999. In addition the direction of health and disability trends has been well documented. Analyses of the 1982 to 1999 NLTCS (Manton & Gu, 2001) showed the age adjusted prevalence of chronic disability and institutional residence for persons above age 65 declined from 26.2% in 1982 to 19.7% in 1999. This is a relative decline of 24.9% and an absolute reduction in the U.S. disabled elderly population of 2.3 million persons in 1999 compared to what would have occurred if 1982 age specific disability rates had not changed. This improvement reflects declines in the prevalence of disability generating medical conditions such as severe cognitive impairment (especially due to mixed and vascular dementia) stroke and atherosclerotic heart disease each of which cause significant chronic disability (Manton & Gu, 2004; Manton *et al*, 2004).

Analyses of other U.S. health surveys such as the Survey of Income and Program Participation (SIPP), Current Medicare Beneficiary Survey (CMBS), Health and Retirement Survey (HRS), the National Health Interview Survey (NHIS; and its two longitudinal supplements on aging) and various epidemiological studies (Freedman & Martin 1998; Allaire *et al*, 1999; Waidmann & Liu, 1998; Crimmins *et al*, 1997; Jacobzone *et al*, 1998) supported the NLTCS finding (Manton & Gu, 2001) of disability declines with per annum decreases between 0.9% and 2.8% depending on the data set and measure of disability.

Stallard (2004) confirmed the acceleration 1994 to 1999 of the rate of decline in disability in an independent analysis of the 1982 to 1999 NLTCS using 'longitudinal' weights. Studies comparing sets of national surveys due to Schoeni *et al* (2001), Freedman *et al* (2002), and Freedman *et al* (2004) also confirmed cross-temporal disability declines. U.S. declines in mortality and disability rates are longstanding, (e.g., 0.6% per annum since 1910 [Costa, 1998; Costa, 2000]) although the rate of early health improvements were slower. Those earlier declines were attributable to nutritional changes, changes in environmental hygiene (e.g., water quality) and other factors in a techno-physiological dynamic (Fogel, 1994; Fogel & Costa, 1997). Recent debates about the future effects of an increased prevalence of obesity in the U.S. suggest such increases are more significant in younger populations with malnutrition and dehydration still being significant problems at late ages (Lakdawalla *et al*, 2003; Manton, 2003; Manton, 2004).

Disability declines have implications for solvency of the Medicare Trust Fund (Singer and Manton, 1998) through the economic potential of increased human capital above age 65. Given projected reductions in future wage tax rate increases, from 4.5% in 1997 to 1.46% in 1999, necessary to preserve long term Medicare Trust Fund solvency (1999 Medicare Trust Fund Report), continuation of the over 1.5% per annum decline in chronic disability observed 1982 to 1999 could contribute significantly to the maintenance of the future actuarial balance of the Trust Fund (Singer & Manton, 1998). Disability declines (e.g., due to cohort specific health improvements resulting from smoking declines in birth cohorts whose behavior was affected by the 1962 Surgeon General's report on smoking) are likely more stable than cyclical changes in the U.S. economy. Thus, some of the decline is likely linked to falling adult U.S. cancer mortality rates (which started in 1990 and continue) as well as improved physical function and declines (possibly education driven) in severe cognitive impairment (Manton *et al*, 2004). Medicare spending decreased a full percent in absolute terms in 1999 (Board of Trustees, 2001) supporting a reduction in the real wage tax rate increase necessary to maintain long-term (75 year) solvency to 1.21% in 2000. Much of the effect was due to the 1997 Balanced Budget Act, which slowed the rapid increase in the Medicare reimbursement costs of home health agencies and skilled nursing facilities as well as for other health care providers (e.g., major teaching hospitals). Some argued that the 1997 BBA reductions were too severe in their effects on health care providers.

In 2001 the projected wage tax rate increases necessary to preserve solvency were raised by increasing projected medical care inflation rates 1% – an action taken by a Medicare Advisory Committee by assuming new medical technology would further accelerate Medicare cost increases. Recent (2002–2004) projections of Medicare fiscal stability have been less optimistic, as tax policy changed, federal deficits grew, and the U.S. economy, especially middle class job growth, has been slow to recover since 2001.

In the Methods section we briefly describe the longitudinal data and methodology used to construct the disability profiles. In Results, we examine disability profiles, changes in prevalence, and profile-specific changes in Medicare costs 1982 to 1999. Finally, we discuss implications of the interaction of disability/expenditure patterns for future Medicare costs – especially if health continues to improve. One important source of uncertainty in forecasts will be the reaction of beneficiaries to modification of the Medicare programs, e.g., the introduction of a drug benefit (Part D) and the Medicare Advantage program. Estimates (Congressional Budget Office vs. Centers for Medicare and Medicaid Services) of program costs depend on assumption about the acceptance of the program.

Methods

1. Data

Data on health and functioning were derived from individual survey records taken from the 1982, 1984, 1989, 1994 and 1999 NLTCS (Manton & Gu, 2001). In each of the NLTCS, list-based samples of approximately 20,000 persons age 65+ were drawn from Medicare enrollment files. A total of 42,000 persons were drawn with roughly 22,000 deaths occurring by 1999. Deaths are updated from Medicare records on an annual basis and, because the enrollment list is electronically maintained, we can track nearly 100% of the list sample and monitor the emergence of sample biases over time.

Persons in each survey were screened for chronic impairment of activities of daily living (ADL) or instrumental activities of daily living (IADL). Chronic means an ADL or IADL impairment lasting, or expected to last, 90 or more days. Persons reporting any chronic disability (1982–1999) were given a detailed community interview. If a person was institutionalized (in 1984–1999), he/she received an institutional interview; in 1982 only the fact of institutional residence was coded. Once a person responded to an in-person interview, they received such an interview in all later NLTCS to assess positive, and negative, changes in health and function. Sample persons who do not have chronic disability are re-screened in later NLTCS.

To ensure a nationally representative sample of the age 65+ population at each survey date, a supplement of 5,000 persons age 65–69 was drawn from Medicare enrollment files in 1984, 1989, 1994, and in 1999. Medicare costs for individuals are derived from records of Medicare Part A and B expenditures (Manton *et al*, 1997; Singer and Manton, 1998) for 1982–2000 i.e., for a full year after the 1982 and 1999 surveys. In 1994 and 1999 supplementary samples (N = 540 and 600) of persons aged 95+ were drawn to better determine the health of the population at extreme ages where the prevalence of nursing home use and severe disability remain high. The NLTCS was repeated in 2004 with a similar sample structure and instrumentation. The 95+ over sample was increased in 2004 to over 1,500.

2. Multivariate Analysis

27 ADL, IADL, and physical performance measures (Table 1) were selected from the NLTCS instrument to represent a comprehensive set of functional impairments. Because many people age 65+ have multiple impairments, no one specific combination of which occurs at high frequency, describing how people are distributed over this broad battery of impairments is difficult. To identify a small number of groups for our cost analyses, and to increase the reliability of the group definitions, we needed a multi-variate procedure to apply to the 27 measures to suppress measurement error and identify the most prevalent patterns. Identification of reliable disability patterns is important in projecting future health costs.

Box 1. Applying GoM to the NLTCS disability measures

To apply GoM to the NLTCS disability measures we defined a discrete variable response vector for person i as, $X_i = (X_{i1}, \ldots, X_{iJ})$ where there were J = 27 disability measures for each person. For a population of I individuals, responses can be summarized by counts in a J-dimensional contingency table containing $L_1 \times L_2 \times \ldots \times L_J$ cells, where L_j = number of levels (categories) for each disability variable, X_j. Dependencies among the J components of $\mathbf{X}_i$ can be represented by scores, g_{ik}, estimated such that the residuals of the measured variables for individuals, $X_{i1}, \ldots X_{iJ}$ are independent. The probability that a given trait is present for the ith person is,

$$\text{Prob}\left[x_{ijl} = 1.0\right] = \sum_{k=1}^{K} g_{ik} \cdot \lambda_{kjl} \qquad (1)$$

where λ_{kjl}'s are probabilities describing which of J traits are associated with the kth group and are g_{ik} scores for each person on each group where $0.0 \le g_{ik}$ $1.0 \le$ and

$$\sum_k g_{ik} = 1.0. \ \sum_{l_j=1}^{L_j} \lambda_{k,j,l_j} = 1 \text{ for } 1 \le j \ge J \text{ and } 1 \le k \le K.$$

K is the number of profiles determined by likelihood ratio χ^2 statistics as necessary to describe all non-random variation in the 27 disability measures. Estimation of parameters in (1) is done by maximum likelihood (Manton *et al*, 1994; Kovtun *et al*, 2004, 2005).

Since we wished to examine the 27 measures for all of the NLTCS conducted 1982 to 1999 we applied GoM to data accumulated across all survey years in a single data set by adding a variable to reflect time. This also required adding an indicator, t, reflecting the date of the interview, into parameters of the GoM equation, or,

$$\text{Prob}\left[x_{ijl}\ (t) = 1.0\right] = \sum_{k=1}^{K} g_{ik}\ (t)\ .\ \lambda_{kjl}\ (\cdot) \qquad (2)$$

In (2) the parameters defining disability profiles, $\lambda_{kjl}(\cdot)$, are assumed to be constant over time, i.e., disability patterns are defined the same in each year. This means variation in disability over time for any individual present in two or more surveys is forced to be represented in the g_{ik} (t). Forecasts or projections reflecting reliable changes in functional status would be done by modeling changes in g_{ik} (t) over time. This will have greater reliability in that stochastic error in the 27 measures is significantly reduced in the K-dimensional GoM solutions. Recently it was demonstrated that the GoM 'scores' (i.e., the g_{ik}) are 'consistent' parameter estimates, uniquely identified, and hence are satisfactory for making Medicare cost forecasts (Kovtun *et al*, 2004).

Since disability variables were discretely measured, instead of principal components analyses, we used Grade of Membership analyses (Manton *et al*, 1994) to identify disability groups or fuzzy 'clusters' (Manton *et al*, 2005b, c). Grade of Membership (GoM) models provide a useful strategy (Berkman *et al*, 1989; Manton *et al*, 1994; Wachter, 1999; Erosheva *et al*, 2004; Kovtun *et al*, 2004) to identify groups with distinctive sets of disability from a large battery of measures which are coded categorically and with error (see Box 1).

3. Cost Calculations

Medicare costs for each of K disability groups were calculated for each of the seven ($K = 6 + 1$, institutional = 7) groups identified by GoM as necessary to explain changes 1982 to 1999 in the 27 disability measures. We calculated mean Medicare expenses for each disability class in specific survey years using K group specific scores applied to Medicare costs for individual services from linked Medicare cost records and individual sample weights (see Box 2).

Box 2. Calculating disability group costs

Given estimates of g_{ik} and λ_{kjl} from the multi-year GoM analysis, we calculated disability group costs using cost parameters (from Medicare expenditure records for individuals) and time specific (adjusted for the period specific non-response profile) sample weights, i.e.,

$$\text{Cost}_{\text{TK}}^{(t)} = \frac{\sum_{i=1}^{I} g_{ik}\,(t) \cdot \text{Cost}_i\,(t) \cdot Sw_i(t)}{\sum_{i=1}^{I} g_{ik}\, Sw_i\ (t)} \qquad (2)$$

where Sw_i (t) is the sample weight for person i in survey (t) (adjusted for response rates in that survey and with persons aging in, i.e., adding persons passing age 65–69 between surveys) and I is sample size. Cost_{TK} is the average Medicare cost for the *Kth* group at a particular survey data in U.S. dollars.

Summing costs for the K disability groups at a given date gives the total U.S. Medicare costs. Further adjustments can be applied to the costs to reflect the effect of cost inflation from a specific survey date. One caution is that different information is reported for persons in Medicare managed care plans. Though this is a minority (about 16%) of the service provided, and costs are available for participation in the plan, this group may not be representative of persons in all other types of Medicare plans.

Results

Table 1 lists the 27 ADL, IADL, and physical performance measures used to describe disability. The first numerical column shows marginal frequencies of each condition averaged over the 1982, 1984, 1989, 1994, and 1999 NLTCS. Best fitting GoM models for each survey year revealed little variation in $\lambda_{kjl}(t)$ across surveys with K = 6 for all years for community residents; so we estimated the $\lambda_{kjl}(\cdot)$, i.e., time averaged λ_{kj1}. This meant the K disability groups are identically defined at each survey date. These coefficients are in columns 1–6 of Table 1.

A seventh category was defined for nursing home residents who reported an average of 4.8 ADLs impaired. An examination of the λ_{kjl} for a given group describes the typical or average disability traits of individuals in the group. The groups or clusters are 'fuzzy', in the sense that a person may be a partial member of more than one group. By using 'continuous' mixtures of groups we can explain a lot more variation of individual expenditures than if we restricted ourselves to discrete groups as in latent structure analysis (Manton *et al*, 1994). Specifically, for an analysis with a specific set of variables (here 27), for a model with K groups, a GoM model must do at least as well as a latent structure model in explaining the data. In a latent structure

Table 1. Estimates of probabilities (λ_{kjl} s x 100) describing the six disability dimensions identified from 27 measures of the ability to perform specific activities in the 1982, 1984, 1989, 1994 and 1999 NLTCS Community Interviews

			Percent With Indicated Characteristics for Pure Type (λ_{kjl})					
Characteristic		%	Active	Modest impairment	Moderate impairment	IADL	ADL	Frail
Needs Help With (ADL):	Eating	10.4	0.0	0.0	0.0	0.0	0.0	80.8
	Getting in/out of bed	27.3	0.0	0.0	0.0	0.0	100.00	100.0
	Getting around inside	39.0	0.0	0.0	0.0	0.0	100.00	100.0
	Dressing	19.9	0.0	0.0	0.0	0.0	0.0	100.0
	Bathing	42.8	0.0	0.0	0.0	0.0	100.0	100.0
	Using toilet	24.7	0.0	0.0	0.0	0.0	87.8	100.0
Bedfast:		0.8	0.0	0.0	0.0	0.0	0.0	5.2
No inside activity:		1.4	0.0	0.0	0.0	0.0	0.0	9.2
Uses Wheelchair:		5.8	0.0	0.0	0.0	0.0	14.0	23.4
Needs Help With (IADL:):	Heavy work	64.1	0.0	100.0	100.0	100.0	100.0	100.0
	Light work	20.7	0.0	0.0	0.0	0.0	0.0	100.0
	Laundry	32.8	0.0	0.0	0.0	100.0	0.0	100.0
	Cooking	24.4	0.0	0.0	0.0	100.0	0.0	100.0
	Grocery Shopping	44.8	0.0	0.0	0.0	100.0	100.0	100.0
	Getting about outside	49.7	0.0	0.0	0.0	100.0	100.0	100.0
	Traveling	43.8	0.0	0.0	0.0	100.0	100.0	85.2
	Managing money	21.7	0.0	0.0	0.0	100.0	0.0	100.0
	Taking medicine	20.9	0.0	0.0	0.0	100.0	0.0	100.0
	Telephoning	13.5	0.0	0.0	0.0	76.7	0.0	75.5
How Much Difficulty Do You Have:								
Climbing 1 Flights Stairs:	None	25.1	100.0	0.0	0.0	0.0	0.0	0.0
	Some	28.7	0.0	100.0	0.0	0.0	0.0	0.0
	Very Difficult	26.3	0.0	0.0	100.0	100.0	46.6	10.01
	Cannot at All	19.9	0.0	0.0	0.0	0.0	53.4	89.9
Bending for Socks:	None	49.2	100.0	0.0	0.0	93.3	0.0	0.0
	Some	26.1	0.0	100.0	49.2	0.0	49.5	13.5
	Very Difficult	15.2	0.0	0.0	50.9	0.0	50.5	22.2
	Cannot at All	9.5	0.0	0.0	0.0	0.0	0.0	64.4
Holding 10 lb. Package:	None	37.3	100.0	0.0	0.0	0.0	0.0	0.0
	Some	17.7	0.0	100.0	0.0	0.0	0.0	0.0
	Very Difficult	13.8	0.0	0.0	76.6	66.5	0.0	0.0
	Cannot at All	31.3	0.0	0.0	23.4	33.5	100.0	100.0
Reaching Over Head:	None	61.4	100.0	100.0	0.0	100.0	100.0	0.0
	Some	19.3	0.0	0.0	64.6	0.0	0.0	21.3
	Very Difficult	11.5	0.0	0.0	29.1	0.0	0.0	31.1
	Cannot at All	7.9	0.0	0.0	6.4	0.0	0.0	47.5
Combing Hair:	None	74.9	100.0	100.0	0.0	100.0	100.0	0.0
	Some	14.3	0.0	0.0	82.1	0.0	0.0	27.6
	Very Difficult	5.8	0.0	0.0	17.9	0.0	0.0	29.0
	Cannot at All	5.1	0.0	0.0	0.0	0.0	0.0	43.5
Washing Hair:	None	61.2	100.0	100.0	0.0	100.0	100.0	0.0
	Some	13.5	0.0	0.0	69.5	0.0	0.0	0.0
	Very Difficult	7.9	0.0	0.0	30.5	0.0	0.0	10.2

model there is a tendency to define too many groups as the model attempts to explain individual variation not represented in the groups (Manton *et al*, 2005b, c).

Brief verbal descriptions of these seven groups are in Table 2. The first three groups represent non-disabled (no ADL's or IADL's chronically impaired; hence independently living) persons differentiated only by limitations of physical performance. Most (98%) non-disabled persons fall in the first of the three groups. The two additional 'non-disabled' but performance-impaired groups occur as 'mitigating' factors in adjusting the application of severely disabled groups (i.e., 4–6) to describing individuals. Specifically, groups 2 and 3 are used as non-disabled constants to help score disability for an individual on a scale, say, defined by groups 2 and 6.

Table 2. Disability profiles of U.S. elderly population

	Disability Profiles
Non-disabled:	1 Active
	2 Modest impairment: some difficulty climbing stairs, lifting a 10 lb. package, and bending for socks [No ADL]
	3 Moderate impairment: difficult to climb stairs, lift a 10 lb. package, reach over head, etc. [No ADL]
Community disabled:	4 All IADLs, great difficulty climbing stairs, lifting a 10 lb. package
	5 Some ADLs and IADLs and difficulty climbing stairs, cannot lift a 10 lb. package
	6 Frail; impairment with ADLs and IADLs, and Physical Performance.
Institutionalized:	7 Institutionalized

Groups 4–6 represent persons with some ADL or IADL disability. Disability increases from group four, with primarily IADL impairments, to group 6 frail with multiple ADL and IADL impairments. Group 7, the institutional population, has the most impairment, i.e., on average, 4.8 of 6.0 ADL's impaired.

Questions have risen in whether the decline was restricted only to IADL's or whether there was significant decline of the prevalence of ADL impairments. This arose because of an issue in sample weight construction where weights for persons in institutions in 1999 were increased by independent renormalizing factors to be consistent with the number of persons projected by the Census Bureau to be in institutions in 1999. This projection, however, was based on the 1990 Census counts of persons in institutions and missed the emergence of the assisted living phenomena in the U.S. from 1994 to 1999 (Manton & Gu, 2001) and declines nursing home use found in other surveys (e.g., Bishop, 1999). When the 2000 Census institutional counts were used, instead of the 1990 projected nursing home counts provided by Census, and account was taken of assisted living, the nursing home population was found to have dropped dramatically in size and, since persons in nursing homes tend to be heavily impaired, the prevalence of severe ADL impairment in the combined community, assisted living and nursing home population clearly declined (Manton & Gu, 2001; Stallard, 2004; Stallard *et al*, 2004).

In 1982, 78.8% (non-age standardized) of the elderly U.S. population is non-disabled, i.e., 98% of these persons are in group 1 and have **no** performance impairments. In 1999, 81.9% (an increase of 3.1%) of the population is non-disabled and in group 1, 97.8% of these have no performance problems ($g_{ik}=1.0$). This increase is consistent with our disability prevalence trend analyses done without age standardization (Manton & Gu, 2001; see also Stallard, 2004). The prevalence change 1982 to 1999 is larger with age standardization, i.e., the 6.5% cited in Manton and Gu (2001) rather than the 3.1% the non-age standardized change.

Table 3 shows the 1982 and 1999 distribution of the U.S. elderly population by disability category. Associated with each disability group are total Medicare costs and costs per person for 1982 and 1999 for 12 months after the survey date. Values for 1982 are adjusted for U.S. annual medical care service (5.9%) inflation rate and are inflated to 1999 so that a comparison in constant dollars can be made.

The elderly chronically disabled population in groups 4–7 shows, despite a substantial increase (+30.9%) in the age 65+ population (from 26.9 million in 1982 to 35.2 million in 1999), an absolute numerical **decrease** (from 4.23 to 4.12 million) rather than the expected 30.9% increase (i.e., to 5.54 million). The population in non-disabled groups 1–3 increased from 22.7 million to 31.1 million persons. These non-disabled numbers are larger than in Manton & Gu (2001) because there non-disability was defined in a more stringent way. Because of declines in disability prevalence 1982–1999 we may define even more stringent non-disability states in future analysis.

In comparing expenditures over time one must specify not only the date for which expenditures were made but also the interval over which costs are aggregated – here one year. Since NLTCS disability estimates are point prevalences, expenditures for individuals for whom the prevalence is calculated will be biased downward by mortality during the year since mortality varies over disability. Expenditures were adjusted to represent Medicare costs over 12 months for persons in a disability category by taking the proportion of the year lived by a person and multiplying costs by the inverse of that proportion. This closely reproduces published estimates of Medicare expenditures in the corresponding year (Cowan *et al*, 2001).

Table 3. Cost reduction for Medicare elderly population specific to disability levels

Disability Category	1982			1999			1999 total cost reduction (Billions) using 1982 CPI adjusted average costs	
	$ Expended (x10^9)	# Persons (x10^5)	$ / Person** (x10^3)	$ Expended (x10^9)	# Persons (x10^5)	$ / Person (x10^3)	1999 disabled rates	1982 disabled rates
Active	35.78	212.24	4.47	116.95	288.59	4.05	14.1	7.0
Modest impairment	2.66	8.10	8.70	10.50	15.09	6.96	2.7	−1.1
Moderate impairment	2.78	6.59	11.18	7.40	7.39	10.01	0.8	2.3
IADL	3.19	6.90	12.25	5.03	4.65	10.82	0.6	6.5
ADL	4.68	9.83	12.62	13.14	10.66	12.33	0.2	3.4
Frail	7.89	10.27	20.36	21.90	11.32	19.35	0.2	6.4
Institution	4.53	15.32	7.84	15.83	14.52	10.90	−4.7	1.4
Subtotal	61.51	269.25	6.05	190.75	352.22	5.42	13.9	25.9

Source: Estimation based on National Long Term Care Surveys 1982 and 1999, and 1982–1983 Medicare Public Bill Use file, and 1999 Medicare claims data from Medicare SAF (Standard Analytical Files).

** adjusted by Consummer Price Index (CPI) for medical care services for U.S. city average, data from Department of Labor (5.9%/ year).

Table 4. Disability specific average Medicare expenditures by gender for age 65+ in the 1982 and 1999 NLTCS

Disability Category	Men: Totals $ Expended (x10^9) (# Persons (x10^5)) 1982	Men: Totals 1999	Men: Average (x10^3) $ / Person 1982*	Men: Average 1999	Women: Totals $ Expended (x10^9) (# Persons (x10^5)) 1982	Women: Totals 1999	Women: Average (x10^3) $ / Person 1982*	Women: Average 1999
Age 65–84								
Active	16.98 (84.99)	50.58 (119.40)	5.29	4.24	16.74 (117.40)	52.87 (147.70)	3.78	3.58
Modest-Impairement	1.00 (2.74)	3.64 (4.30)	9.67	8.47	1.27 (4.36)	4.52 (8.12)	7.72	5.57
Moderate-Impairement	0.77 (1.54)	2.14 (1.48)	13.24	14.46	1.63 (4.08)	3.58 (4.28)	10.58	8.36
IADL	1.04 (1.90)	1.77 (1.28)	14.50	13.83	1.47 (3.22)	1.79 (1.79)	12.09	10.00
ADL	1.17 (2.34)	2.97 (1.98)	13.24	15.00	2.27 (5.64)	6.41 (5.68)	12.77	11.29
Frail	2.90 (3.16)	9.48 (3.01)	24.31	31.50	3.60 (4.50)	7.03 (4.29)	21.19	16.39
Institution	0.79 (2.28)	3.28 (2.27)	7.42	14.45	2.02 (6.20)	4.86 (4.53)	8.63	10.73
Age 85+								
Active	0.81 (3.13)	5.03 (7.87)	6.85	6.39	1.25 (6.72)	8.47 (13.62)	4.93	6.22
Modest-Impairment	0.12 (0.31)	0.67 (0.69)	10.25	9.71	0.27 (0.69)	1.67 (1.98)	10.36	8.43
Moderate-Impairment	0.10 (0.21)	0.54 (0.37)	12.61	14.59	0.28 (0.76)	1.14 (1.26)	9.76	9.05
IADL	0.22 (0.51)	0.53 (0.43)	11.43	12.33	0.46 (1.27)	0.94 (1.15)	9.59	8.17
ADL	0.24 (0.39)	1.31 (0.76)	16.30	17.24	0.55 (1.46)	2.45 (2.24)	9.98	10.94
Frail	0.37 (0.62)	1.94 (0.98)	15.81	19.80	1.02 (1.99)	3.45 (3.04)	13.58	11.35
Institution	0.46 (1.22)	2.39 (1.31)	9.99	18.24	1.26 (5.08)	5.30 (6.41)	6.57	8.27

Source: Estimation based on National Long Term Care Surveys 1982 and 1999, 1982–1983 Medicare Public Use Bill file, and 1999 Medicare claims data from Medicare SAF (Standard Analytical Files).

*adjusted by Consummer Price Index (CPI) for medical care services for U.S. city average, data from DOL (5.9%/year).

We examined more detailed trends decomposed by age and gender in Table 4.

Disabled and institutional residents have the highest per person Medicare expenditures for both men and women, regardless of age, and the fastest increase 1982 to 1999. Thus, reductions in the number of severely disabled persons and institutional residents have the largest potential savings in per-person Medicare expenditures.

As Table 4 shows, there were substantial increases in the number of non-disabled persons 1982 to 1999 for both men and women and each age group (i.e., age 65–84 and 85+). Per capita Medicare costs changed within disability groups. For frail men (group 6) age 65–84+ per person year expenditures in 1999 are 7.5 times those for those non-disabled (an increase from the 1982 ratio of 4.6 to 1). For disabled women age 65–84, per person year expenditures are 4.5 times those of the non-disabled (a decrease from the 1982 ratio of 5.6 to 1). A person who might have been severely disabled in 1982 but who is, in 1999, non-disabled represents a substantial saving, e.g., $27,200 per person year for each non-disabled male aged 65–84 in 1999. For females the differential declined but remained substantial – about $12,900.

For males aged 65–84, per person costs increased 1982 to 1999 by a larger amount for the frail and institutional residents than for any other group. After adjusting for the 6% medical inflation, Medicare costs for the non-disabled group declined $1,000 per year per person. Because of this, and the rapid growth of the non-disabled population, total average Medicare expenditures (Table 4) decreased for both men and women after being adjusted by the Consumer Price Index (CPI) for Medical Care Services (5.9%) 1982 to 1999 (see http://data.bls.gov/servlet/SurveyOutputServlet).

A second component of change reflected in Medicare costs are changes in the distribution of the population across disability groups. Specifically, there is a proportionately larger proportion of disabled persons in 1982 than 1999. If costs increase for the severe disability category then using the 1982 proportion times the 1999 population size and applying 1982 inflated Medicare costs provides an estimate of the effect of shifts in disability holding inflation adjusted costs constant. This is the second source of change in total Medicare expenditures 1982 to 1999.

The decline in disability prevalence **and** decrease in per capita Medicare costs for non-disabled persons saved $26 billion dollars in 1999 over what would have occurred if 1982 costs, and the 1982 prevalence, for each disability group had not changed (see Table 3). This is a 14% reduction in total 1999 expected Medicare costs, including expenses required to help elderly persons become, and remain, non-disabled.

Table 5 shows that of the $26 billion roughly half is associated with increases in the proportion of non-disabled and

Table 5. Summary of Medicare expenditures changes for age 65+ between 1982 and 1999 NLTCS

Disability	1999 total cost reduction ($x10^9$) $ using 1982 CPI adjusted average costs			
	disable rates are 1999		disable rates no change since 1982	
Category	Men	Women	Men	Women
Age 65–84				
Active	12.06	2.91	9.87	0.95
Modest-Impairment	0.52	1.74	–0.08	–0.44
Moderate-Impairment	–0.18	0.95	0.60	1.66
IADL	0.09	0.37	1.93	2.94
ADL	–0.35	0.85	1.20	2.33
Frail	–2.16	2.06	0.84	4.54
Institution	–1.60	–0.95	–0.47	1.63
Subtotal	8.92	7.94	13.89	13.62
Age 85+				
Active	0.36	–1.76	–0.86	–3.00
Modest-Impairment	0.04	0.38	–0.05	–0.49
Moderate-Impairment	–0.07	0.09	–0.03	0.09
IADL	–0.04	0.16	0.60	1.07
ADL	–0.07	–0.21	–0.08	–0.04
Frail	–0.39	0.68	–0.04	1.02
Institution	–1.08	–1.09	–0.02	0.22
Subtotal	–1.25	–1.75	–0.48	–1.14

Source: Estimation based on National Long Term Care Surveys 1982 and 1999, and Medicare claims data from Medicare SAF (Standard Analytical Files).

*adjusted by Consumer Price Index (CPI) for medical care services for U.S. city average, data from DOL (5.9%/year).

half with lower inflation adjusted Medicare costs for the non-disabled.

Cost benefits occur for the 65 to 84 age group. At ages 85+ costs increase in some groups, (e.g., non-disabled females) but are moderated by declines in other groups so the net effect on Medicare costs, despite large increases in this very old population, is small.

Discussion

Manton & Gu (2001) and Stallard (2004) suggested a 1.7% per annum decline in chronic disability in the U.S. elderly population was achieved 1982 to 1999 and may be sustainable in the future. This would keep the support ratio (ratio of economically active persons age 20–64 to the number of chronically disabled persons age 65+) above its 1994 value (Singer & Manton 1998, p. 2), 22:1, when the Hospital Insurance (HI) Trust Fund was in fiscal balance, to 2070. This decline, however, masks variation in per annum changes in the prevalence of disability and institutional residents. From 1982 to 1999, the absolute decline in the number of persons in the most severely disabled (group 6 and 7) category, translates into a 2.4% per annum and 2.6% per annum decline for men age 65–84 and 85+, respectively. For women at the same ages in the severely disabled group, per annum declines are 2.3% and 1.2%.

These statistics identify where, by age and sex, changes in disability have occurred. Declines were large in categories where the potential for Medicare savings is large. The increase in per person Medicare costs from 1982 to 1999 is higher for males in the most severely disabled categories and institutional residents. Although this is a relatively small portion of the U.S. elderly population it has a considerable effect on overall Medicare expenditures. The healthy group had the lowest per person costs and a decrease in real costs 1982 to 1999 for both males and females after the 6% inflation adjustment.

An indication of the Medicare savings in population shifts from a severely disabled category –or the institutionalized population – to the non-disabled group is revealed by the ratio of disabled to non-disabled per person expenditures. For disabled women age 65–84 in 1999, per person expenditures are 4.5 times those for non-disabled women. For disabled men aged 65–84 in 1999, per person expenditures are 7.5 times those in the non-disabled group. For men age 85+ per person expenditures in the disabled group are over four times those costs for the non-disabled. An example of the absolute Medicare cost savings is that the reduction of 2.3 million disabled persons in 1999 from what would have been if 1982 rates had not declined represents savings in 1999 of $26 billion or 14% reduction in Medicare expenditures. This does not include gains in economic productivity and increases in federal tax revenue that should accrue, due to increased human capital at later ages (Tolley *et al*, 2004a, b). As the population ages, and the elderly and oldest-old population grows, savings from health improvements increase.

Though the potential for reducing Medicare costs in the future by reducing disability is clear, how can this be accomplished? There are several potential sources of reductions in disability. First, many disabilities decline in prevalence with increasing years of schooling. Preston, 1993, projected the proportion of persons age 85–89 with less than 8 years of education will decline from 65% in 1980 to 15% in 2015. A projection (Singer & Manton, 1998; Daviglus *et al*, 1998) assuming all persons age 65+ had 8+ years of education in 1990 implied disability could decline 2.1–2.2% per annum to 2025. That the effect of education may be due to improved access to care is suggested by reductions in severe cognitive impairment risks in highly educated persons being larger in 1999 than 1982 (Manton & Gu, 2004).

Issues of Medicare costs relate to the compression of morbidity (Fries, 1980). In this model there was a biological constraint on the increase in life expectancy at levels near those currently observed (i.e., for females in Japan and several European countries about 85 years). Fortunately the rate of improvement in mortality at extreme ages has not slowed down (Manton & Stallard, 1996) which suggests we are not approaching a boundary to future human longevity increases. Thus one must consider a more flexible model (Manton, 1989a, b) where the rate of decline in disabled life years is faster than the increase in total expected years of life. The data seems to better fit this more general model. Since much of the improvement has been through education and social factors we must now ascertain if biomedical research advances are having an increasing impact, i.e., 'Regenerative Medicine' where aging processes can be reversed.

Reductions in disability have implications beyond health costs. If disability prevalence is low at ages 65–74, it may be feasible to raise the normal SSA retirement age to parallel increases in life expectancy and active life expectancy past age 65. Statutory changes in 1983 mandated changes in the normal retirement age from 65 to 67 starting after 2000. Kerry-Danforth suggested increasing the normal retirement age to 70. If done, assuming pension payments averaged $10,620 per year in 1995 the pension savings for males would be $43.7 billion. Annual disability payments would increase $1.53 billion (Tolley & Manton, 1996). A net savings of $42.2 billion in SSA payments might be achieved in five years. If five successive male cohorts had similar experiences, the per year saving (as of 1995) would be $42.2 billion. – with similar savings for females – or $80 billion per year reduction in SSA costs for increasing retirement age from 65 to 70. Disability reductions become increasingly significant the greater the age increase in retirement.

With the 1982 to 1999 NLTCS we have a longitudinal time series of data linked to a continuous history of detailed Medicare Service Use, expenditures and diagnostic records. Our analysis suggests the potential of these data in forecasting the future expense of the U.S. Medicare programs and the health of its beneficiaries. To do this, forecasting methodologies have to be developed and applied. Procedures where health expenditures, health changes and longevity change independently are not acceptable. The estimates made in the paper, based on a battery of measures of functional states made over a large time, may be a reasonable improvement.

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