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RESEARCH ARTICLE

Cumulative Expenditures under the DI, SSI, Medicare, and Medicaid Programs for a Cohort of Disabled Working-Age Adults

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Objective. To estimate cumulative DI, SSI, Medicare, and Medicaid expenditures from initial disability benefit award to death or age 65.

Data Sources. Administrative records for a cohort of new CY2000 DI and SSI awardees aged 18–64.

Study Design. Actual expenditures were obtained for 2000–2006/7. Subsequent expenditures were simulated using a regression-adjusted Markov process to assign individuals to annual disability benefit coverage states. Program expenditures were simulated conditional on assigned benefit coverage status. Estimates reflect present value of expenditures at initial award in 2000 and are expressed in constant 2012 dollars. Expenditure estimates were also updated to reflect benefit levels and characteristics of new awardees in 2012.

Data Collection. We matched records for a 10 percent nationally representative sample.

Principal Findings. Overall average cumulative expenditures are $292,401 through death or age 65, with 51.4 percent for cash benefits and 48.6 percent for health care. Expenditures are about twice the average for individuals first awarded benefits at age 18–30. Overall average expenditures increased by 10 percent when updated for a simulated 2012 cohort.

Conclusions. Data on cumulative expenditures, especially combined across programs, are useful for evaluating the long-term payoff of investments designed to modify entry to and exit from the disability rolls.

Key Words. Disability, Medicare, Medicaid, Social Security Disability Insurance, Supplemental Security Income

Rapidly rising costs under the Medicare, Medicaid, and Social Security disability programs have been of long-standing concern to policy makers. A key driver of increasing program costs is disabled working-age adults, who

frequently are eligible for benefits under multiple programs (Livermore, Stapleton, and O'Toole 2011; Riley and Rupp 2012). The Social Security Disability Insurance (DI) program provides cash benefits to disabled workers with sufficient earnings experience and automatically leads to Medicare entitlement after a 24-month waiting period. Supplemental Security Income (SSI) is a federal means-tested cash benefit program targeting aged, blind, and disabled individuals; in most states, SSI eligibility also qualifies the recipient for Medicaid with no waiting period (Rupp and Riley 2012). As of 2012, DI enrollment stood at 10.1 million, with program expenditures of approximately $131 billion (Social Security Administration [SSA] 2012a). There were 4.9 million disabled adult enrollees under the SSI program, accounting for about $34 billion in program expenditures (SSA 2012b).

Several recent initiatives have attempted to control costs under these four programs (CMS 2012a,b; SSA 2012c,d). Some analysts have called for more fundamental reforms that would seek to enable disabled workers to remain in the workforce and off the disability rolls. Efforts to keep disabled individuals in the workforce and return-to-work initiatives are potentially costly, and it is difficult to evaluate potential savings, given long durations on DI and SSI, their impact on Medicare and Medicaid coverage and expenditures, and individual heterogeneity.

Important policy questions about these programs are inherently longitudinal because long-term effects may substantially differ from immediate effects or even effects accounting for the standard 10-year federal budget cycle. Most data available for program evaluation are cross-sectional, which can be very misleading if taken as an indication of relative program cost associated with a new award. Duration on the disability rolls, often spanning decades, varies substantially by individual characteristics. This paper describes a methodology to estimate expenditure patterns under the four programs over the working-age life cycle of a cohort of disabled individuals first awarded DI and/or SSI benefits in CY2000. We also update these expenditure estimates to reflect benefit levels and beneficiary characteristics of new awardees in 2012. From a policy perspective the estimates presented in this paper will permit a more complete assessment of public expenditures associated with disability benefit awards than analyses that are constrained to one program or have limited fol-

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low-up. Potential applications involve evaluating savings associated with preventing or delaying entry to the disability rolls, and analyzing the financial impact of initiatives to encourage beneficiaries to re-enter the workforce.

We build on previous work by Hennessey and Dykacz (1989), Rupp and Scott (1995), and Bye et al. (1991). The previous studies were limited to independent analyses of DI awardees (Hennessey and Dykacz 1989) and SSI awardees (Rupp and Scott 1995); both estimated benefit eligibility separately and did not analyze expenditures. One study (Bye et al. 1991) estimated Medicare expenditures for DI awardees. To our knowledge, this is the first study that estimates combined cumulative DI, SSI, Medicare, and Medicaid expenditures using linked administrative data.

Data and Methods

Data

This study uses matched administrative records from the Social Security Administration (SSA) and the Centers for Medicare and Medicaid Services (CMS) for a 10 percent sample of DI and SSI program participants in 1996–2008. Some records were available through 2008 and others were available only through 2006 or 2007. Our analysis focuses on an awardee cohort first eligible for disability cash benefits at age 18–64 in 2000 ($N = 68{,}794$). We selected a CY2000 cohort to yield several years of actual expenditure data and to allow a sufficiently long period for transition and expenditure patterns to stabilize following complex enrollment dynamics during the first few years. About half the sample was aged 50–64 at time of program entry and 48 percent had a primary diagnosis of diseases of the musculoskeletal system or mental disorders (excluding intellectual disability) (Table 1). Four previous studies have been conducted from this dataset, focusing on various issues, but none used estimates beyond the first 7 years after disability award (Rupp and Riley 2011, 2012; Riley and Rupp 2012; Coe and Rupp 2013). Riley and Rupp (2012) covers the structure and contents of the data set.

Overview of Simulation Methodology

The goal of the analysis was to estimate cumulative expenditures for the study sample from time of first disability benefit award in 2000 until death or attainment of age 65, by program. Administrative records provided actual expenditure data for 2000–2006 for Medicare and Medicaid, and 2000–2007

Table 1: Selected Characteristics of Social Security Disability Insurance (DI) and Supplemental Security Income (SSI) Beneficiaries with First Award in 2000

Beneficiary Characteristics	*Percent Distribution (%)*
N	68,794
Total percent	100.0
Age in CY2000	
18–30	9.6
31–40	15.4
41–50	26.8
51–60	40.0
61+	8.3
Sex	
Male	51.3
Female	48.1
Unknown	0.6
Primary diagnosis	
Diseases of the musculo-skeletal system	25.5
Mental disorders (excluding intellectual disability)	22.6
Diseases of the circulatory system	12.2
Neoplasms	9.2
Diseases of the nervous system and sense organs	7.9
Diseases of the respiratory system	4.3
Injuries	3.8
Endocrine, nutritional, and metabolic diseases	3.0
Intellectual disabilities	2.6
Diseases of the genitourinary system	2.2
Other/unknown diagnoses	6.7
Disability benefit eligibility 2000–2007	
DI only	60.0
SSI only	15.5
DI and SSI	24.5

Source. Social Security Administration and Centers for Medicare and Medicaid Services administrative records.

for DI and SSI. Expenditures for all subsequent years were simulated using a multistage estimation method. Our approach was based on the fact that beneficiaries can transition into and out of the disability programs as their circumstances change, and that eligibility for Medicare and Medicaid are largely determined by eligibility for DI and SSI benefits respectively.

To estimate expenditures beyond our period of direct observation, a first-order Markov process was used to assign individual cohort members to DI and/or SSI status for each year they were alive and under age 65. Actual age was determined from date of birth and deaths were simulated using a

separate equation. Assignment to a disability benefit state in a given year was accomplished through regression-adjusted transition probabilities that depended on the prior year state, age for that year, sex, primary diagnosis, and observed disability benefit history in the years 2000–2007. Regression adjustment was designed to account for heterogeneity in transition probabilities due to variation in beneficiary characteristics and cohort aging. We then estimated annual DI, SSI, Medicare, and Medicaid expenditures conditional on assigned disability benefit status. Expenditures were summed across years to obtain cumulative expenditure estimates for each individual in the sample. Several sensitivity analyses were performed to test the validity of model assumptions, which are described in the Electronic Supplemental Materials (ESM). As an additional check on the validity of our Markov process results, we estimated average years in DI and SSI benefit status and compared them to previous published estimates, as described in Appendix SA2-1 in the ESM. The following sections address the major sequential steps in our estimation methodology.

Actual Expenditures in 2000–2006/7

We captured actual DI and SSI expenditures between 2000 and 2007 from administrative records. SSI expenditures included federal payments only because data on state SSI benefits were missing in our dataset, resulting in an undercount of combined federal and state benefits of about 10 percent. Medicare Part A and Part B fee-for-service expenditures were collected from CMS administrative records for 2000–2006. Managed care expenditures are not included in the administrative records, so we imputed expenditures for these observations by multiplying months of managed care enrollment by the average per member per month payment to managed care plans, by year. Expenditures under the Part D prescription drug program, which began in 2006, were estimated in a similar manner. Medicaid expenditures were captured for 2000–2006, including actual capitation amounts paid to managed care plans and amounts paid under other prepaid arrangements. Medicaid payments for Medicare Part B premiums ("buy-in" payments) were estimated and added to Medicaid expenditure amounts. For all Medicare and Medicaid expenditures, we included only amounts incurred from the month of first disability benefit eligibility and did not include costs incurred prior to that. Because SSI, Medicare, and Medicaid benefits may continue beyond age 64 based on categorical eligibility as aged and are no longer conditional on disability status, we did not include in the analysis expenditure data incurred at age 65 or older.

Transition Probabilities

Our dataset contained disability benefit eligibility through 2008 (although expenditures were available through 2007 only). In 2008, the last year in which actual disability status was observed, each cohort member who was alive and under age 65 was assigned to one of four disability benefit states based on having eligibility for DI and/or SSI benefits: DI ONLY, SSI ONLY, DI AND SSI, and NEITHER. A new disability benefit state was assigned for 2009 using a first-order Markov process based on transition probabilities derived from observed transitions among the study cohort from 2004 to 2008. Probabilities associated with relatively common transitions were regression-adjusted for beneficiary characteristics, including time varying age. Disability benefit states were assigned for subsequent years in a similar manner, based on the prior year state and on beneficiary characteristics. Appendix Table 1 in Appendix SA2-2 in the ESM shows the crude transition probabilities among disability benefit states, by year and pooled across years. Binomial and multinomial logistic regression models used to adjust transition probabilities for beneficiary characteristics are described in Appendix Table 2 in the ESM.

Probabilities of dying were estimated separately through a logistic regression model that incorporated current disability benefit state and other factors (Appendix Table 3). Probabilities derived from the model were used to simulate deaths in each year. Death and attainment of age 65 (calculated from actual date of birth) were treated as absorbing states; no disability benefit state was assigned after the simulated year of death or after attaining age 65. The maximum number of simulated years was 39 for individuals who were first awarded disability benefits at age 18 and survived to age 65.

Estimating Cash Benefit and Health Care Expenditures

Cash benefit and health care expenditures were estimated for each year conditional on simulated disability benefit status for that year. We used different estimation methods for cash benefit and health care expenditures reflecting the different ways those expenditures are incurred and differences in their distributional properties. For each year of simulated DI eligibility, a DI expenditure amount was assigned based on the individual's DI benefit history. DI benefits do not change over time for most beneficiaries, except for cost-of-living adjustments. Similarly, for each year of simulated SSI eligibility, a SSI expenditure amount was assigned based on the individual's SSI benefit history. SSI bene-

fits concurrent with a DI benefit were considered separately because SSI benefits are offset by concurrent DI benefits at an essentially 100 percent offset rate. In a few instances of nonobserved benefit data from one or the other cash benefit program we imputed a DI (or SSI) expenditure amount equal to average benefits for the study cohort.

Estimating Medicare and Medicaid expenditures involved two steps: determining program enrollment and estimating expenditures conditional on enrollment. Medicare enrollment was assumed to begin following the accumulation of 2 years of DI benefits (actual or assigned), and to end if DI benefits ceased for 8 consecutive years. These assumptions were based on the 24-month waiting period for Medicare entitlement and on the fact that Medicare benefits may continue for up to 93 months following exit from the DI rolls. Cohort members with a history of end-stage renal disease (ESRD) were also assumed to have Medicare coverage because ESRD is a basis for Medicare entitlement. For each year of Medicare coverage, Medicare expenditures were estimated using a generalized linear model with a log link and gamma distribution developed from cohort data covering 2004–2006. The model incorporated demographics, primary diagnosis, disability benefit status, and death. This modeling approach has the advantages that predicted expenditures cannot be negative, and the gamma distribution has been shown to accommodate skewness in the data (Manning, Basu, and Mullahy 2005).

Annual Medicaid expenditures were estimated for each year using a two-part model based on data from the cohort for 2004–2006. The first part was a binary logistic regression model predicting Medicaid enrollment based on SSI eligibility, demographics, and primary diagnosis. The second part was a generalized linear model that predicted annual Medicaid expenditures conditional on Medicaid enrollment, similar to our Medicare methodology. For a given person-year, estimates from the two parts of the model were multiplied to produce a predicted Medicaid expenditure. A similar two-part model was employed to predict participation in the Part D prescription drug program among Medicare enrollees, and to estimate annual Medicare prescription drug expenditures conditional on participation. Table 2 lists the variables used to estimate annual program expenditures, as well as transition probabilities. Appendix Tables 4 and 5 in the ESM provide further detail.

Adjustments for Inflation and the Time Value of Money

Our main estimates reflect present value of expenditures in 2000 and are expressed in constant 2012 dollars. The main estimates presented in the

Table 2: Independent Variables Used to Predict Transitions between Disability Benefit States, Death, and Annual Expenditures for Purposes of Estimating Cumulative Expenditures per Beneficiary under the DI, SSI, Medicare, and Medicaid Programs

	Predicted Variables						
Independent Variable	*Disability Benefit Status Transitions**	*Death*	*DI Annual Expend.*	*SSI Annual Expend.*	*Medicare Parts A and B Annual Expend.*	*Medicare Part D Drug Annual Expend.*	*Medicaid Annual Expend.*
Age	X	X			X	X	X
Sex	X	X			X	X	X
Primary diagnosis	X	X			X	X	X
History of end-stage renal disease		X			X	X	X
Current disability benefit status	X	X	X	X	X	X	X
History of DI	X				X	X	
History of SSI	X					X	X
Level of monthly DI benefits (2000–2007)	X		X				
Level of monthly SSI benefits (2000–2007)				X			
Died					X	X	X

Note. Prediction equations are described in the Electronic Supplemental Material.
*Transitions refer to year-to-year transitions between disability benefit states: DI ONLY; SSI ONLY; DI AND SSI; and NEITHER DI nor SSI.
DI, Social Security Disability Insurance; SSI, Supplemental Security Income, federal expenditures only.
Source. Social Security Administration and Centers for Medicare and Medicaid Services administrative records.

paper make three major assumptions. First, we assumed that the nominal value of monthly disability benefits will continue to grow proportionally with inflation. We use the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W) (SSA 2012e). This was the basis of our estimate of DI and SSI cash benefits, since both programs use the CPI-W for annual benefit updates. Second, for Medicare and Medicaid, we assumed

that the nominal value of expenditures increased by CPI + 2 percent during the period when actual expenditures are unobserved. The impact of alternative assumptions regarding rates of growth in health care expenditures is described in sensitivity analyses in the ESM. Third, we accounted for the time value of money by discounting, assuming a rate reflecting the time horizon of expenditure flows. Our default estimate assumes a discount rate equal to the current yield of inflation-indexed Treasury bills as reported by the Federal Reserve Board, reflecting rates on 9-12-2013 (Board of Governors of the Federal Reserve System 2013). We also assessed the sensitivity of estimates to alternative assumptions about the appropriate discount rate (see ESM for details).

Average Cumulative Expenditures of a Simulated 2012 Cohort

Cumulative expenditures for more recent cohorts of new disability awardees may differ from those of our 2000 cohort for several reasons. Average benefit levels have increased, particularly for Medicare and Medicaid benefits, after adjustment for inflation. The characteristics of new awardees may have changed as the baby boom generation has aged, increasing the average age at initial eligibility. The distribution of diagnostic categories may also have changed consistent with national trends in obesity, mental health care, etc.

We updated our expenditure estimates for the 2000 cohort to reflect program benefit levels and characteristics of new disability benefit awardees in 2012. We used published data on DI and SSI awards from the Social Security Administration (SSA 2000, 2002, 2012a,b) and published data on Medicare and Medicaid per capita costs from the Centers for Medicare and Medicaid Services (CMS 2002, 2012c, 2008, 2013a,b). Briefly, we increased the average expenditure estimates for the 2000 cohort by the change in per capita costs between 2000 and 2012 under each program, after controlling for inflation. Medicare Part D expenditures were also increased to account for the fact that the 2000 cohort had no Medicare Part D expenses between 2000 and 2005, whereas a 2012 cohort would begin to incur such expenses right away. Lastly, we recalculated average cumulative expenditures to reflect changes between 2000 and 2012 in the distribution of new disability benefit awardees across age, sex, diagnosis, and initial disability program status. Details on the methodology are contained in the ESM. The updated estimates represent average cumulative expenditures of a simulated 2012

cohort of new disability benefit awardees, reflecting benefit levels and awardee characteristics in 2012.

RESULTS

Cumulative Expenditures per Beneficiary

We estimated that the 2000 study cohort will incur, on average, $292,401 (in 2012 dollars) in cash benefit and health care expenditures between initial award and death or attainment of age 65, expressed in present value terms at time of award (Table 3). DI accounted for 46.6 percent of this amount, with Medicare, Medicaid, and SSI accounting for 29.1, 19.5, and 4.8 percent, respectively. Cumulative expenditures are markedly higher for those first awarded benefits at earlier ages, reflecting the large difference in years of potential disability benefit eligibility. We estimate that on average 14.2 years elapse between initial award and death or attainment of age 65, and this average is much higher (33.0 years) for disability awardees aged 18–30 years. Note that these statistics refer to years of exposure to the risk of program participation and include years on and off the disability rolls. SSI and Medicaid account for a higher percentage of total expenditures among those entering the disability rolls at younger ages.

Cumulative expenditures per beneficiary also vary substantially by primary diagnosis. Those diagnosed with diseases of the genitourinary system incur the highest average expenditures ($620,807) largely due to Medicare-covered dialysis and transplant costs. Cumulative expenditures per beneficiary for other common conditions vary from $472,913 for individuals with intellectual disabilities to $101,079 for those with neoplasms, with higher cost diagnoses generally associated with more years of potential benefit eligibility. Beneficiaries disabled with diseases of the musculoskeletal system, who accounted for a quarter of the study cohort, incurred about two-thirds of their expenditures in the form of income support on DI and SSI. Expenditures for beneficiaries disabled with mental disorders or diseases of the circulatory system, the next most common conditions, were more evenly split between income support and health care payments. Diagnoses sometimes interact with age to affect expenditure patterns. Beneficiaries with intellectual disabilities and mental disorders tend to enter the disability programs at a young age and frequently qualify for SSI and Medicaid, producing relatively high expenditures.

Table 3: Estimated Present Value, at Time of Initial Disability Benefit Award, of Average Cumulative Expenditures under the DI, SSI, Medicare, and Medicaid Programs for a Cohort of Disabled Adults, from Initial Award in 2000 to Death or Attainment of Age 65, by Age and Primary Diagnosis

Characteristic	Average Years*	Average Cumulative Expenditures (in 2012 Dollars)	Program				
			All	DI	SSI	Medicare	Medicaid
			Percent of Expenditures				
All	14.2	292,401	100.0	46.6	4.8	29.1	19.5
Age in CY2000							
18–30	33.0	582,629	100.0	26.7	9.0	28.6	35.7
31–40	22.5	472,764	100.0	45.4	4.8	30.2	19.7
41–50	15.1	333,908	100.0	50.9	3.6	30.6	14.9
51–60	8.1	175,134	100.0	57.3	2.9	27.5	12.4
61+	3.4	52,560	100.0	67.7	3.2	13.8	15.3
Primary diagnosis							
Genitourinary	10.9	620,807	100.0	17.2	1.4	70.6	10.8
Intellectual disabilities	28.6	472,913	100.0	21.1	14.9	16.7	47.3
Mental disorders	20.6	388,324	100.0	42.6	6.9	25.8	24.8
Injuries	16.6	330,342	100.0	47.1	3.8	24.7	24.4
Nervous system	15.4	323,270	100.0	50.6	3.5	27.5	18.5
Endocrine	12.1	317,041	100.0	38.6	3.7	41.2	16.5
Musculoskeletal	13.6	253,562	100.0	64.2	2.6	25.2	8.1
Circulatory	9.5	231,579	100.0	49.9	3.0	31.3	15.8
Respiratory	8.5	198,437	100.0	48.0	3.5	32.5	16.0
Neoplasms	4.9	101,079	100.0	45.5	2.7	29.7	22.1
Other/unknown	13.6	303,238	100.0	37.9	5.7	29.1	27.4

Note. Cumulative expenditures have been discounted at rates reflecting the yield on inflation-indexed Treasury bills with variable maturation schedules as of September 12, 2013. Discounted expenditure estimates are given in 2012 constant dollars. Estimates assume growth in the nominal value of monthly disability benefit expenditures at CPI, and growth in health care expenditures at CPI + 2 percent beyond the observation period for actual expenditures.

*Years from first disability benefit eligibility to the earlier of death or attainment of age 65.

DI, Social Security Disability Insurance; SSI, Supplemental Security Income, federal expenditures only.

Source. Social Security Administration and Centers for Medicare and Medicaid Services administrative records.

Cumulative expenditure data provide a different perspective on program costs than cross-sectional data, which are more commonly available for program evaluation and analysis. Average annual expenditures in 2000 for prevalent DI and SSI program participants were $20,975 under the four programs (expressed in 2012 constant dollars) (Table 4). The estimated

Table 4: Comparison of the Present Value of Cumulative Expenditures with Cross-Sectional Per Capita Expenditures under the DI, SSI, Medicare, and Medicaid Programs, by Age and Primary Diagnosis

	New Disability Benefit Awardees in 2000		*All CY2000 Disability Beneficiaries*		
	Percent Distribution (%)	*Average Cumulative Expenditures (in 2012 Dollars)*	*Percent Distribution (%)*	*Avg. Cross-Sectional Expenditures (in 2012 Dollars)*	*Ratio Cumulative/ Cross-Sectional*
N	68,794		820,656		
Characteristic					
All	100.0	292,401	100.0	20,975	14
Age in CY2000					
18–30	9.6	582,629	5.7	18,671	31
31–40	15.4	472,764	15.7	21,158	22
41–50	26.8	333,908	27.7	21,633	15
51–60	40.0	175,134	36.4	20,821	8
61+	8.3	52,560	14.5	20,817	3
Primary diagnosis					
Genitourinary	2.2	620,807	1.5	53,999	11
Intellectual disabilities	2.6	472,913	7.3	19,330	24
Mental disorders	22.6	388,324	28.5	19,827	20
Injuries	3.8	330,342	3.9	22,491	15
Nervous system	7.9	323,270	8.2	22,036	15
Endocrine	3.0	317,041	4.9	22,469	14
Musculoskeletal	25.5	253,562	20.4	17,329	15
Circulatory	12.2	231,579	9.7	22,667	10
Respiratory	4.3	198,437	3.3	21,450	9
Neoplasms	9.2	101,079	2.9	20,840	5
Other/unknown	6.7	303,238	9.3	24,238	13
Disability benefit eligibility					
DI only	60.0*	256,591	60.2†	20,949	12
SSI only	15.5*	294,540	28.7†	20,024	15
DI and SSI	24.5*	378,894	11.2†	23,573	16

Note. Cumulative expenditures have been discounted at rates reflecting the yield on inflation-indexed Treasury bills with variable maturation schedules as of September 12, 2013. Discounted expenditure estimates are given in 2012 constant dollars. Estimates assume growth in the nominal value of monthly disability benefit expenditures at CPI, and growth in health care expenditures at CPI + 2 percent beyond the observation period for actual expenditures. Prevalent annual expenditures for CY2000 beneficiaries refer to expenditures incurred in calendar year 2000 among beneficiaries first eligible for disability benefits in 2000 or earlier at age 18 or older.

*Based on disability benefit eligibility in 2000–2007.

†Based on disability benefit eligibility in 2000.

DI, Social Security Disability Insurance; SSI, Supplemental Security Income, federal expenditures only.

Source. Social Security Administration and Centers for Medicare and Medicaid Services administrative records.

cumulative expenditure per CY2000 awardee is 14 times larger than average cross-sectional expenditures in 2000, and it varies substantially by age and diagnosis. For example, average cumulative expenditures for those entering the disability rolls at age 18–30 are the highest of any age group and their cross-sectional expenditures are the lowest, resulting in the highest ratio of cumulative to prevalent expenditures (31). The ratio of cumulative to prevalent expenditures is generally higher for diagnoses that are associated with many years of potential benefit eligibility.

Expenditures by Revenue Source

Public expenditures to support the disabled adult population come from several different revenue sources. DI and Medicare Part A expenditures are paid for by federal payroll taxes (FICA). SSI federal expenditures and Medicare Parts B and D are supported by federal general tax revenues. Medicaid relies on a combination of federal and state general tax revenues. In 2013 Part A accounted for 49 percent of Medicare Part A and B expenditures for the disabled (CMS, 2013b); 57 percent of Medicaid benefits represented federal spending (Medicaid and CHIP Payment and Access Commission [MACPAC] 2014). Applying these percentages to our average cumulative expenditure estimate suggests that approximately 59 percent of combined program expenditures are supported by payroll taxes, 32 percent are supported by federal general taxes, and 8 percent are supported by state taxes (calculations not shown). If SSI state supplemental expenditures are considered, the percent supported by state taxes would rise slightly.

Aggregate Expenditures

Aggregate expenditures, summed across individual awardees, provide a measure of the total financial impact of CY2000 awardees on the four programs. For purposes of presentation the aggregate expenditures for the study sample have been multiplied by 10 to produce national program estimates. We estimate that all new disability benefit awardees in CY2000 will incur $201.2 billion in cumulative program expenditures (Table 5). Aggregate expenditures are disproportionately influenced by younger beneficiaries, who have many more potential years of program eligibility. Those first awarded disability benefits at age 18–30 account for 9.6 percent of awardees and 19.2 percent of aggregate expenditures. Aggregate

Table 5: Estimated Present Value, at Time of Initial Disability Benefit Award, of Aggregate Expenditures under the DI, SSI, Medicare, and Medicaid Programs for a Cohort of Disabled Adults, from Initial Award in 2000 to Death or Attainment of Age 65, by Age and Primary Diagnosis

Characteristic	*Percent of Awardees*	*Aggregate Expenditures in Billions (in 2012 Dollars)*	*Percent of Expenditures*
All	100.0	201.2	100.0
Age in CY2000			
18–30	9.6	38.6	19.2
31–40	15.4	49.9	24.8
41–50	26.8	61.4	30.5
51–60	40.0	48.2	23.9
61+	8.3	3.0	1.5
Primary diagnosis			
Mental disorders	22.6	60.3	30.0
Musculoskeletal	25.5	44.4	22.1
Circulatory	12.2	19.4	9.7
Nervous system	7.9	17.5	8.7
Genitourinary	2.2	9.6	4.8
Injuries	3.8	8.5	4.2
Intellectual disabilities	2.6	8.3	4.1
Endocrine	3.0	6.6	3.3
Neoplasms	9.2	6.4	3.2
Respiratory	4.3	5.9	2.9
Other/unknown	6.7	14.2	7.1

Note. Expenditures of the 10% sample cohort were multiplied by 10 to get program totals. Cumulative expenditures have been discounted at rates reflecting the yield on inflation-indexed Treasury bills with variable maturation schedules as of September 12, 2013. Discounted expenditure estimates are given in 2012 constant dollars. Estimates assume growth in the nominal value of monthly disability benefit expenditures at CPI, and growth in health care expenditures at CPI + 2 percent beyond the observation period for actual expenditures.
DI, Social Security Disability Insurance; SSI, Supplemental Security Income, federal expenditures only.
Source. Social Security Administration and Centers for Medicare and Medicaid Services administrative records.

expenditures are dominated by beneficiaries diagnosed with mental disorders (who incur 30.0 percent of aggregate expenditures) and diseases of the musculoskeletal system (who incur 22.1 percent). Persons diagnosed with diseases of the circulatory system and diseases of the nervous system and sense organs account for about 9 percent of aggregate expenditures each, with no other diagnoses accounting for more than 4.8 percent. Neoplasms account for only 3.2 percent of aggregate expenditures, despite accounting for 9.2 percent of new awardees.

Simulated 2012 Cohort

Average cumulative expenditures for a simulated 2012 cohort of new awardees were estimated to be $322,021 (Table 6). This represents a 10 percent increase over the estimated $292,401 for our 2000 cohort. Most of the increase was attributable to Medicare expenditures, which experienced the highest growth in benefit levels among the four programs between 2000 and 2012. The addition of Part D expenditures in the first 6 years of eligibility among new 2012 awardees also increased estimated Medicare expenditures for that cohort. Disability awardees in 2012 were older than those in 2000—beneficiaries who are awarded disability benefits at older ages spend less time on the disability rolls, and therefore have lower cumulative expenditures. Musculoskeletal conditions accounted for a higher proportion of awards in 2012 and mental disorders for a lower proportion, which also affected average expenditure estimates and the proportions going to each program. Average Medicaid expenditures did not increase in part because drug expenses for

Table 6: Estimated Present Value, at Time of Initial Disability Benefit Award, of Average Cumulative Expenditures under the DI, SSI, Medicare, and Medicaid Programs for Two Cohorts of Disabled Adults, from Initial Award to Death or Attainment of Age 65

	Average Cumulative Expenditures in 2012 Dollars			
	2000 Cohort		*Simulated 2012 Cohort*	
Program	*Dollars*	*Percent (%)*	*Dollars*	*Percent (%)*
Total	292,401	100.0	322,021	100.0
DI	136,388	46.6	143,068	44.4
SSI	13,982	4.8	11,645	3.6
Medicare	85,058	29.1	112,067	34.8
Medicaid	56,974	19.5	55,242	17.2

Note. The 2012 cohort data represent a simulated cohort of new disability benefit awardees in 2012. Expenditure amounts were derived from estimated cumulative expenditures for a 2000 cohort, adjusted for changes in case mix and benefit levels observed in published data. Cumulative expenditures have been discounted at rates reflecting the yield on inflation-indexed Treasury bills with variable maturation schedules as of September 12, 2013. Discounted expenditure estimates are given in 2012 constant dollars. Estimates assume growth in the nominal value of monthly disability benefit expenditures at CPI, and growth in health care expenditures at CPI + 2 percent beyond the observation period for actual expenditures.
DI, Social Security Disability Insurance; SSI, Supplemental Security Income, federal expenditures only.
Source. Social Security Administration and Centers for Medicare and Medicaid Services administrative records.

beneficiaries eligible for both Medicare and Medicaid are covered by Medicare for all years for the 2012 cohort.

DISCUSSION

The cumulative expenditures presented in this paper provide a unique perspective on the public program costs involved in supporting the working-age disabled population. Such data illustrate the long-term financial implications of new awards under the disability programs, which may be understated or distorted by analysis of data limited to prevalent DI and SSI populations. A long-term perspective is especially important for evaluating initiatives focusing on youth such as SSA's Youth Transition Demonstration, and the redetermination of SSI eligibility at age 18 for youths with childhood SSI benefits (Hemmeter, Kauff, and Wittenburg 2009; SSA 2012f). Note that the standard budget analysis cycle is only 10 years, which results in the potential underestimation of true budget expenditures (Kliesen and Thornton 2012). Ten years would clearly be a short time horizon for evaluating policies related to younger awardees. The estimation of expenditures under four interrelated programs, rather than one or two, further broadens the perspective these findings bring to policy debates.

Average cumulative expenditures increased between 2000 and 2012 despite a shift to older ages at award. The most important driver of program expenditures, however, was the increase in total awards, particularly under the DI program. DI awards to disabled workers increased by 57 percent (610,700 to 960,206) and SSI awards to adults aged 18–64 increased by 36 percent (485,798 to 661,265) between 2000 and 2012, producing substantial increases in program expenditures (SSA 2012a,b; SSA, 2007). Much of the increase in disabled-worker enrollment has been attributed to population growth, aging of the baby boom generation, and an increase in the proportion of women insured for disability (Pattison and Waldron 2013). Growth in disability program enrollment and expenditures has prompted proposals to encourage individuals with disabilities to enter or remain in the workforce. Such proposals address a variety of domains, including workplace accommodations, vocational rehabilitation, employer and worker incentives to encourage work, and tax policy (Autor 2011; Burkhauser and Daly 2011; Stapleton 2011; Kennedy, Gimm, and Blodgett 2013). Although proposals to support workplace participation can be costly, our findings suggest that the potential payoff of investments to keep potential

beneficiaries in the labor force is very high, particularly for younger age groups. These findings provide a tool for measuring potential benefits of proposals to support work efforts of disabled people that can be weighed against the costs of implementing such proposals. We note, however, the substantial heterogeneity of beneficiaries by case severity, a factor that needs to be considered both on the cost and the benefit sides of the equation.

Mental disorders and diseases of the musculoskeletal system account for over half of aggregate expenditures, confirming these conditions as important drivers of disability-related program costs. The overall financial impact of mental disorders is especially high because of the high cumulative health care costs that accompany this condition. Mental disorders have contributed to substantial increases in disability awards in recent years, placing them near the top of the list of concerns of policy makers (Burkhauser and Daly 2011). The two conditions—mental and musculoskeletal—differ from each other in several significant ways, including age at first award, program participation rates, and expenditure patterns. Awardees with mental disorders are younger (Rupp and Riley 2011) and have higher rates of participation in the means-tested SSI and Medicaid programs (Rupp and Riley 2011, 2012). In contrast, beneficiaries with musculoskeletal conditions have fewer years of potential benefit eligibility, have lower exposure to SSI and Medicaid, and rely heavily on DI and Medicare, with relatively high benefit rates under DI. Effective interventions to forestall entry on the disability rolls, facilitate program exits, or provide health care more efficiently (e.g., through better coordination of Medicare and Medicaid services) would likely focus on different strategies for these two conditions.

The Affordable Care Act (ACA) raises additional issues for future exploration. Medicaid expansion (in the states that accept the financial subsidies by the federal government) should result in a substantial increase in Medicaid coverage among nondisabled adults, especially at the lower tail of the income distribution (Henry J. Kaiser Family Foundation 2012). As a result, for many disability benefit awardees, eligibility for Medicaid may no longer be contingent on cash benefit eligibility, in contrast to the vast majority of cases under the policy regime in place during the period reflected in this study. That is, more individuals may enter the disability rolls with Medicaid coverage already in place. This may reduce the amount of Medicaid expenditures directly attributable to disability awards, and any future reductions in the disability rolls may therefore have limited effects on Medicaid expenditures. Moreover, the new ACA environment may alter the incentives to apply for disability benefits, if health insurance becomes more widely available through

Medicaid expansion, health insurance exchanges, and continued coverage of young people under their parents' policies. In past years, individuals with severe disabilities who lacked health insurance had an incentive to apply for disability benefits to qualify for Medicaid or Medicare. Under the expanded insurance options available under the ACA, fewer disabled individuals may be induced to apply for SSI or DI to obtain health insurance coverage.

It should be noted that although we only counted Medicare and Medicaid expenditures following first disability benefit award, we cannot necessarily attribute all these expenditures to eligibility for DI or SSI. This is less of an issue with Medicare, since very few first-ever disability awardees in our sample received Medicare prior to 2000. However, pathways other than SSI exist for working-age adults to acquire Medicaid coverage, such as programs for the medically needy, parents with dependent children, and various state programs. Our estimates do not attempt to distinguish between Medicaid expenditures related to disability status and other circumstances. According to Rupp and Riley (2012), about 24 percent of SSI-only awardees received Medicaid 12 months prior to award, so for the SSI-only subgroup, this fact needs to be considered in interpreting our results. It should also be noted that many disabled beneficiaries receive benefits from other public programs like SNAP and veterans' benefits. They also receive benefits from private sources like workers' compensation programs and private disability insurance. Our estimates therefore do not cover all expenditures related to support of the disabled adult population, and returns from investment that lead to greater self-sufficiency may go beyond the programs included in our study.

Our estimates are affected by various assumptions that support our methodology. For example, we assumed that transition probabilities and expenditure patterns based on data from 2004 to 2008 are representative of beneficiary experiences in later years. Expenditure estimates for Medicare managed care enrollees and for Medicare prescription drugs were based on program averages and did not take into account individual beneficiary characteristics that influence payment through risk adjustment. Lastly, our estimates do not take into account various program and market changes since 2006 that may affect participation and expenditures under Medicaid and Medicare. Despite these limitations, our sensitivity analyses suggest that the magnitude of variation is not sufficiently large to raise substantial concerns about the validity of our overall estimates.

As the ACA implementation unfolds, the baby boom generation ages, and changes in the early and full retirement age are contemplated by policy

makers, it is essential to have a better understanding of the full impact of disability-related programs on public expenditures, where the dollars are spent, and how cash benefit and health insurance programs interact. Our findings show that accounting for long-term expenditures is essential for policy development and evaluation. This study provides the first effort to estimate cumulative DI, SSI, Medicare, and Medicaid expenditures for disability awardees. We accomplish these objectives using a unified framework accounting for complex interactions among the four programs. Our results will inform decisions about program eligibility, retention, and payment policies and would be helpful to replicate as the ACA changes the landscape of insurance coverage.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Appendix SA2: Electronic Supplemental Material (ESM).

Appendix SA2-1: Supplementary Analyses.

Appendix SA2-2: Tables.

Appendix Table 1: Transition Probabilities between Disability Benefit States, 2004–2008.

Appendix Table 2: Binomial and Multinomial Logistic Regression Models Predicting Selected Changes in Disability Benefit Status from a Baseline Year to a Subsequent Year, 2004–2008.

Appendix Table 3: Logistic Regression Model Predicting Death in a Calendar Year Based on Beneficiary Characteristics, 2004–2008.

Appendix Table 4: Logistic Regression Models Predicting Annual Enrollment in Medicaid and the Medicare Part D Prescription Drug Program, 2004–2006.

Appendix Table 5: Generalized Linear Regression Models with Log Link and Gamma Distribution Predicting Annual Medicare and Medicaid Expenditures.

Appendix Table 6: Estimated Present Value, at Time of Initial Disability Benefit Award, of Average Cumulative Expenditures under the DI, SSI, Medicare, and Medicaid Programs for a Cohort of Disabled Adults, from Initial Award in 2000 to Death or Attainment of Age 65, under Alternative Assumptions Regarding Transition Probabilities, Probability of Death, and Increases in Health Care Costs.

Appendix Table 7: Estimated Present Value, at Time of Initial Disability Benefit Award, of Average Cumulative Expenditures under the DI, SSI, Medicare, and Medicaid Programs for a Cohort of Disabled Adults, from Initial Award in 2000 to Death or Attainment of Age 65, under Alternative Assumptions Regarding Rates of Discounting.