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Use of Physical and Occupational Therapy by Medicare Beneficiaries within Five Conditions: 1994-2001

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Abstract

Objective—To examine use of physical therapy (PT) and occupational therapy (OT) among Medicare beneficiaries nationwide before and after the 1997 Balanced Budget Act (BBA), which introduced prospective payment for rehabilitation services.

Design—We analyzed responses from the longitudinal Medicare Current Beneficiary Survey, merged with Medicare claims, to track PT and OT rates and intensity (units of service) from 1994 through 2001. This observational study focused on elderly and disabled Medicare beneficiaries within five conditions: stroke, acute myocardial infarction, chronic obstructive pulmonary disease, arthritis, and lower extremity mobility problems. We used cubic smoothing spline functions to describe trends in service intensity over time and generalized estimating equations to assess changes in service intensity.

Results—Controlling for demographic characteristics, adjusted mean level of PT and OT intensity rose significantly between 1994 and 2001 for all five conditions. Service intensity leveled off in 1999 for OT and 2000 for PT. With few exceptions, PT and OT intensity was not significantly associated with patients' demographic characteristics.

Conclusions—Medicare beneficiaries with conditions that can potentially benefit from PT and/or OT continued to get these services at similar – and sometimes increasing – intensity during years following passage of the BBA.

Keywords

Physical Therapy; Occupational Therapy; Medicare; Prospective Payment

Although critics often raise concerns about Medicare's acute care focus,^{1,2} the program also covers substantial services beyond acute care, including rehabilitation therapy in inpatient rehabilitation hospitals, skilled nursing facilities, hospital outpatient departments, private therapists' offices, and patients' homes. Lumped broadly under the phrase "post-acute care," Medicare costs for such services grew rapidly, especially after adoption of prospective

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payment for acute care hospitalizations.³⁻⁷ To slow and contain these rising Medicare costs, the 1997 Balanced Budget Act (BBA) introduced prospective payment for post-acute care, phasing in these systems in different settings across several years.^{4, 7-11} Since then, governmental agencies (e.g., the Medicare Payment Advisory Commission or MedPAC) and researchers have examined how BBA's payment policy changes have affected post-acute care service use and expenditures.^{3, 5, 9, 11-19} Early draconian drops in home health care prompted Congress to pass the 1999 Balance Budget Refinement Act (BBRA), which eased certain BBA payment provisions. Congress worried that some persons who needed post-acute care no longer had access to these services.

Studies of recent trends in rehabilitation therapy use by Medicare beneficiaries have generally relied on information with limited clinical content, notably reimbursement claims.^{11, 20} Claims-based analyses provide excellent information about the volume and costs of covered services. However, claims analyses offer little insight into whether service patterns have changed for persons with strong clinical indications for rehabilitation services. In other words, has service intensity changed over time for patients who likely need these services?

This study explored use of physical and occupational therapy (PT and OT) between 1994 and 2001 using data from the Medicare Current Beneficiary Survey (MCBS). MCBS data include respondents' self reports of various diagnoses, functional impairments, and activities of daily living (ADL) limitations; MCBS files also include the amount of services used with and without Medicare reimbursement. We examined therapy patterns within five conditions that often could benefit from PT and/or OT: new (incident) stroke; new (incident) acute myocardial infarction (AMI); chronic obstructive pulmonary disease (COPD); arthritis or degenerative joint disease (DJD); and lower extremity mobility problems, regardless of cause. These five conditions represent three broad clinical indications for PT and/or OT: acute events with potentially chronic, debilitating consequences (stroke and AMI); chronic, progressive conditions with potentially acute exacerbations (arthritis/DJD and COPD); and a functional impairment representing a "final common pathway" for many debilitating diseases, regardless of etiology (lower extremity mobility problems).

This research was part of a larger study looking at outcomes of PT and OT provided in community settings. Given its policy and practical importance, we took advantage of our longitudinal data set to examine trends of service use immediately before and after passage of the BBA. An earlier publication used cross-sectional analyses of MCBS data from 1995, 1999, and 2001 to explore patterns of PT and OT use in different settings of care (inpatient rehabilitation facility, skilled nursing facility, home health agency, and outpatient settings).⁷ The analyses presented here use the complete longitudinal data file (1994-2001) and sophisticated mathematical modeling methods to explore three primary research questions: (1) What proportion of persons with these clinical indications for PT and/or OT received services from 1994 through 2001? (2) How did their service intensity (i.e., units of services used) vary from 1994 through 2001? (3) Did service intensity vary by patients' demographic characteristics (e.g., were there disparities in care by gender or race/ethnicity)? We hypothesized that the proportion of persons receiving these services – and the intensity of service use – would decline in the years following the BBA passage as new prospective payment systems were implemented. We also hypothesized that certain subsets of patients, such as those with low incomes, less education, and racial and ethnic minorities, would be less likely to receive PT and/or OT services.

METHODS

Data Sources

We obtained Medicare Current Beneficiary Survey (MCBS) Cost and Use files for eight years (1994 through 2001) from the Centers for Medicare & Medicaid Services (CMS). MCBS is a continuous, longitudinal survey of nationally representative samples of elderly and disabled Medicare beneficiaries. It aims to collect detailed information about beneficiaries' demographic characteristics, their health conditions, satisfaction with care, and patterns of service use. As described on the MCBS Web site (<http://www.cms.hhs.gov/MCBS/>) and in other publications,²¹⁻²³ interviewers query respondents (or appropriate proxies) three times per year over four years (12 interviews total). MCBS introduces new panels or cohorts of interviewees each fall and retires completed panels each summer. Each panel has approximately 3,000 active respondents; every year, supplementary sampling replenishes cells reduced by refusals or deaths. MCBS Cost and Use files merge Medicare claims with survey responses for each interviewee. The Cost and Use database contains complete Medicare payment and utilization information, including information from post-acute care facilities and private clinicians' offices. Using unique identifiers assigned to each MCBS interviewee, we linked survey responses across years, creating longitudinal files with complete information for individual respondents encompassing their period of MCBS participation.

As noted above, MCBS tracks interviewees across residential locations (e.g., from the community into institutional settings), conducting two types of surveys: (1) a computer-assisted community questionnaire; and (2) a facility questionnaire for respondents in long-term care settings, including nursing homes, retirement homes, domiciliary care facilities, and assisted living and foster care homes. Institutional administrators or designated staff answers the facility questionnaires, not the Medicare beneficiary. Facility questionnaires contain similar but shortened queries as those in the community survey, including questions about the respondents' health and functional status, insurance coverage, residence history, and the use and cost of services. Following MCBS participants is important for our study because of the debilitating nature of our target conditions and the likelihood that persons may require institutional care.

During its three annual rounds, community questionnaires emphasize slightly different topics, with updates on health insurance coverage, service use, and household characteristics during every round. Interviews typically last one hour. The first round (which occurs each year in September-December) collects demographic and income information, details about health and functional status, and information about access to and satisfaction with medical care.²⁴ Respondents receive a calendar to record their use of health care services, and interviewers encourage them to collect Medicare and other health insurance statements, bills, receipts, and prescriptions to assist subsequent interviews.

For each calendar year, MCBS Cost and Use files aim to include information about all health care services, whether or not reimbursed by Medicare. CMS links MCBS responses to administrative data, including: Medicare enrollment files; Social Security information on date of death for decedents; and the National Claims History file, which contains all claims submitted for Parts A and B Medicare payments. Because health maintenance organizations (HMOs) do not submit claims to Medicare for reimbursement, we excluded HMO enrollees from the analyses (i.e., we would not have had complete information on HMO enrollees' PT and/or OT use). Cost and Use data also contain information on services reported by MCBS respondents during their interviews, with details about covered and uncovered services. This list includes emergency room visits, acute care and other hospital services, outpatient services from medical and other providers, prescription drugs, dental care, home health

services, and other institutional care. Interviewers review bills and receipts gathered by respondents, noting costs covered by Medicare and other insurers and those paid out-of-pocket by beneficiaries. During each round, interviewers review utilization reported during the previous round, updating billing and other financial and utilization information.

In creating our eight-year longitudinal file, we used MCBS respondent identifiers to link information across up to four years (full panel participation). Westat, the CMS contractor that conducts MCBS, provides cross sectional sampling weights for MCBS Cost and Use files, allowing cross sectional analyses to control for the complex survey design and thus produce nationally representative estimates.⁷ However, Westat does not produce sampling weights for longitudinal Cost and Use files.

Identification of Study Subjects

We examined PT and OT use within five conditions that, at the time of our grant application to conduct this research (2003), had scientific evidence supporting use of these therapies: new (incident) stroke;²⁵⁻³⁶ new (incident) AMI;³⁷⁻⁴⁴ COPD;^{42, 45-53} arthritis or DJD;⁵⁴⁻⁵⁸ and lower extremity mobility problems regardless of cause (walking difficulties).⁵⁹⁻⁶⁴ MCBS Cost and Use files offered two sources of information about study conditions: responses to September-December MCBS questions about specific health conditions; and diagnoses coded on physician or hospital claims using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes. We used the following information to identify cases:

Stroke (n = 826): ICD-9-CM code 431, 434, or 436 as principal diagnosis from acute care hospitalization

AMI (n = 757): ICD-9-CM code 410 as principal diagnosis from acute care hospitalization

COPD (n = 6,896): ICD-9-CM code 491, 496, or 4928 on inpatient, SNF, outpatient, or physician claim. From MCBS: “ever told had emphysema, COPD, asthma”

Arthritis/DJD (n = 12,983): ICD-9-CM code 714, 715, 7165, or 7169 on inpatient, SNF, outpatient, or physician claim. From MCBS: “ever told had arthritis”

Lower extremity mobility problems (n = 16,414). From MCBS: “difficulty walking 2-3 blocks”

If persons had more than one of these five conditions, we assigned them to all categories that applied. MCBS data do not contain details about the severity, chronicity, or extent of these clinical conditions. Because of relatively small sample sizes for AMI and stroke, standard errors (SE) for estimated values (such as weighted percents or coefficient from regression models) are larger for these two conditions than for the other three conditions.

Identification of PT and OT Service Use and Intensity

We had two sources of information about PT and OT use: Medicare claims, and MCBS survey responses. Medicare claims use the *Healthcare Common Procedure Coding System* (HCPCS) and American Medical Association's *Current Procedural Terminology* (CPT-4) codes to identify PT or OT services. One 15-minute session constitutes an individual unit of PT or OT services.^{13, 20} Medicare Part B claims, including claims from institutional providers (e.g., SNF), must include both HCPCS codes and numbers of 15-minute units for each type of therapy. We identified PT and OT use from inpatient, SNF, outpatient and HHA claims using revenue center codes 0420-0429 for PT and 0430-0439 for OT. From the physician and supplier claims, we identified PT by provider specialty or service type codes

and HCPCS codes 97001, 97002, 97112-97113, or 97116. Similarly, for OT, we used provider specialty codes or service type codes and HCPCS codes 97003-97004, or G0152. From service information gathered directly from respondents during their MCBS interviews, we identified services using PT and OT provider specialty codes. This file did not indicate units of service; we therefore assumed 1 unit for each date of PT or OT identified. This choice is consistent with the distribution of units per claim date from the claims information. We eliminated duplications from records appearing in both the physician/supplier claims and the MCBS interview files.

Construction of Analytic Files

We identified study subjects with each of the five conditions as described above and created separate analytic files for each condition (i.e., five analytic files for five conditions). Since MCBS could follow each subject for up to four years – and asked about demographic characteristics each year the subject was surveyed – we could have up to four reports of basic demographics characteristics (e.g., age, sex) per subject. We examined the change in these baseline variables across the four years and found that most values generally did not vary over time (e.g., education level, income, marital status). Therefore, we chose to assign demographic characteristics to each subject based on their first year's response. We assigned subjects to all analytic files for which they qualified (e.g., persons could have more than one of the five study conditions and thus be assigned to more than one file).

As described above, we identified all PT (OT) units received by each study subject. Data included the day, month, and year of each PT (OT) service. Given Medicare billing procedures (e.g., rolling up of bills across days for periodic submission), we did not feel confident about individual PT and OT service dates; we viewed the reported month as a more reliable indicator of service timing. We compared the date of the first report of the clinical condition to the date of PT (OT) and only counted PT (OT) services that occurred on or after the date of the reported condition. We viewed services occurring after the data of the reported condition as likely to be related to that condition. Our data did not contain information that would have allowed us to determine definitively whether the specific PT (OT) service was provided for the particular study condition.

Analysis

We performed analyses separately within each of the five conditions. All analyses were conducted using SUDAAN analytic software version 9.1. Our analyses used sampling weights to account for the complex survey design and produce population estimates. All reported means, percents, and corresponding standard errors come from these weighted analyses. To characterize the distribution of PT and OT intensity, we first aggregated daily PT (OT) units into monthly units for each person as described above. We computed the proportion of subjects who used PT (OT) in a given year, as well as the annual means, medians, lower and upper quartiles, and standard deviations of PT (OT) intensity (units of service). We performed these analyses in two ways: (1) considering all study subjects but assigning 0 units to subjects who did not use PT (OT); and (2) eliminating subjects without PT (OT) services.

To graphically explore patterns of PT (OT) intensity over time, we employed a mathematical technique called cubic smoothing spline functions. The mathematics underlying smoothing spline functions are described in detail elsewhere.^{65,66} Briefly, the purpose of smoothing spline functions is to allow analysts to see trends in data without any prior assumptions (such as parametric structures of linear or quadratic functions) about the shapes of those trends. Our cubic smoothing spline function used the time-series of PT (OT) monthly units of service that we had calculated for each study subject. We assigned 0 units

to those who received no PT (OT) services in a given month. We used all monthly observations for each subject in the cubic smoothing spline function to produce the underlying trend of service intensity over time. We present results from these cubic smoothing spline functions graphically in figures with time on the horizontal axis (x axis) and units of service on the vertical axis (y axis).

We used generalized estimating equations (GEE) to model the monthly units of PT (OT) services controlling for the year (8 variables for years from 1994 to 2001) and demographic characteristics. These GEE models allowed us to examine the trend of PT (OT) intensity over the 8-year period and the associations of PT (OT) use with demographic characteristics. The GEE models allowed us to test our hypotheses about trends in PT (OT) intensity over time and about whether certain subgroups of patients experienced disparities in their care. Given the structure of our data set (each study subject had their own time series of monthly PT or OT units, as described above), the GEE approach allowed us to take into account within-subject correlations, along with the sampling weights related to MCBS's complex survey design. For each category within a given variable (e.g., each year within the YEAR variable), we report the estimates (offset from the reference category within that variable: 2001 is the reference category for YEAR) and the corresponding 95% confidence intervals.

These GEE models (one for PT and one for OT) included the following independent variables: year of MCBS enrollment (categorical variable with 8 levels: 1994 to 2001); age (in 7 categories to capture potential nonlinear relationships between age and PT [OT] intensity); sex (male, female); race/ethnicity (white, black, Hispanic, other); household income (greater or less than \$25,000); education (more than high school, high school, less than high school); marital status (married or not married); living arrangement (lived alone or with others); residence at time of survey (community, institution); and activity of daily living (ADL) dependencies (yes or no). MCBS asked about six ADLs. We counted the number of ADLs reported as requiring assistance by each study subject (range: 0-6). Based on the distribution of these findings, we dichotomized our ADL dependency variable (0 or 1+ dependency). We included ADL dependencies in the models for COPD, arthritis, and walking difficulties only, because of large numbers (about 30%) of missing ADL data for AMI and stroke.

RESULTS

Demographic Characteristics

Table 1 shows basic demographic characteristics of the study populations within each of the five conditions. Demographic characteristics varied across the study conditions, with stroke patients having the highest weighted mean age. AMI had the highest percentage of male patients, while stroke included the highest percentage of black individuals. Between 75% and 80% of persons in all five conditions had annual household incomes below \$25,000, and between 73% and 79% of persons had a high school or lesser education. While 84.6% of stroke patients were community residents, 93.9% of persons with walking difficulties lived in the community. About 13% of persons with incident stroke died compared with only 2.6% of those with arthritis.

Patterns of PT Use over Time

Table 2 shows the percent of cases receiving PT within each of the five study conditions and the intensity of PT use (mean, median, lower and upper quartile of PT service units) in each year from 1994 through 2001. The percentage of persons receiving PT services was higher in 2001 than in 1994 for all five conditions, but there did not appear to be a uniform upward trend across conditions from year to year in these percentages. As suggested by comparing

mean to median numbers of PT units and by the interquartile ranges, the intensity of PT service use varied widely across patients. However, the median number of annual PT units increased steadily from 1994 through 1999 across all five conditions before leveling off in 2000 and 2001.

Figure 1 shows the observed monthly PT units over time for each of the five study conditions: the x axis represents time (96 monthly observations across 8 years) and the y axis represents the smoothed estimates of the observed number of units of PT services. A vertical line placed at 1997 along the x axis indicates the date of BBA passage. Stroke patients had the highest PT intensity across all eight years. The three smoothing lines for COPD, arthritis, and walking difficulty overlapped for most of the 96 months. As suggested by the numbers in Table 2, the cubic smoothing spline functions also indicate that PT intensity rose through the years immediately following BBA passage before leveling off in 2000 and 2001.

PT and Demographic Characteristics

As shown in Table 3, few demographic characteristics demonstrated significant associations with PT use. For COPD, arthritis, and walking difficulty, the youngest age group (0-44) had significantly lower adjusted mean monthly PT intensity (between 6.7 and 9.0 units of service) than the oldest age group (85+). No significant differences appeared by sex, race/ethnicity, marital status, education level, household composition, and rural versus urban residence. With the exception of AMI patients, individuals living in either the community or facilities had smaller adjusted mean estimate of PT intensity (about 3 to 6 fewer units of service) compared with those who transitioned between the two sites. For the three conditions with adequate ADL information, differences in PT use between those with versus without ADL dependencies were small – less than one unit.

Controlling for demographic characteristics, the year (i.e., time indicator variable) did show statistically significant increases in the adjusted mean number of PT units per patient from 1994 to 1997 (pre-BBA) and from 1998 to 2001 (post-BBA) for all five conditions. As shown in Table 3, PT intensity appeared significantly higher in 2001 compared with PT intensity in each year from 1994 through 1997 for all five study conditions. PT intensity also appeared significantly higher in 2001 than in 1998 for all conditions except COPD. However, PT intensity did not differ significantly for any condition between 2001 and 1999 and between 2001 and 2000 with one exception (PT intensity was significantly higher in 2001 than in 1999 for walking difficulties).

Patterns of OT Use over Time

Table 4 shows the percentages of persons receiving OT and the intensity of OT use by condition for 1994 through 2001. As with PT, a higher percentage of persons received OT in 2001 than in 1994 for each condition, but without a smooth and consistent upward trend in OT use. Again, comparing mean and median numbers of OT services, along with the interquartile ranges, highlights the considerable variability in OT use. Nonetheless, OT intensity appeared to increase across all four conditions before leveling off in 1999. Figure 2 shows the underlying trends of OT intensity for each condition from 1994 through 2001 and confirms the leveling off of intensity around 1999. As with PT, stroke patients had the highest intensity OT use. The smoothing lines for the other four conditions tended to cluster together.

OT and Demographic Characteristics

As with PT, few demographic characteristics demonstrated strong associations with OT intensity (Table 5). For three conditions (stroke, arthritis, and walking difficulties), persons

with incomes greater than \$25,000 had significantly lower monthly OT intensity (between 2.1 and 4.1 fewer units per month). No other demographic characteristics showed significant associations with OT intensity in more than two conditions – and most had no significant associations. OT intensity appeared significantly higher in 2001 than in 1994 through 1998, with some notable exceptions (e.g., stroke OT intensity did not vary significantly between 2001 and most earlier years). As for PT, OT intensity did not differ significantly between 2001 and 1999 and between 2001 and 2000, with the exception of walking difficulties (OT intensity in 2001 was significantly higher than in 1999).

DISCUSSION

Our study suggests that Medicare beneficiaries with conditions that can potentially benefit from PT and/or OT continued to get these services at similar – and sometimes increasing – intensity during the years following passage of the BBA, a law designed to slow the pace of escalating rehabilitation expenditures. Several years after the law's passage, service intensity had seemingly leveled off, no longer rising significantly. We failed to find significant, consistent disparities in PT and OT intensity by patients' sociodemographic characteristics, including education, income, and race and ethnicity.

Efforts to examine the BBA's effects face important challenges. Notably, implementation of major provisions of the law was staggered over time.^{4, 10, 11} For instance, the BBA created an interim payment system for home health agencies, which was phased in over 12 months beginning in October 1997; full home health agency prospective payment was implemented in October 2000. Skilled nursing facility prospective payment was implemented in July 1998; prospective payment arrived for inpatient rehabilitation facilities in January 2002. Following passage of the BBA, dramatic post-acute care spending reductions and reports of widespread layoffs of rehabilitation therapists raised concerns that certain BBA provisions were excessive. Consequently, the 1999 Balanced Budget Refinement Act (BBRA) delayed implementation of some BBA provisions, instituting a moratorium on outpatient PT and OT payment caps until January 2006.

A second and perhaps even more difficult challenge to examining the BBA's impact involves determining whether any changes have compromised essential PT and OT services. Little is currently known about which clinical indications make PT and/or OT appropriate and necessary. Even less is known about precisely how many units of these services represent appropriate care. While no one disputes that Medicare expenditures for rehabilitation services rose rapidly during the late 1980s and early 1990s, the assumption underlying many BBA provisions was that these increases represented waste – or at least services that may not be medically necessary according to Medicare's rules.^{1, 67-69} If these services were not essential, then cutting back should theoretically not affect patients' outcomes. Patient advocates worried that blanket cuts of PT and OT services could potentially harm patients who truly needed these therapies.

We concentrated on clinical areas where – at the time of our research grant application (2003) – some evidence about the benefits of PT and/or OT did exist. For example, studies had demonstrated benefits of PT and/or OT for persons with strokes,²⁵⁻³⁶ heart attacks,³⁷⁻⁴⁴ and COPD.^{42, 45-53} Arthritis and DJD,⁵⁴⁻⁵⁸ walking difficulties, and propensity to fall⁵⁹⁻⁶⁴ also appeared amenable to rehabilitation services. More recent guidelines and reports support our choices of these conditions.⁷⁰⁻⁷⁴

Our study failed to find significant systematic associations between PT and OT service use and various demographic characteristics. In particular, we did not find systematic disparities in service rates or intensity by age, gender, and race or ethnicity, as have been found for

other types of care.⁷⁵ Somewhat surprisingly, we found little relationship between ADL performance reported by MCBS respondents and use of PT and OT services. The ADL findings could reflect an artifact of the data gathering. As noted in the Methods section, ADL ratings are collected during the September-December round of MCBS interviews. However, the September-December interview date may be distant from the dates of PT or OT or the dates of the target conditions (e.g., incident stroke, AMI). This makes it difficult to interpret the finding about the lack of association between ADL performance and rehabilitation therapy use.

Our study had the significant advantage of 8 years of data but also had some important limitations. We did not know the exact date that patients received PT or OT services; instead, the date recorded in our database likely represented the date that the provider submitted the Medicare claim. In addition, we only knew the dates of the targeted health conditions for persons in two study groups – incident strokes and AMIs. Therefore, our efforts to relate the timing of PT and OT services to specific health conditions likely suffered from some errors. Despite the benefits of having longitudinal data, CMS MCBS analysts do not construct or release longitudinal sampling weights for technical reasons. As other researchers and CMS's data contractor have done, our weighted analyses used cross-sectional sampling weights to produce nationally representative estimates. Using cross-sectional weights for longitudinal analyses could theoretically reduce the precision of our estimates in the GEE models.

Another methodological challenge was the large number of MCBS respondents who did not receive any PT or OT services. This situation introduced many zero values for our intensity of service use variable. In response, we conducted analyses of service intensity twice: once using all data including zero values, and again using only data from patients who received PT (or OT, for OT analyses). Finally, although our data contain much more clinical information than the Medicare claims files used for many analyses of service use, we still did not have critical details about patients' functional impairments or preferences for care. Many factors beyond financial resources (i.e., Medicare reimbursement or the ability to self-pay) could explain use of rehabilitation therapies, including the nature and extent of patients' functional impairments, their underlying general health, recommendations by their clinicians, availability of rehabilitation services, and patients' preferences for these therapies.

Our study provides evidence that passage of the BBA did not decrease the percentage of persons receiving PT or OT services or the intensity of those services – at least among individuals with conditions that might benefit from this care. However, except for persons with new strokes – of whom approximately 80% received PT and 70% received OT – less than half of Medicare beneficiaries with new AMIs, COPD, arthritis, and walking difficulties obtained these therapies during the study period. Less than one third of persons with arthritis/DJD or walking difficulties received PT during those years. From our data set, we cannot determine whether this rate is clinically appropriate or whether more Medicare beneficiaries with these conditions should receive this care. We know that approximately half of Medicare beneficiaries do not receive evidence-based medical services, in general.⁷⁷ Future research needs to assess the clinical outcomes and value of PT and OT in different contexts and assess whether Medicare beneficiaries currently receive adequate rehabilitation care.

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Figure 1.
Smoothing lines of the distributions of PT over time for the five conditions

Figure 2.
Smoothing lines of the distributions of OT over time for the five conditions

Table 1
Demographic Characteristics of Study Population (weighted percents and standard errors)

Number of Patients	Incident Stroke n=826	Incident AMI n=757	COPD n=6896	Arthritis n=12983	Walking Difficulties n=16414
	Percent (SE)	Percent (SE)	Percent (SE)	Percent (SE)	Percent (SE)
Age					
Age (mean) in years	77.85 (0.33)	75.52 (0.32)	73.84 (0.14)	74.89 (0.11)	74.73 (0.13)
Age < 65 years	4.79 (0.89)	6.24 (1.05)	10.51 (0.46)	7.57 (0.30)	14.88 (0.36)
Age 65 years	95.21 (0.89)	93.76 (1.05)	89.49 (0.46)	92.43 (0.30)	85.12 (0.36)
Sex					
Male	41.33 (1.90)	52.47 (1.64)	48.83 (0.73)	32.21 (0.45)	36.02 (0.39)
Female	58.67 (1.90)	47.53 (1.61)	51.17 (0.73)	67.79 (0.45)	63.98 (0.39)
Race/Ethnicity					
White	78.95 (1.83)	88.54 (1.28)	85.29 (0.88)	82.32 (0.91)	81.02 (0.91)
Black	12.60 (1.44)	6.42 (0.97)	7.16 (0.55)	9.16 (0.60)	10.73 (0.71)
Hispanic	6.43 (1.25)	3.64 (0.72)	5.02 (0.61)	6.17 (0.72)	5.71 (0.65)
Other	2.02 (0.57)	1.40 (0.56)	2.53 (0.29)	2.35 (0.23)	2.54 (0.27)
Income					
Income \$25,000	20.78 (1.43)	22.68 (1.73)	24.80 (0.73)	28.35 (0.81)	19.71 (0.49)
Income < \$25,000	79.22 (1.43)	77.32 (1.73)	75.20 (0.73)	71.65 (0.81)	80.29 (0.49)
Education					
Less than high school	44.81 (2.09)	46.87 (2.12)	45.91 (1.15)	40.52 (1.14)	48.43 (0.91)
High school	30.36 (1.72)	31.90 (2.21)	31.44 (0.92)	32.83 (0.71)	30.48 (0.64)
More than high school	24.82 (1.70)	21.23 (1.95)	22.65 (0.84)	26.65 (0.85)	21.09 (0.63)
Marital status					
Not married	56.46 (2.07)	49.32 (2.12)	51.78 (0.70)	50.93 (0.57)	58.10 (0.44)
Married	43.54 (2.07)	50.68 (2.12)	48.22 (0.70)	49.07 (0.57)	41.90 (0.44)
Living situation					
Lived with others	70.26 (1.90)	70.21 (1.81)	70.15 (0.56)	69.20 (0.48)	72.14 (0.47)
Lived alone	29.74 (1.90)	29.79 (1.81)	29.85 (0.56)	30.80 (0.48)	27.86 (0.47)
Community/Facility					
Community	84.62 (1.34)	92.09 (0.95)	90.15 (0.34)	92.58 (0.25)	93.94 (0.39)
Facility	5.20 (0.71)	4.59 (0.75)	6.63 (0.27)	5.21 (0.19)	12.29 (0.30)

Number of Patients	Incident Stroke n=826		Incident AMI n=757		COPD n=6896		Arthritis n=12983		Walking Difficulties n=16414	
	Percent	(SE)	Percent	(SE)	Percent	(SE)	Percent	(SE)	Percent	(SE)
Both	10.18	(1.12)	3.33	(0.65)	3.22	(0.24)	2.21	(0.14)	3.77	(0.18)
Rural/Urban										
Lived in rural area	30.39	(2.06)	30.87	(2.97)	29.13	(1.97)	29.35	(1.62)	30.82	(1.75)
Lived in urban area	69.61	(2.06)	69.13	(2.97)	70.87	(1.97)	70.65	(1.62)	69.18	(1.75)
Deceased										
Alive	87.21	(1.09)	90.33	(1.05)	92.06	(0.37)	97.41	(0.14)	91.45	(0.24)
Dead	12.79	(1.09)	9.67	(1.05)	7.94	(0.37)	2.59	(0.14)	8.55	(0.24)

Table 2

Per cent Receiving PT and Intensity of PT Service Use^a

	1994	1995	1996	1997	1998	1999	2000	2001
Stroke								
N	114	108	118	100	110	121	88	80
Percent with PT	71.9%	66.7%	74.6%	79.0%	72.7%	76.9%	83.0%	76.3%
Median PT units	9.0	8.0	11.0	11.5	12.0	17.0	15.0	27.0
Mean (SD) PT units	14.8 (17.5)	16.8 (21.6)	17.2 (18.9)	20.0 (21.9)	20.5 (22.2)	23.2 (23.0)	23.8 (26.6)	32.5 (27.5)
Lower, Upper Quartile	4, 19	4, 19	5, 22	5, 26	5, 30	6, 32	3, 35	10, 47
AMI								
N	93	79	93	103	106	100	110	87
Percent with PT	35.5%	38.0%	40.9%	36.9%	35.8%	47.0%	43.6%	44.8%
Median PT units	6.0	9.0	9.0	8.5	12.5	15.0	14.0	14.5
Mean (SD) PT units	9.5 (12.9)	13.1 (14.7)	13.3 (15.6)	14.3 (16.5)	16.8 (16.2)	20.8 (20.0)	20.2 (20.3)	21.3 (21.0)
Lower, Upper Quartile	2, 12	4, 15.5	4, 16	4, 18	5, 23	6, 29	4, 32	4, 34
COPD								
N	1268	1174	1224	1303	1337	1321	1277	1358
Percent with PT	23.4%	25.6%	27.2%	36.9%	27.7%	26.7%	31.6%	32.7%
Median PT units	7.0	8.0	8.0	8.0	10.0	11.0	16.0	11.0
Mean (SD) PT units	11.4 (14.7)	12.4 (15.1)	12.5 (14.7)	13.3 (15.1)	17.0 (19.4)	18.5 (19.3)	21.7 (21.1)	18.7 (20.1)
Lower, Upper Quartile	3, 13	3, 14	4, 15	4, 17	4, 23	5, 26	5, 32	4, 26
Arthritis								
N	2452	2305	2298	2382	2412	2469	2572	2622
Percent with PT	24.3%	25.0%	27.2%	28.9%	29.3%	28.4%	30.1%	32.0%
Median PT units	7.0	8.0	8.0	8.0	10.0	12.0	14.0	12.0
Mean (SD) PT units	10.9 (13.6)	12.1 (15.0)	12.3 (14.5)	13.6 (16.5)	16.7 (18.6)	18.9 (19.4)	19.8 (19.1)	20.0 (21.6)
Lower, Upper Quartile	3, 13	3, 14	4, 15	3, 16	4, 23	5, 27	6, 28	5, 27
Walking difficulties								
N	3838	3587	3334	3423	3440	3442	3590	3639
Percent with PT	23.9%	25.9%	26.8%	29.2%	27.6%	27.0%	28.6%	29.8%
Median PT units	7.0	8.0	8.0	8.0	10.0	12.0	14.0	13.0

	1994	1995	1996	1997	1998	1999	2000	2001
Mean (SD) PT units	11.3 (14.3)	12.0 (14.5)	12.4 (14.5)	13.9 (16.8)	16.2 (18.1)	19.1 (19.5)	20.5 (20.9)	20.7 (22.0)
Lower, Upper Quartile	3, 13	3, 14	4, 15	4, 17	4, 14	5, 27	5, 30	5, 31

^dCalculation of percentage with PT was based on entire study sample. The measures of PT intensity (mean, median, and interquartile range of units of PT services) were calculated only for persons receiving PT (i.e., eliminating individuals who did not receive any PT services)

Table 3
Association of Monthly PT Intensity with Year and Patients' Demographic Characteristics^a

	Incident Stroke		Incident AMI		COPD		Arthritis		Walking difficulties	
	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)
Grand mean	41.47 [*]	(6.79)	29.96 [*]	(6.64)	23.64 [*]	(4.09)	25.08 [*]	(2.79)	28.58 [*]	(2.08)
Year (reference "2001")										
1994	-18.75 [*]	(5.40)	-18.16 [*]	(5.42)	-7.32 [*]	(1.89)	-11.05 [*]	(1.51)	-11.08 [*]	(1.22)
1995	-15.88 [*]	(5.44)	-15.43 [*]	(5.63)	-5.65 [*]	(1.83)	-9.79 [*]	(1.42)	-10.59 [*]	(1.22)
1996	-15.81 [*]	(5.50)	-15.26 [*]	(5.70)	-6.02 [*]	(2.01)	-9.64 [*]	(1.53)	-9.25 [*]	(1.27)
1997	-13.09 [*]	(5.63)	-14.46 [*]	(5.71)	-5.92 [*]	(1.95)	-8.08 [*]	(1.55)	-8.72 [*]	(1.33)
1998	-12.49 [*]	(5.75)	-10.96 [*]	(5.44)	-0.08	(2.28)	-4.62 [*]	(1.61)	-5.33 [*]	(1.40)
1999	-11.13	(5.88)	-8.01	(5.48)	0.83	(1.99)	-1.81	(1.66)	-3.33 [*]	(1.27)
2000	-9.54	(6.16)	-7.7	(5.69)	4.05	(2.28)	-0.28	(1.63)	-1.02	(1.37)
Age (reference "age 85+")										
Age 0-44	-0.87	(6.32)	-6.1	(3.87)	-9.01 [*]	(2.61)	-6.68 [*]	(2.07)	-7.25 [*]	(1.07)
Age 45-64	-0.92	(3.31)	-1.04	(3.41)	-1.13	(1.79)	-1.54	(1.57)	-2.67 [*]	(0.98)
Age 65-69	-1.17	(2.30)	-3.97 [*]	(1.88)	-0.79	(1.33)	-0.36	(1.21)	-2.27 [*]	(0.70)
Age 70-74	0.6	(1.93)	-0.79	(2.39)	-0.23	(1.27)	0.65	(0.78)	-0.92	(0.78)
Age 75-79	-1.75	(1.90)	-0.66	(1.52)	-0.67	(1.03)	0.12	(0.70)	-0.24	(0.59)
Age 80-84	0.88	(1.78)	4.19 [*]	(1.74)	0.39	(0.73)	-0.22	(0.49)	0.11	(0.45)
Sex (reference "female")										
Male	-2.32	(1.52)	0.02	(1.91)	0.75	(0.91)	0.53	(0.65)	0	(0.50)
Race/Ethnicity (reference "other")										
White	-2.82	(2.36)	4.57	(2.75)	1.09	(3.11)	0.12	(1.90)	-1.43	(1.30)
Black	-2.8	(2.68)	1.69	(3.66)	1.8	(3.30)	0.01	(2.10)	-1.34	(1.44)
Hispanic	-1.4	(3.48)	0.15	(3.99)	1.69	(3.71)	0.18	(2.31)	-1.37	(1.81)
Income (reference "income <\$25,000")										
Income \$25,000	-1.31	(1.79)	-4.04 [*]	(1.28)	-1.45	(0.86)	-0.7	(0.74)	-0.95	(0.50)

	Incident Stroke		Incident AMI		COPD		Arthritis		Walking difficulties	
	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)
Education (reference "more than high school")										
Less than high school	1.13	(1.47)	0.21	(1.77)	-1.04	(0.87)	-0.28	(0.70)	-0.39	(0.51)
High school	2.73	(1.65)	-0.58	(1.62)	0.82	(1.02)	1.15	(0.72)	0.74	(0.52)
Marital Status (reference "married")										
Not married	-2.53	(1.75)	-2.42	(1.98)	-0.08	(1.03)	1.09	(0.78)	0.04	(0.51)
Living situation (reference "lived alone")										
Lived with others	-0.38	(1.64)	-2.15	(1.73)	-1.77	(1.07)	-0.11	(0.69)	-0.54	(0.55)
Community/Facility (reference "both")										
Community	-5.14 [*]	(2.33)	-4.06	(2.70)	-4.72 [*]	(1.50)	-3.77 [*]	(1.01)	-3.95 [*]	(0.84)
Facility	-6.33 [*]	(3.15)	-4.8	(4.81)	-3.24	(1.79)	-2.82 [*]	(1.21)	-3.81 [*]	(0.94)
Rural/Urban (reference "urban")										
Lived in rural area	1.02	(1.72)	1.07	(1.57)	-0.22	(1.04)	-0.88	(0.74)	-0.23	(0.49)
ADL (reference "yes")										
No					-0.64	(0.81)	-0.48	(0.60)	-0.84 [*]	(0.43)

* Statistically significant at $p = 0.05$

^aMultivariable generalized estimating equation model of PT intensity (monthly units of PT services) controlling for variables listed in Table 3

Table 4

Per cent Receiving OT and Intensity of OT Service Use^a

	1994	1995	1996	1997	1998	1999	2000	2001
Stroke								
N	114	108	118	100	110	121	88	80
Percent with OT	47.4%	43.5%	56.8%	64.0%	60.0%	67.8%	73.9%	66.3%
Median OT units	9.0	10.0	9.0	12.0	12.0	15.0	11.0	23.5
Mean (SD) OT units	16.7 (21.0)	20.3 (25.4)	15.7 (18.0)	20.7 (22.6)	19.6 (21.9)	21.1 (20.1)	22.7 (23.9)	31.6 (27.5)
Lower, Upper Quartile	4, 20	5, 20	3, 18	4, 21	4, 23	5, 34.5	6, 31	6, 39
AMI								
N	93	79	93	103	106	100	110	87
Percent with OT	11.8%	16.5%	17.2%	21.4%	22.6%	28.0%	22.7%	26.4%
Median OT units	5.0	8.0	8.0	11.0	13.0	14.0	12.0	28.5
Mean (SD) OT units	8.3 (8.6)	12.9 (13.7)	13.3 (18.1)	18.1 (19.8)	16.6 (15.6)	20.2 (17.1)	19.1 (19.5)	28.2 (24.1)
Lower, Upper Quartile	2, 9	3, 12	4, 15	3, 15	3, 20.5	6, 25.5	5, 30	4, 33
COPD								
N	1268	1174	1224	1303	1337	1321	1277	1358
Percent with OT	9.7%	10.7%	12.0%	15.6%	14.4%	15.5%	18.0%	18.7%
Median OT units	7.0	7.0	8.0	7.0	12.0	12.0	14.0	12.0
Mean (SD) OT units	13.8 (19.2)	12.4 (16.9)	13.0 (15.5)	14.0 (17.1)	20.2 (22.2)	18.8 (19.2)	21.3 (20.9)	17.6 (18.0)
Lower, Upper Quartile	3, 18	2, 15	3, 16	3, 15	3, 21	4, 28	6, 30	4, 29
Arthritis								
N	2452	2305	2298	2382	2412	2469	2572	2622
Percent with OT	8.7%	9.9%	10.6%	12.6%	14.2%	13.6%	14.5%	15.0%
Median OT units	6.0	6.0	8.0	8.0	11.0	14.0	14.0	14.0
Mean (SD) OT units	11.5 (16.2)	12.5 (16.8)	14.5 (17.6)	14.7 (18.3)	17.3 (19.3)	20.0 (19.6)	19.3 (18.3)	21.4 (21.0)
Lower, Upper Quartile	2, 13	2, 14	2, 16	3, 17	3, 20	4, 29	5, 27.5	5, 31
Walking difficulties								
N	3838	3587	3334	3423	3440	3442	3590	3639
Percent with OT	10.8%	11.9%	13.1%	14.8%	14.3%	15.0%	15.8%	17.0%
Median OT units	7.0	7.0	8.0	9.0	11.0	13.0	13.0	14.0

	1994	1995	1996	1997	1998	1999	2000	2001
Mean (SD) OT units	11.9 (16.4)	12.3 (16.6)	13.5 (16.7)	15.3 (18.4)	17.4 (19.7)	19.6 (19.4)	20.2 (20.8)	21.2 (21.0)
Lower, Upper Quartile	2, 13	2, 15	2, 15	3, 15	3, 19	5, 29	5, 28	5, 31

^a Calculation of percentage with OT was based on entire study sample. The measures of OT intensity (mean, median, and interquartile range of units of OT services) were calculated only for persons receiving OT (i.e., eliminating individuals who did not receive any OT services)

Table 5
Association of Monthly OT Intensity with Year and Patients' Demographic Characteristics^a

	Incident Stroke		Incident AMI		COPD		Arthritis		Walking difficulties	
	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)
Grand mean	35.31 [*]	(7.94)	25.05 [*]	(8.46)	33.07 [*]	(7.97)	25.61 [*]	(4.95)	32.33 [*]	(3.36)
Year (reference "2001")										
1994	-12.6 [*]	(5.02)	-21.07 [*]	(7.34)	-5.38 [*]	(2.56)	-11.51 [*]	(1.97)	-10.72 [*]	(1.49)
1995	-9.44	(4.85)	-15.4 [*]	(6.68)	-6.06 [*]	(2.82)	-11.08 [*]	(2.04)	-10.81 [*]	(1.47)
1996	-12.68 [*]	(5.07)	-15.43 [*]	(6.92)	-5.91 [*]	(2.45)	-8.73 [*]	(1.97)	-8.6 [*]	(1.56)
1997	-7.24	(5.54)	-12.02	(7.02)	-4.88 [*]	(2.38)	-9.32 [*]	(1.69)	-7.87 [*]	(1.37)
1998	-8.91	(5.09)	-14.68 [*]	(7.43)	1.82	(2.95)	-4.25 [*]	(1.84)	-4.6 [*]	(1.78)
1999	-7.93	(5.41)	-6.95	(7.06)	1.69	(2.54)	-1.98	(2.19)	-3.14 [*]	(1.50)
2000	-5.06	(5.61)	-8.93	(7.07)	5.26	(2.82)	-2.45	(2.14)	-1.61	(1.72)
Age (reference "age 85+")										
Age 0-44	2.03	(4.60)	-9.21	(5.15)	-10.65 [*]	(3.54)	-2.69	(6.64)	-3.98	(2.87)
Age 45-64	-2.18	(3.18)	1.27	(3.08)	0.16	(2.66)	0.61	(3.32)	-0.65	(1.79)
Age 65-69	-2.46	(2.99)	-4.59	(4.04)	-0.64	(2.13)	-1.92	(1.96)	-2.58 [*]	(1.24)
Age 70-74	0.23	(2.22)	6.35	(5.09)	-1.84	(1.81)	-0.19	(1.44)	-2.03	(1.18)
Age 75-79	-1.34	(2.32)	-3.3	(2.36)	-2.65 [*]	(1.31)	-1.32	(1.34)	-1.21	(0.96)
Age 80-84	-0.37	(2.43)	-1.77	(2.71)	0.15	(1.41)	0.17	(1.40)	-0.24	(0.95)
Sex (reference "female")										
Male	-1.31	(1.52)	-1.05	(1.88)	1.68	(1.22)	0.91	(1.40)	-0.51	(0.99)
Race/Ethnicity (reference "other")										
White	-0.76	(3.78)	7.86 [*]	(2.84)	-11.04	(7.04)	-1.36	(4.87)	-4.8	(3.17)
Black	-1.59	(3.99)	5.77	(3.86)	-8.56	(7.33)	-0.85	(5.23)	-5.04	(3.24)
Hispanic	-3.62	(4.94)	0.98	(2.94)	-4.31	(7.63)	3.62	(5.46)	-0.95	(3.27)
Income (reference "income <\$25,000")										
Income \$25,000	-4.09 [*]	(1.79)	-3.39	(2.34)	-1.2	(1.24)	-2.95 [*]	(1.23)	-2.14 [*]	(0.81)

	Incident Stroke		Incident AMI		COPD		Arthritis		Walking difficulties	
	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)
Education (reference "more than high school")										
Less than high school	-0.87	(1.74)	-0.3	(2.82)	-1.35	(1.56)	-1.01	(1.38)	-0.96	(0.89)
High school	-0.87	(1.85)	1.16	(2.91)	1.52	(1.63)	0.84	(1.58)	0.45	(0.91)
Marital Status (reference "married")										
Not married	-2.02	(1.81)	-1.73	(2.40)	0.07	(1.62)	0.57	(1.35)	-0.69	(0.87)
Living situation (reference "lived alone")										
Lived with others	1.00	(2.06)	-2.97	(2.45)	-1.25	(1.50)	0.48	(1.23)	-0.32	(0.92)
Community/Facility (reference "both")										
Community	-3.16	(2.65)	0.97	(2.75)	-3.44	(1.90)	-1.12	(1.20)	-2.82*	(1.12)
Facility	-4.77	(3.88)	-2.66	(5.24)	-4.43	(2.41)	-2.96*	(1.44)	-5.95*	(1.14)
Rural/Urban (reference "urban")										
Lived in rural area	0.49	(1.92)	-0.34	(1.89)	-2.06	(1.40)	-1.29	(1.25)	-0.50	(0.95)
ADL (reference "yes")										
No					0.95	(1.25)	1.15	(1.09)	0.68	(0.87)

* Statistically significant at $p = 0.05$

^a Multivariable generalized estimating equation model of OT intensity (monthly units of OT services) controlling for variables listed in Table 5