


RESEARCH ARTICLE

Impact of Medicare eligibility on informal caregiving for surgery and stroke

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Funding information

Agency for Healthcare Research and Quality, Grant/Award Number: 5T32HS000053; National Clinician Scholars Program

Abstract

Objective: To assess whether the intensity of family and friend care changes after older individuals enroll in Medicare at age 65.

Data Sources: Health and Retirement Study survey data (1998–2018).

Study Design: We compared informal care received by patients hospitalized for stroke, heart surgery, or joint surgery and who were stratified into propensity-weighted pre- and post-Medicare eligibility cohorts. A regression discontinuity design compared the self-reported likelihood of any care receipt, weekly hours of overall informal care, and intensity of informal care (hours among those receiving any care) at Medicare eligibility.

Data Collection: Not applicable.

Principal Findings: A total of 2270 individuals were included; 1674 (73.7%) stroke, 240 (10.6%) heart surgery, and 356 (15.7%) joint surgery patients. Mean (SD) care received was 20.0 (42.1) weekly hours. Of the 1214 (53.5%) patients who received informal care, the mean (SD) care receipt was 37.4 (51.7) weekly hours. Mean (SD) overall weekly care received was 23.4 (45.5), 13.9 (35.8), and 7.8 (21.6) for stroke, heart surgery, and joint surgery patients, respectively. The onset of Medicare eligibility was associated with a 13.6 percentage-point decrease in the probability of informal care received for stroke patients ($p = 0.003$) but not in the other acute care cohorts. Men had a 16.8 percentage-point decrease ($p = 0.002$) in the probability of any care receipt.

Conclusions: Medicare coverage was associated with a substantial decrease in family and friend caregiving use for stroke patients. Informal care may substitute for rather than complement restorative care, given that Medicare is known to expand the use of postacute care. The observed spillover effect of Medicare coverage on informal caregiving has implications for patient function and caregiver burden and should be considered in episode-based reimbursement models that alter professional rehabilitative care intensity.

This manuscript was presented at the Academy Health Annual Research Meeting 2021.

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KEYWORDS

caregiving, discontinuity, Medicare, stroke, surgery

What is known

- Family and friend care is received by millions of older Americans
- Medicare spends \$124 billion on surgical care, \$30 billion on stroke care, and is known to increase the use of postacute services for new enrollees
- Informal care can substitute for maintenance and well-being assistance requiring less skilled support

What this study adds

- Older Medicare beneficiaries receive substantial family and friend caregiving after acute health events
- Medicare eligibility is associated with decreased informal caregiving use for those who experience a stroke
- Ongoing restorative services for stroke patients may decrease the need for complementary support from family and friends

1 | INTRODUCTION

Each year, Medicare spends approximately \$124 billion on surgical care, \$30 billion on stroke care, and \$60 billion on posthospital care.¹⁻⁴ It is well recognized that universal coverage with Medicare increases utilization of elective surgery, postacute care spending, and other services.^{5,6} For well-insured, clinically similar individuals, entry into Medicare is associated with 68% to 230% greater postacute spending for medical and surgical conditions, including stroke and joint replacement.⁶ Yet, because of limited evidence that it improves patient outcomes, postacute care has been targeted for cost reductions under shared risk payment models in Medicare, including for participants treated in the Bundled Payments for Care Improvement (BPCI) program and by Accountable Care Organizations.⁷⁻⁹

Postacute care, which includes posthospital care in skilled nursing facilities, long-term acute care hospitals, inpatient or outpatient rehabilitation, or home nursing and rehabilitation care, provides ongoing recovery support for recently hospitalized patients unable to discharge directly home without additional support. For those patients discharged to postacute care, further recovery commonly continues at home with unpaid care from family and friends, known as “unpaid family and friend caregiving” or “informal caregiving,” which is associated with substantial burdens (although in some cases, benefits) in terms of emotional health and economic costs to caregivers.¹⁰⁻¹⁴ It is unknown whether more expansive Medicare coverage will increase (supplement) or decrease (replace) this informal care. More generous coverage of postacute care could alleviate the need for or replace informal care for some of the 6–8 million older Americans receiving informal care.¹⁵⁻¹⁸ An alternative hypothesis is that informal care use would stay the same or increase, given that any additional formal postacute care received by beneficiaries after Medicare entry may supplement rather than replace longer term informal care support or

increase informal care (e.g., through transportation or other supports for additional formal health care use).¹⁹ Informal care may also support longer term postrehabilitation needs, while postacute care services support time-limited recovery.⁶ Changes in unpaid caregiving may also vary by underlying acute condition.

Only a few studies, which used smaller, convenience samples, have examined informal caregiving after surgery, in contrast to the vast literature on informal care for older individuals with chronic illness.^{17,18,20,21} In this work we evaluate longer term informal caregiving after Medicare eligibility for older patients after acute hospitalizations, including surgery, that commonly entail postacute care. Specifically, we identify the amount of informal care received by older individuals experiencing a stroke, heart surgery, and joint surgery and whether informal care use differs among patients hospitalized before versus after Medicare eligibility. We hypothesized that informal care use decreases among patients hospitalized after Medicare eligibility, as compared to those not yet eligible, due to the substitution of formal postacute care for care from family and friends. Further, we hypothesized that – given that women provide a majority of informal care, even as men's contributions are increasing²² – there may be gender differences in the degree to which male and female patients rely on informal care after entry into Medicare. Our findings will provide data about the potential benefits of Medicare coverage in reducing informal caregiving needs for patients experiencing acute hospitalizations. If informal care is decreased, it would suggest that Medicare has additional benefits to American families beyond medical coverage, offering relief to a largely unpaid and overworked caregiving force. These findings may have particularly important policy implications as payment reform efforts in Medicare increasingly incentivize reductions in costly postacute care spending; such reductions in postacute care may negate any potential benefits in terms of reductions in informal care.

2 | METHODS

2.1 | Data

Our primary dataset was the publicly available Health and Retirement Study (HRS), a longitudinal biennial survey primarily including community-dwelling older adults. This nationally representative dataset surveys adults ages 51 years and older to study factors associated with retirement, including health and function, health services utilization, health insurance status, family structure, and sociodemographics. We selected the HRS because it additionally provides comprehensive caregiving information reported by the care recipient, including self-reported care received from family members and friends. We used data from the 1998–2018 surveys. This study was deemed exempt by the University of Michigan Institutional Review Board.

2.2 | Cohorts

Our study population included individuals ages 59 to 74 who reported hospitalization for any of three acute events: stroke, heart surgery, joint replacement, and other operations for arthritis. Respondents who reported experiencing more than one event were assigned to the event with the highest acuity; stroke was the highest acuity, then heart surgery, then joint surgery. Individuals experiencing an event in more than one wave (e.g., a stroke in 2002 and again in 2006) contributed multiple observations to the sample. We chose these three conditions because they are common, have well-defined acute onsets, and frequently require postacute care.^{23–27} They are also targeted in federal episode-based reimbursement reform, including mandatory bundles for joint and cardiac surgery. Additionally, these three conditions are featured in Medicare's Bundled Payments for Care Improvement-Advanced (BPCI-A), in which hospitals are accountable for postacute care costs within 90 days of discharge.²⁸ We expected informal caregiving to be highest among the stroke cohort and sought to evaluate differences between the conditions. We restricted the sample to those with at least one activity of daily living (ADL) and/or instrumental activity of daily living (IADL) limitation, given that caregiving questions are only asked of individuals with such limitations; absent this, individuals who receive care but without such a limitation could not report that care.

To assess the effect of Medicare eligibility on informal caregiving, we created two similar cohorts of individuals around age 65, accounting for the design of the HRS. The HRS asks respondents whether they experienced each of the three acute events (stroke, heart, and joint surgery) since the prior interview (or during the past two years for respondents without a prior interview). To conservatively account for the two-year lookback period used by the HRS, our pre-Medicare cohort included individuals ages 59 to 66 years old who were not covered by Medicare (i.e., a 66-year-old respondent could recall an event at age 64, not covered by Medicare). The Medicare cohort included individuals ages 67 to 74 years old. To reduce the chance of misattribution or incorrectly assigning caregiving information to the wrong

cohort, we used the age cutoff of 66 years. As an example, a 66-year-old interviewee who reported having a stroke 2 years ago (age 64) would not have yet been eligible or enrolled in Medicare at the time of the stroke. That interviewee's caregiving received pre-Medicare eligibility despite his or her measured age of 66 years. By using the age 66 years cutoff, we are less likely to attribute pre-Medicare eligibility caregiving to the post-Medicare cohort, choosing to bias our results to the null. In order to increase the comparability of the two cohorts, we used propensity score matching to balance sociodemographic (sex, race/ethnicity, education) and clinical characteristics (chronic illnesses) and difficulties with activities of daily living (ADLs) and instrumental ADLs, across the cohorts.

2.3 | Outcomes

The primary outcomes were (a) any receipt of informal care, (b) weekly hours of informal care receipt for those receiving any informal care ("intensity of care"), and (c) overall weekly hours of informal care receipt (including those with no care received). The HRS asks respondents who report receiving help with any ADL and/or IADL the amount of average weekly care received for each ADL and/or IADL during the past month for each caregiver, as well as the identity of each caregiver.²⁹ Care provided by family members (including a spouse, children, siblings, cousin, or grandchildren) or friends were categorized as informal caregiving hours. Care received at an institution or from a formal caregiver was excluded (not counted as informal caregiving), as we considered that respondents receiving postacute care might report those care hours as formal care. We summed all family or friend caregiving to create an average weekly informal caregiving variable. We created an "intensity of care" variable, which is the average weekly informal care hours received among those receiving any care (>0 h of weekly care). Further, we identified any care received (>0 h of weekly care). We also separately identified (mutually exclusive) categories of informal care – spousal caregiving, other (non-spousal) family caregiving, and nonrelative caregiving.

2.4 | Statistical analyses

First, we balanced pre- and post-Medicare cohorts using propensity scores, where the likelihood of being in the Medicare cohort was estimated based on marital status (married/not married), education (<high school, high school, some college, college or more), race/ethnicity (African-American, Hispanic, non-Hispanic White), and having been ever diagnosed with hypertension, diabetes, cancer, lung disease, heart problems, psychiatric illness, or arthritis (indicators for each of these chronic conditions were used). We then described the sample overall and according to cohort (Medicare and non-Medicare) and the type of acute hospitalization, using t-tests and analysis of variance to statistically evaluate differences.

Next, a parametric regression discontinuity design³⁰ was used to assess differences, at the age of onset of Medicare eligibility, in (a) the

probability of using any informal care, (b) the intensity of care (average weekly care hours received among those receiving any care), and (c) the overall care (average weekly care hours received among all respondents) used after an acute event. A parametric estimation approach is preferred in cases where the regression discontinuity score is discrete as opposed to continuous, and there are not a large number of mass points.³¹ We followed Zhu et al. in estimating multiple functional forms (including higher order polynomials and interaction terms) and using F-tests to identify restrictive model specifications.³² For the first outcome, we estimated logistic regression models that regressed informal care on Medicare status, a centered (discrete) age variable, and an interaction between Medicare status and centered age, and then tested the effect of the Medicare (age-eligibility) indicator. We then used the results to obtain predicted probabilities of any care used for the first outcome. For the second outcome, we used negative binomial regression models with the same regressors. For the third outcome, we used two-part models to account for overdispersion and a large number of zeroes in the dependent variable through independent modeling of zero values. All models used cluster-robust standard errors to account for repeated observations for respondents. We report the expected mean (e.g., the adjusted number of weekly caregiving hours received) for beneficiaries just before Medicare eligibility and the adjusted discontinuity (e.g., the difference in the adjusted number of weekly caregiving hours received for those just before compared to just after Medicare eligibility). We illustrate the results with pre and post-Medicare entry trends (from our regression models) and plotted unadjusted values.

We explored additional models that did not use propensity-score matching (instead adjusting for sociodemographic, health, and functional characteristics), that removed outlier data, that included the interaction term, and that included quadratic effects of age and interactions between quadratic age and Medicare status, following Jacob et al.^{30,32,33} We also examined a shorter age range (ages 61–72) around Medicare eligibility. The McCrary test was used to assess discontinuity in the density of the age variable at Medicare entry.³⁴ Results from that test and from other models are reported in the Appendix (Figure A1, Tables A2–A4). All analyses were performed using statistical software (Stata 16/MP, College Station, TX) at the 5% significance level.

3 | RESULTS

Among 2270 individuals in the cohort, 1674 (73.7%) had a stroke, 240 (10.6%) underwent heart surgery, and 356 (15.7%) underwent joint surgery. In comparing the propensity score matched pre-eligibility and post-eligibility cohorts, there were no statistically significant differences in demographics or clinical characteristics, with the exception of age, suggesting good balance in the cohorts (Table 1).

By event, the mean (SD) number of ADL limitations (range: 0–5) was the highest in the stroke cohort, averaging 1.9 (1.6), compared with 1.5 (1.2) for each of the heart and joint surgery cohorts.

(Table A1; specific number of ADL limitations provided in Table A5). Male patients were a significantly larger proportion of the heart surgery cohort ($n = 131$, 54.6%), than the stroke ($n = 747$, 44.6%) or joint surgery ($n = 74$, 20.8%) cohorts ($p < 0.001$).

Overall, the cohort received an average of 20.0 hours (42.1) of weekly informal care (Table 2). Among the 1214 (53.5%) patients who reported receiving care from an informal caregiver, they received an average of 37.4 (51.7) weekly hours. Among the stroke cohort, 58.6% received informal care, compared to 42.1% of the heart surgery cohort and 37.1% of the joint surgery cohort. Mean (SD) overall weekly informal caregiving hours were 23.4 (45.5) for stroke, 33.9 (35.8) for heart surgery, and 7.8 (21.6) for joint surgery. Among those who received care, weekly care intensity was 40.0 (53.6) hours for stroke, 33.1 (49.3) for heart surgery, and 20.9 (31.5) for joint surgery.

Male care recipients received 19.2 (40.6) overall weekly hours of care, compared to 20.5 (43.2) hours for female care recipients (Table 2). Care intensity was 37.6 (50.4) hours for males and 37.2 (52.5) for females. Greater percentages of women compared to men used any care in the heart (women: 52.3%; men: 33.6%) and joint surgery (women: 41.1%; men: 21.6%) cohorts.

3.1 | Adjusted results

3.1.1 | Overall

Adjusted results are shown in Figure 1 and Table 3. At Medicare entry, we found evidence of changes in caregiving in the full sample. The proportion of respondents receiving any care decreased by 24.5% ($p < 0.001$). While care intensity (the amount of care received by those receiving any care) remained similar ($-6.7%$, $p = 0.66$), total care decreased by 29.4% ($p = 0.05$). Results were similar when adjusting for covariates rather than using propensity score matching (total care decreased by 30.4%, $p = 0.03$), and when removing outlier data (see Appendix, Table A5).

3.1.2 | By acute condition

Caregiving reductions at entry into Medicare were observed in the stroke cohort but not in the other two cohorts. In the stroke cohort, the adjusted proportion of respondents using any care decreased by 19.8% ($p < 0.001$), while care intensity ($-8.4%$, $p = 0.64$) and overall care ($-22.6%$, $p = 0.20$) did not change. In the heart and joint surgery cohorts, the percentages of respondents using any care, care intensity, and overall care did not change (Table 3, Figure 1).

3.1.3 | By gender

The proportion of men receiving care after Medicare entry decreased by 26.6% ($p = 0.002$), but neither care intensity nor overall care was

TABLE 1 Matched cohort characteristics, by Medicare eligibility status

	Overall	Pre-eligibility	Posteligibility	p value
Total	2270	1135 (50.0)	1135 (50.0)	
Mean age (SD)	66.6 (4.5)	62.7 (2.2)	70.6 (2.3)	<0.001
Gender, N (%)				0.80
Male	952 (41.9)	473 (41.7)	479 (42.2)	
Female	1318 (58.1)	662 (58.3)	656 (57.8)	
Race, N (%)				0.72
Non-Hispanic White	1261 (55.6)	627 (55.2)	634 (55.9)	
Non-Hispanic Black	693 (30.5)	341 (30.0)	352 (31.0)	
Hispanic	160 (7.1)	83 (7.3)	77 (6.8)	
Other	156 (6.9)	84 (7.4)	72 (6.3)	
Marital status, N (%)				0.86
Married	1370 (60.4)	687 (60.5)	683 (60.2)	
Not married	900 (39.7)	448 (39.5)	452 (39.8)	
Highest level of education, N (%)				0.96
< High school	900 (39.7)	454 (40.0)	446 (39.3)	
High school	779 (34.3)	391 (34.5)	388 (34.2)	
Some college	375 (16.5)	183 (16.1)	192 (16.9)	
College or more	216 (9.5)	107 (9.4)	109 (9.6)	
Comorbid conditions, N (%)				
Hypertension	1827 (80.5)	911 (80.3)	916 (80.7)	0.79
Diabetes	967 (42.6)	476 (41.9)	491 (43.3)	0.52
Cancer	343 (15.1)	172 (15.2)	171 (15.1)	0.95
Lung disease	531 (23.4)	265 (23.4)	266 (23.4)	0.96
Cardiac disease	3159 (13.9)	167 (14.7)	148 (13.0)	0.25
Psychological disease	928 (40.9)	460 (40.5)	468 (41.2)	0.73
Arthritis	1806 (79.6)	907 (79.9)	899 (79.2)	0.68
Mean ADL limitation (SD)	1.8 (1.5)	1.8 (1.5)	1.8 (1.5)	0.92
Mean IADL limitation (SD)	1.4 (1.4)	1.4 (1.4)	1.4 (1.5)	0.83

Note: Pre and post-Medicare eligibility cohorts were matched on sociodemographic, functional status, and disease characteristics. Abbreviations: ADL, activity of daily living; IADL, instrumental ADL.

TABLE 2 Unadjusted informal caregiving receipt, overall and by condition and gender

	Percentage receiving care (%) (n = 2270)	Caregiving intensity ^a (n = 1214)		Overall weekly caregiving hours ^b (n = 2270)	
		Mean	SD	Mean	SD
Overall	53.4	37.4	51.7	20.0	42.1
Male	51.1	37.6	50.4	19.2	40.6
Female	55.2	37.2	52.5	20.5	43.2
Stroke	58.6	40.0	53.6	23.4	45.5
Male	57.0	38.7	51.6	22.1	43.4
Female	59.9	41.0	55.2	24.5	47.2
Heart	42.1	33.1	49.3	13.9	35.8
Male	33.6	31.0	42.9	10.4	28.7
Female	52.3	34.6	54.0	18.1	42.6
Joint	37.1	20.9	31.5	7.8	21.6
Male	21.6	25.8	30.9	5.6	17.6
Female	41.1	20.2	31.6	8.3	22.6

^aCaregiving intensity is the average number of weekly hours among those receiving care.

^bOverall caregiving hours are those among the total cohort, that is, individuals not receiving any caregiving.

observed to change. For women, none of the percentage of respondents using any care, care intensity, and overall care were observed to change.

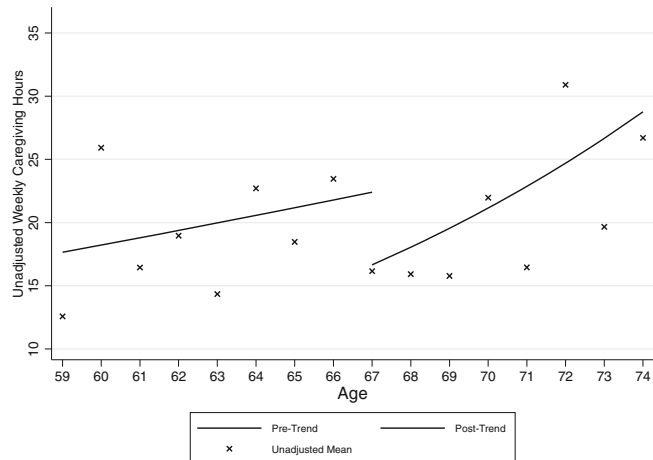


FIGURE 1 Change in overall weekly caregiving hours received at Medicare eligibility. HRS respondents ages 59 to 74, comparing pre and post-eligibility cohorts, matched on sociodemographics and health characteristics. The year 67 was used as the cut-point given the HRS' use of a 2-year lookback window on interview questions about stroke and heart and joint surgeries. The pre and post-Medicare eligibility trends are estimated using a two-part regression model with a post indicator, a continuous age indicator, and an interaction of post and age; plotted values are unadjusted values of the dependent variable at given values of the age.

4 | DISCUSSION

In this study of older adults who experienced a stroke, heart surgery, or joint surgery and had at least one functional limitation, we found that more than one-half of these patients received care from a family or friend (“informal”) caregiver. The overall usage and intensity, or amount of care among those receiving any care, was highest among stroke patients and higher for women than men. Post-Medicare eligibility use of care and overall weekly care hours received decreased by approximately 25% compared to pre-eligibility. While use of informal care decreased for respondents who experienced a stroke, compared to stroke patients pre-eligibility, there was no difference in caregiving between pre-eligibility and post-eligibility in the heart or joint surgery cohorts. Men had large decreases in the uptake of care but no change in care intensity after the onset of Medicare eligibility, while no changes were observed among women. Collectively, these findings suggest that Medicare provides services that may substitute for informal care after stroke, reducing informal care burdens for family members and friends of older beneficiaries.

Previous literature on cardiac and joint surgery patients focuses on complications and postacute care use but has limited information about unpaid care after surgery.^{35–39} This study, therefore, fills gaps in the literature by contributing knowledge about the prevalence and intensity of informal caregiving for postsurgical patients. With nearly 42% of heart surgery and 37% of joint surgery patients receiving informal care, averaging 33 and 21 h of care per week, respectively, it is clear that care needs for postsurgery patients are substantial and

TABLE 3 Regression discontinuity results for caregiving use, intensity, and average hours pre/post Medicare eligibility

		Expected mean	Adjusted discontinuity (percentage point)	Percentage change (%)	p-value
Whole sample	Use (%) ^a	60.8	−14.9	−24.5	<0.001
	Intensity (hours)	35.8	−2.4	−6.7	0.66
	Average (hours)	21.8	−6.4	−29.4	0.05
Stroke cohort	Use (%) ^a	68.7	−13.6	−19.8	0.003
	Intensity (hours)	38.1	−3.2	−8.4	0.64
	Average (hours)	25.2	−5.7	−22.6	0.20
Heart surgery	Use (%)	42.3	−11.5	−27.2	0.36
	Intensity (hours)	43.0	−14.2	−33.0	0.53
	Average (hours)	18.2	−9.3	−51.1	0.35
Joint surgery	Use (%) ^a	29.0	3.9	13.4	0.67
	Intensity (hours)	11.2	−2.5	−22.3	0.65
	Average (hours)	3.2	−0.4	−12.5	0.83
Men	Use (%) ^a	63.2	−16.8	−26.6	0.002
	Intensity (hours)	33.8	−2.2	6.5	0.73
	Average (hours)	21.4	−6.7	−31.3	0.08
Women	Use (%) ^a	56.9	−11.6	−20.4	0.07
	Intensity (hours)	39.4	−3.1	−7.9	0.76
	Average (hours)	22.4	−6.0	−26.8	0.32

^aThe expected mean for use is the adjusted percentage of respondents receiving any care prior to Medicare enrollment. The adjusted discontinuity for use is the percentage point change in the percentage of respondents receiving any care from before to after Medicare enrollment.

potentially underexplored in the broader caregiving literature that primarily focuses on older individuals with chronic illnesses or injury.¹⁰ A broader understanding of the specific care modalities informal caregivers provide to these patients could bolster caregiver support, including ensuring robust provider-caregiver communications both before and after surgery and stroke for older adults.

We also offer a novel contribution to policy discussions surrounding Medicare and informal caregiving. To the extent it is focused on policy, the informal caregiving literature has examined state and local policies as avenues for improving caregiver support, including respite care, caregiver training, tools to improve caregiver involvement during care recipients' hospitalizations, and educational resources.⁴⁰ What has been neglected in these discussions is the role that Medicare may play in shaping informal care patterns. As our results suggest, Medicare eligibility influences informal caregiving – decreasing the proportion of stroke patients receiving care and the total amount of care received. Therefore, advocates for caregivers might shift focus to federal policy, and specifically how the Medicare program, including new payment models, directly or inadvertently shapes informal care patterns.

Further work is needed to understand the mechanisms underlying these novel findings. It is plausible that the findings may reflect a substitution effect. This contention is supported by literature showing that complex formal care, including skilled nursing that is commonly received by stroke survivors,⁴¹ can substitute for informal care.^{42–44} On the other hand, services offered by formal care may complement rather than substitute for informal care, and this may explain why we did not observe effects among heart and joint surgery recipients, who may need less sustained, skilled physical rehabilitation than stroke patients. Null results for the other cohorts may also be due to patients regaining function, and therefore, having shorter-lived needs after heart and joint surgery; because needs are shorter-lived, there may also be reporting differences across cohorts. In sum, Medicare's generous postacute care services, including skilled rehabilitation,⁶ may relieve the need for skilled, informal care for stroke patients.

If so, our findings also raise important policy questions for Medicare in the context of the proliferation of alternative payment models (APM) that are known to broadly reduce the utilization of postacute care.^{7–9} Medicare's APMs tie payments to patient outcomes in order to remove incentives for volume (as opposed to quality) under fee-for-service medicine. To date, the literature suggests that APMs do not harm quality (when measured using readmissions and mortality)^{45–47}; yet, little is known about any impacts on patient function or emotional or financial impacts on family and friend caregivers. Because our findings suggest that increased postacute care use may be responsible for a reduced need for informal stroke care, this means that APMs may have important but as yet unexamined policy effects on informal care.

Further reductions in postacute care may also have clinical implications for patients' rehabilitation and longer term well-being. A large proportion of caregivers around the onset of Medicare eligibility were spouses, many of whom may still be working and therefore less able

to meet patients' needs.⁴⁸ Therefore, potential changes to Medicare coverage of postacute care may have lasting implications for patient welfare if spousal caregivers do not have additional time to commit to caregiving tasks (as care from other caregivers may be more challenging to obtain or less beneficial). Changes may not affect just the patient: still-working caregivers often experience temporarily reduced hours, changed schedules, or unpaid leave secondary to caregiving responsibilities.⁴⁹ Therefore, Medicare entry could have lasting employment effects for younger spousal or other caregivers without access to workplace leave protections. The already tenuous balancing act of caregivers has been highlighted and has worsened during the COVID-19 pandemic with associated decreased support services and economic stress.⁵⁰

4.1 | Limitations

Our study has several limitations. First, HRS surveys are biennial, and therefore self-reported caregiving hours may reflect care received that is remote from one of the acute hospitalizations assessed in this study. However, previous studies of caregiver burden after cardiac surgery have found caregiving needs to be maintained over 1–2 years after surgery.⁵¹ Second, our cohort is limited to patients ages 59–74, and studies have shown differences in informal care needs throughout different phases of older adulthood. However, by restricting to this narrow age band and using a regression discontinuity design, we are able to discern any differences in informal care received that are related to Medicare eligibility and coverage rather than needs associated with aging and associated functional needs. Additionally, after matching our cohorts, our findings on caregiving (remaining differences in use of or amount of informal caregiving) are unlikely to be driven by residual differences in patient characteristics or clinical outcomes. Despite our efforts, there may be residual confounding due to unmeasured and self-reported clinical characteristics. Third, we do not account for formal care; however, in post hoc analyses, results were robust to the inclusion of paid organizational care as a model covariate. Specifically, we measured the amount of weekly formal (paid) care received by respondents and included this term in regression models, with no change in our findings. Fourth, we did not explore health or functional impacts on caregivers, given our focus on potential care recipients. Fifth, recall bias could influence our findings; in the survey, respondents assess average care received in the past month but describe health events (e.g., stroke, heart surgery) that occurred in the past 2 years. Because more distant or less severe health events are less accurately recalled,⁵² care receipt may be overstated if individuals less often report less recent surgeries requiring more limited care. Additionally, care received cannot be fully ascribed to the medical event, though we attempted to partially ameliorate this by controlling for baseline functional status. Sixth, some patients age 66 (who are not considered in this study to be Medicare-eligible) may have been hospitalized for surgery or stroke while enrolled in Medicare; this could add noise to model estimates. Finally, if some caregiving hours preceded rather than followed the hospitalized

event, this would (while not introducing bias) make model estimates less precise.

These limitations notwithstanding, our findings have implications for new, increasingly used Medicare policies that incorporate value into reimbursements. Under BPCI and the BPCI-Advanced programs that incentivize reductions in utilization, spending decreased by 1.6%–3.9%, driven primarily by decreased spending on nursing facilities and inpatient rehabilitation, though home health care use increased.^{53–56} To the extent that these programs are expanded and continue to only measure formal health care utilization, any spillovers to the informal caregiving system will remain unrecognized, with potential impacts on a largely female family and friend workforce.

This inattention to informal care considerations in light of major payment reform is concerning, given what is already known about potential, unforeseen policy impacts. Previous studies identify substitution effects between informal and formal care,^{17,23–26} spillovers between Medicare and other programs or within Medicare,^{57–59} plus the immense burdens of family caregiving,^{60–62} including work showing that family caregivers provide three-quarters of the care received during home health care episodes.⁶³ In a qualitative study of institutions participating in bundled payment programs, hospital leaders already recognize the contribution of support at home to outcomes influenced by these policy changes.⁶⁴ Therefore, broader recognition in the policy community of the impacts on informal caregiving of these new policies and on future reform proposals, including those aiming to restrict (or expand) Medicare benefits, is critical.

5 | CONCLUSION

The onset of Medicare eligibility is associated with decreased family and friend weekly caregiving hours among patients with stroke. As policy makers face pressure to decrease costs associated with postacute care, this may perversely impact family and friend caregiving burdens, with potentially disproportionate effects for women caregivers.²⁷ Some policy makers may view informal care as “free”, but many studies have quantified its enormous impact on caregivers, including effects on caregivers’ lives and health, plus a massive unreimbursed financial value of over \$500 billion annually.^{65–68} Moving forward, the effects on caregivers of Medicare entry and recent widespread efforts to restrict postacute care intensity are important areas of study.

AUTHOR CONTRIBUTIONS

Study concept and design: Geoffrey J. Hoffman, Ana C. De Roo, Scott E. Regenbogen; Acquisition of data: Geoffrey J. Hoffman, Jinkyung Ha; Analysis and interpretation of data: Geoffrey J. Hoffman, Jinkyung Ha, Ana C. De Roo, Scott E. Regenbogen; Preparation of manuscript: Geoffrey J. Hoffman, Ana C. De Roo, Jinkyung Ha, Scott E. Regenbogen.

ACKNOWLEDGMENTS

We are grateful to Jun Li, PhD of Syracuse University for her assistance and suggestions regarding the regression discontinuity design.

FUNDING INFORMATION

Ana C. De Roo was supported by the Agency for Health care Research and Quality by 5T32HS000053 and by the National Clinician Scholars Program.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

SPONSOR'S ROLE

The sponsor had no role in the design, methods, subject recruitment, data collection, analysis and interpretation of data, or preparation of the manuscript.

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How to cite this article: De Roo AC, Ha J, Regenbogen SE, Hoffman GJ. Impact of Medicare eligibility on informal caregiving for surgery and stroke. *Health Serv Res*. 2023;58(1):128-139. doi:[10.1111/1475-6773.14019](https://doi.org/10.1111/1475-6773.14019)

APPENDIX A

	Stroke	Heart	Joint	p-value
Total	1674	240	346	
Age (mean, (SD))	66.7 (4.5)	66.2 (4.6)	66.6 (4.6)	0.37
Gender, N (%)				<0.001
Male	747 (44.6)	131 (54.6)	74 (20.8)	
Female	927 (55.4)	109 (45.4)	282 (79.2)	
Race, N (%)				<0.001
Non-Hispanic White	870 (52.0)	156 (65.0)	235 (66.0)	
Non-Hispanic Black	576 (34.4)	42 (17.5)	23 (9.6)	
Hispanic	113 (6.8)	23 (9.6)	24 (6.7)	
Other	115 (6.9)	19 (7.9)	22 (6.2)	
Marital status, N (%)				0.09
Married	991 (59.2)	159 (66.3)	220 (61.8)	
Not married	683 (40.8)	81 (33.8)	136 (38.2)	
Education, N (%)				<0.001
<High school	709 (42.4)	95 (39.6)	96 (27.0)	
High school	545 (32.6)	90 (37.5)	144 (40.5)	
Some college	264 (15.8)	38 (15.8)	73 (20.5)	
≥College	156 (9.3)	17 (7.1)	43 (12.1)	
Comorbid conditions, N (%)				
Hypertension	1373 (82.0)	186 (77.5)	268 (75.3)	0.01
Diabetes	772 (46.1)	115 (47.9)	80 (22.5)	<0.001
Cancer	277 (16.6)	27 (11.3)	39 (11.0)	0.006
Lung disease	414 (24.7)	62 (25.8)	55 (15.5)	0.001
Cardiac disease	75 (4.5)	240 (100.0)	0 (0.0)	<0.001
Psychological disease	730 (43.6)	89 (37.1)	109 (30.6)	<0.001
Arthritis	1252 (74.8)	202 (84.2)	352 (98.9)	<0.001
Mean ADL limitations (SD)	1.9 (1.6)	1.5 (1.2)	1.5 (1.2)	<0.001
Mean IADL limitations (SD)	1.6 (1.5)	1.0 (1.1)	0.8 (1.0)	<0.001

TABLE A1 Cohort characteristics, by condition

TABLE A2 Parametric analysis

Model	Treatment estimate	SE	AIC
Linear	-7.1	3.5	14,337.9
Linear interaction	-6.4	3.3	14,339.2
Quadratic	-6.9	3.3	14,337.8
Quadratic interaction	-9.2	6.1	14,338.6
Cubic	-8.3	4.6	14,341.1
Cubic interaction	-18.9	13.5	14,335.5

TABLE A3 Parametric analysis using ages 62-73

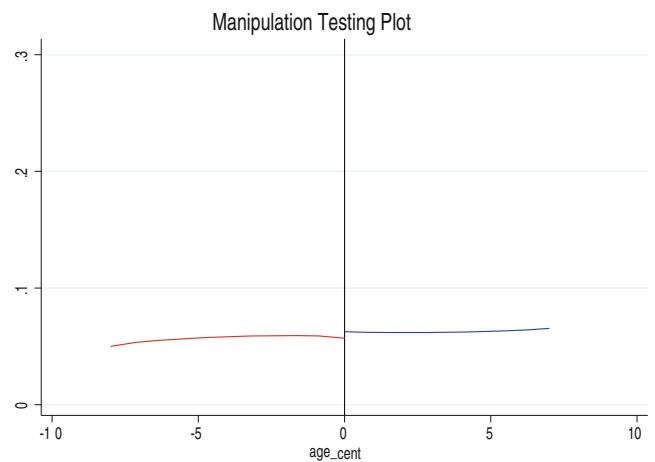
Model	Treatment estimate	SE	AIC
Linear	-10.2	4.1	10,912.9
Linear interaction	-9.3	4.0	10,924.8
Quadratic	-9.9	3.9	10,924.8
Quadratic interaction	-9.9	8.0	10,944.7
Cubic	-7.6	5.3	10,934.5
Cubic interaction	-10.2	14.6	10,974.2

TABLE A4 Results using alternative functional forms

Model		Expected mean	Adjusted discontinuity	p-value
Quadratic	Use (%) ^a	61.7	-15.0	<0.001
	Intensity (hours)	36.7	-3.1	0.58
	Average (hours)	22.7	-6.9	0.04
Quadratic interaction	Use (%) ^a	53.9	-11.7	0.07
	Intensity (hours)	44.8	-9.5	0.37
	Average (hours)	24.2	-9.2	0.13
Cubic	Use (%) ^a	61.1	-14.0	0.009
	Intensity (hours)	47.1	-7.7	0.68
	Average (hours)	23.6	-8.3	0.07
Cubic interaction	Use (%) ^a	73.6	33.6	<0.001
	Intensity (hours)	47.1	-7.7	0.68
	Average (hours)	34.7	-18.9	0.16

TABLE A5 ADL frequencies and percentages in sample

Number	Frequency	Percentage (%)
0	454	20.0
1	773	34.1
2	413	18.2
3	279	12.3
4	184	8.1
5	167	7.4

**FIGURE A1** McCrary test results. The test was performed using 'rddensity' command in Stata. $T = 1.24$, $p = 0.22$. [Color figure can be viewed at wileyonlinelibrary.com]