RESEARCH ARTICLE

The role of Medicaid home- and community-based services in use of Medicare post-acute care

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Abstract

Objective: Medicaid-funded long-term services and supports are increasingly provided through home- and community-based services (HCBS) to promote continued community living. While an emerging body of evidence examines the direct benefits and costs of HCBS, there may also be unexplored synergies with Medicare-funded post-acute care (PAC). This study aimed to provide empirical evidence on how the use of Medicaid HCBS influences Medicare PAC utilization among the dually enrolled.

Data Sources: National Medicare claims, Medicaid claims, nursing home assessment data, and home health assessment data from 2016 to 2018.

Study Design: We estimated the relationship between prior Medicaid HCBS use and PAC (skilled nursing facilities [SNF] or home health) utilization in a national sample of duals with qualifying index hospitalizations. We used inverse probability weights to create balanced samples on observed characteristics and estimated multivariable regression with hospital fixed effects and extensive controls. We also conducted stratified analyses for key subgroups.

Data Extraction Methods: The primary sample included 887,598 hospital discharges from community-dwelling duals who had an eligible index hospitalization between April 1, 2016, and September 30, 2018.

Principal Findings: We found HCBS use was associated with a 9 percentage-point increase in the use of home health relative to SNF, conditional on using PAC, and a meaningful reduction in length of stay for those using SNF. In addition, in our primary sample, we found HCBS use to be associated with an overall increase in PAC use, given that the absolute increase in home health use was larger than the absolute decrease in SNF use. In other words, the use of Medicaid-funded HCBS was associated with a shift in Medicare-funded PAC use toward home-based settings.

Conclusion: Our findings indicate potential synergies between Medicaid-funded HCBS and increased use of home-based PAC, suggesting policymakers should cautiously consider these dynamics in HCBS expansion efforts.

What is known on this topic

- Existing literature acknowledges the increasing use of Medicaid Home and Community-Based Services (HCBS) to support community living among eligible individuals.
- Prior research has examined the direct benefits of HCBS, for example, reduce nursing home admissions; however, there is limited exploration of potential interactions with Medicare-funded post-acute care (PAC).
- Studies have recognized the significance of dual enrollment but have not extensively investigated how Medicaid HCBS utilization may influence Medicare PAC utilization among dually enrolled individuals.

What this study adds

- This study provides empirical evidence that HCBS utilization is associated with an increase in home health use over skilled nursing facilities (SNF) among dually enrolled individuals who use PAC, shedding light on an important synergy between Medicaid and Medicare services.
- The findings of this study reveal that HCBS use leads to a meaningful reduction in the length of stay in SNFs for dual-eligible individuals.
- This study investigates the role of HCBS among subgroups of duals who were understudied, such as Medicare Advantage participants, Medicaid managed care enrollees, and patients with certain medical conditions, expanding our understanding of HCBS impact across diverse populations.

1 | INTRODUCTION

Every year, 5 million Medicare beneficiaries are admitted to a hospital, and about 40% of them receive post-acute care (PAC) after being discharged.[1] The PAC period is often critical in influencing the subsequent trajectory of health care utilization and health outcomes for hospitalized older adults, such as readmission to the hospital, nursing home placement, and mortality.[2,3] As the largest funder for PAC, Medicare spends about 60 billion dollars on PAC annually, and PAC alone accounts for three quarters of the geographic variation in total Medicare spending.[4,5] These high and variable expenditures make PAC a prime target for efforts to reduce Medicare spending under alternative payment models, such as Accountable Care Organizations and bundled payments. A key strategy to reduce PAC costs is to shift use from institutional PAC to home-based services. Accordingly, these payment reforms have lowered the use of institutional PAC in recent years; for example, the number of admissions to Medicare SNF care decreased 21% between 2015 and 2020.[4]

Receipt of home-based PAC is likely to require an appropriate home environment and supports. Whether the need for and the use of PAC change when supports are available in the home and community setting is a critical question. For older adults who are dually enrolled in both Medicare and Medicaid (duals), a costly and vulnerable population with high rates of hospitalization and PAC use, these supports are often funded by Medicaid as home- and community-based services (HCBS). In the last three decades, somewhat parallel to recent Medicare PAC trends, Medicaid has been shifting its provision of long-term services and supports (LTSS) toward HCBS relative to institutional care, with the percentage of total Medicaid LTSS expenditures going to HCBS, increasing from 12% in 1989 to 59% in 2019.[6] In addition, HCBS users account for the vast majority (84%) of Medicaid LTSS users.[7] With the expansion of Medicaid HCBS, these services are increasingly positioned to act as a potential substitute for, or complement to, formal, Medicare-funded institutional PAC services. By offering a home-based alternative to institutional care, HCBS have the potential to significantly reshape how duals interact with the Medicare PAC system, thus affecting Medicare spending in a meaningful way.

Evidence on the effect of Medicaid HCBS on PAC use and outcomes is scant. Several studies investigating this relationship suggest that the more generous HCBS policies are, the less skilled nursing facility (SNF) care is used: SNF patients in states with higher HCBS spending had shorter length of SNF stay among duals[8] and higher rates of successful discharge from SNF to the community.[9] SNF patients in counties with greater breadth of HCBS were more likely to return to the community and had better post-discharge outcomes.[10,11] However, these studies did not examine the role of individual beneficiaries' use of Medicaid HCBS on their use of Medicare PAC and focused on SNF care without examining home health use.

The objective of this study was to examine the relationship between the use of Medicaid HCBS and the use of Medicare PAC following a hospital stay at the individual level, including SNF care and home-based care. Using national Medicare and Medicaid claims data and patient assessment data for SNF and home health agencies, we applied propensity score weighting to balance duals who did and did not receive HCBS and modeled these relationships using hospital

fixed effects. As PAC is a critical component of Medicare spending that can affect health outcomes, our study provides evidence on how the use of Medicaid HCBS may influence the pattern of Medicare PAC utilization, thereby improving the understanding of the relationship between these two important services and potential synergies that policymakers should take into account.

2 | CONCEPTUAL FRAMEWORK

We use a modified Andersen Behavioral Model to structure our approach to modeling the impact of HCBS use among individuals who required PAC at hospital discharge. The Andersen Behavioral Model is commonly used to explain and predict the use of health services, including long-term care and PAC services.[12,13] The Andersen model posits that health service use by an individual is a function of predisposing and enabling characteristics of the individual and his/her need for medical care. Specifically, the predisposing variables include those that describe the propensity of an individual to use the services (e.g., age and sex of the individual, family structure, preferences); the enabling variables include resources that an individual has available for the use of services (e.g., income, Medicaid enrollment, Medicare enrollment, local availability of Medicaid HCBS); and healthcare need refers to health status or illness (e.g., the need for PAC following an acute hospital stay, dementia status, and other relevant diagnoses).

Our study focuses on the role of a key enabling factor (availability, and consequently use, of Medicaid HCBS), contingent on a potential need for PAC. Despite the inherent differences between HCBS and PAC services, availability of Medicaid HCBS offers alternative pathways for PAC, thereby modifying conventional discharge planning procedures. Specifically, hospital discharge planners may incorporate HCBS availability into their decision-making process, potentially shifting the balance in favor of home-based PAC solutions. This occurs as HCBS can supplement areas of care that might typically necessitate institutional PAC, thereby serving as an enabling factor for home-based PAC options, identified in this study with multiple outcomes (Appendix Figure 1). Furthermore, the presence of HCBS may influence the timing of discharge from institutional settings like SNFs, potentially shortening the length of stay by providing an additional layer of support in home-based settings. To address the Andersen model's emphasis on individual predisposing characteristics, our analysis includes a secondary approach using individual fixed effects. This methodology allows us to account for unobserved, time-invariant personal factors that could influence healthcare service utilization, further aligning our analysis with the behavioral model's comprehensive view of healthcare decision-making processes.

3 | METHODS

3.1 | Data

We linked several national datasets for the years 2015–2018, including Medicare, Medicaid, the nursing home minimum data set (MDS),

and the Outcome and Assessment Information Set (OASIS), at the individual level. For Medicare data, we used the Medicare Master Beneficiary Summary File (MBSF), Medicare Provider and Analysis Review (MedPAR), SNF claims data, and home health claims data. MBSF data include Medicare beneficiary enrollment information, Medicare–Medicaid dual status, and Medicare Advantage (MA) enrollment. MedPAR contains information about the use of inpatient care, including acute care hospitals and SNFs. Medicare home health claims capture episodes of Medicare-funded home health. For Medicaid, the T-MSIS Analytic Files (TAF) Personal Summary (PS) file includes data on beneficiaries' demographic characteristics, monthly Medicaid managed care enrollment and waiver enrollment, and the TAF Other Services (OT) file includes the use and type of services including HCBS. The MDS and OASIS contain federally required comprehensive assessment data for all clients, regardless of payment sources, who use Medicare- or Medicaid-certified SNFs and home health agencies. These data sets provide detailed information on individuals' start and end dates of services regardless of payer.

3.2 | Sample

The study sample includes community-dwelling duals who had an eligible index hospitalization between April 1, 2016, and September 30, 2018. This population was identified as those who were 65 years or older and were dually enrolled in Medicare (including both traditional Medicare and MA) and Medicaid at the time of hospital admission and did not receive any nursing home care in the prior 100 days. The index hospitalizations were defined as Medicare-covered acute hospitalizations that were at least 3 days long and with no other hospitalizations or PAC use in the 100 days prior to it. Alternative look back periods, for example, 60 days, were considered, but we decided to use the 100-day look back period as it minimizes the influence of recent PAC use on subsequent care decisions, and the number of hospitalizations being excluded with 60- or 100-day look back periods was relatively close (15.7% vs. 18.9% of all hospitalizations). As we focus on individuals who used HCBS prior to hospitalization as an enabling variable, we excluded people who newly started to use HCBS only after the index hospitalization. We also excluded those who were discharged from the hospital to hospice, as the needs for PAC among end-of-life patients are different.

3.3 | Measures

To provide a comprehensive view of how HCBS use is associated with the use of PAC after an index hospitalization, we included several outcome variables to measure PAC use, including whether an individual used (1) any PAC (including SNF and home health), (2) SNF for PAC, (3) home health for PAC, (4) home health versus SNF use, conditional on any PAC (SNF or home health) use, and (5) the SNF length of stay conditional on using SNF. We excluded the small percentage (<3%) of patients with a hospitalization who were discharged to an Inpatient

Rehabilitation Facility or a Long-Term Care Hospital for PAC, as we did not have assessment data from those settings and therefore could not identify stays among MA enrollees. Following prior literature, we required the gap between hospital discharge and PAC admission to be 1 day or less for SNF and 30 days or less for home health.[14] The SNF length of stay was calculated based on SNF claims in MedPAR. As the SNF claims are not complete for beneficiaries who enroll in MA and the date that SNF stay transitioned into custodian care cannot be identified from MDS data, only fee-for-service (FFS) beneficiaries are included in the sample for analysis of SNF length of stay. For all other outcomes, both FFS and MA enrollees are included in our main analyses.

The independent variable of interest, use of HCBS prior to the index hospitalization, was constructed based on Medicaid TAF data. An individual is identified as an HCBS user if they were enrolled in a 1915(c) aged or aged/disabled HCBS waiver for at least 1 month during the 90 days before index hospitalization, and/or used any Medicaid HCBS services, either through a 1915(c) waiver or through state plan offerings,[15] in the 90 days prior to index hospitalization.

For controls, reflecting the Andersen Behavioral Model, our selection integrates individual-level covariates related to PAC use, emphasizing the model's components of personal health practices and the external environment's influence on healthcare utilization. These include sociodemographic characteristics (age, gender, and rurality of the county of residence), insurance characteristics (original reason for Medicare entitlement, enrollment in MA, and enrollment in Medicaid managed care), and health-related characteristics (number of hospitalizations in the past year, number of institutional PAC admissions in the past year, characteristics of the index hospitalization (type of index hospitalization [surgical vs. medical, elective vs. urgent], weights of diagnosis-related group [DRG], length of stay), and diagnoses of 31 conditions that are included in the Elixhauser comorbidity index).[16]

3.4 | Statistical analysis

We first conducted a descriptive analysis of the individual characteristics of the study cohort. We compared the unadjusted individual characteristics, such as sociodemographics, insurance coverage, characteristics of index hospitalization, comorbidities, and use of PAC, between HCBS users and nonusers.

In the main analysis, we used a propensity score weighting strategy (inverse probability weighting) at the individual level to ensure that HCBS users and nonusers were comparable on observable characteristics. The propensity scores were derived from logistic regression models, developed with the goal of balancing the treatment (HCBS users) and control (non-HCBS users) groups. These models incorporated a comprehensive list of individual-level factors selected for their relevance to healthcare utilization patterns and their potential to influence the decision to use HCBS or institutional PAC. Specifically, the model included age and gender, reflecting basic demographic influences on healthcare needs; insurance coverage, to

account for variation in access to services; history of hospitalization and institutional PAC use, as indicators of prior healthcare needs and patterns; characteristics of the index hospitalization, such as length of stay and discharge disposition, to capture the immediate context influencing PAC decisions; and diagnosed health conditions, chosen for their known impact on PAC requirements. These variables were selected based on a review of the literature and available evidence indicating their significance in predicting the use of PAC services, thereby ensuring a robust and informed model for estimating propensity scores. For all the stratified analyses, propensity score weighting was conducted with weights for specific subgroups.

Balance checks were conducted before and after the propensity score weighting (Appendix Figure 2). While HCBS users and nonusers were noticeably different, the two groups were balanced, that is, standardized difference <0.1,[17] on all covariates after the propensity score weighting was applied.

Using the propensity score weights described above, we conducted multivariate regression analyses using a repeated cross-sectional study design. The first part of the main analysis was to estimate linear probability models at the individual level with hospital fixed effects and robust standard errors for each of the five outcomes described in the Measures section, among duals with qualified index hospitalizations. To avoid over-sampling individuals with frequent hospitalizations, we randomly selected one hospitalization if an individual had multiple eligible index hospitalizations during the study period for this analysis (analytical sample $N = 887,598$ hospital discharges). The hospital fixed effects account for facility-level unobserved time-invariant factors, such as the hospital's practice patterns of discharging, which may affect patients' PAC use. Hospital fixed effects also account for time-invariant county or state characteristics, which may otherwise be a significant source of confounding often seen in cross-sectional studies. In addition, we controlled for individual characteristics listed in the Measures section as well as year dummy variables.

However, this hospital fixed-effects analysis may suffer from individual-level confounders such as personal preferences over PAC options and the availability of family caregivers, factors that the propensity score weighting may not address unless they are correlated with observable characteristics. Thus, in a secondary analysis, we used a subsample of older duals who had multiple index hospitalizations during the study period, including 231,435 individuals and 474,929 hospital discharges, to estimate discharge-level linear models including individual fixed effects, with multiple discharges per individual. By including individual-level fixed effects, this analysis accounts for all measured and unmeasured individual-level characteristics that are time-invariant, thus minimizing confounding at the individual level using subjects as controls for themselves over time. We present both analyses because these two approaches entail trade-offs; the hospital-level fixed-effects analysis uses more of the sample and therefore maximizes external validity, while the individual-level fixed-effects analysis maximizes internal validity for the smaller subset of people with multiple hospitalizations.

In addition to the main analysis that includes all older duals with a qualified hospitalization, we conducted stratified analyses to explore

potential variation in the relationship between HCBS and PAC use across different populations. We first stratified our sample based on race and ethnicity (non-Hispanic White, Black, Hispanic, other), to account for known disparities in access to and outcomes of care, which may influence utilization patterns of HCBS and PAC.[18,19] We then stratified the sample by type of hospitalization (surgical vs. medical) and by common health conditions for the index hospitalization (e.g., septicemia, major joint replacement, heart failure, stroke, COPD, and pneumonia) to understand whether the impact of HCBS on PAC use varies by the acute care need, reflecting differing care pathways and recovery processes. The analysis was also stratified by the diagnosis of Alzheimer's disease and related dementia (ADRD) prior to index hospitalization, acknowledging the common frailty and unique challenges and needs of this population. Analyses of the subgroup of patients with ADRD were limited to FFS Medicare beneficiaries, as the ADRD indicator from Medicare Chronic Condition File is only reliable for FFS beneficiaries. We then stratified the analysis by whether the patient was identified as having high need, defined by a modified definition based on CMS High Need Population ACO and Independence at Home criteria.[20,21] Next, we stratified the sample by insurance status (Medicare FFS vs. MA, Medicaid FFS vs. Medicaid managed care, original reason for Medicare eligibility), and by whether the individual lived in a rural county. Finally, we stratified the sample by whether the index hospitalization was elective, and by whether this hospitalization could be considered nondiscretionary, referring to those hospitalizations resulting from conditions for which a hospital admission is almost always advised.[14]

We used linear models for primary analyses for ease of interpretation. To check the robustness of our results to this decision, we employed alternative modeling specifications. In these robustness checks, for the four binary outcomes, we used logistic regressions, and for SNF length of stay, we used Poisson regression and negative binomial regression. All the alternative models included hospital fixed effects.

4 | RESULTS

4.1 | Descriptive analysis

Table 1 compares the unadjusted, non-propensity-score-weighted individual characteristics of duals who did and did not use HCBS within the 90 days prior to index hospitalization. 55.8% of older duals in our sample were Medicaid HCBS users. Overall, not surprisingly, HCBS users are older, are less likely to have been eligible for Medicare due to age, are more likely to have been hospitalized and have used institutional PAC in the past year, and have a higher number of health conditions compared with nonusers.

4.2 | Main analysis

The results from our main analysis (Figure 1 and Table 2) suggest that having used any HCBS prior to index hospitalization was associated with a 5.6 percentage-point higher likelihood of using any PAC (SNF or home health), an 8.1 percentage-point higher likelihood of home health use and a 2.6 percentage-point lower likelihood of using SNF. Conditional on using either SNF or home health after the index hospitalization, prior HCBS use was associated with a 9.2 percentage-point higher likelihood of using home health (vs. SNF). Among those who were discharged to SNF after the index hospitalization, prior HCBS use was associated with a 1.97-day shorter SNF stay. In other words, HCBS use was associated with higher absolute probability of use of home health and a relative shift toward home-based care and shorter SNF stays. Full results for all covariates for the main models are presented in Appendix Table 1.

In the secondary analysis, using the cohort of duals with multiple hospital discharges and including individual-level fixed effects, we found that the use of HCBS prior to the index hospitalization was not significantly associated with PAC use overall or with SNF length of stay. It was associated with 2.7 percentage-point higher likelihood of home health PAC and 2.2 percentage-point lower likelihood of SNF use (Table 3).

4.3 | Stratified analysis

The results for stratified analysis from subgroups are presented in Figure 1 and Appendix Tables 2–5. While the results from most subgroups were mostly consistent with the overall analysis, there were exceptions. Table 4 presents the regression results for a highlighted subgroup where the magnitudes of effect are substantially larger: beneficiaries with ADRD. Being an HCBS user with ADRD was associated with higher likelihood of using home health and lower likelihood of using SNF, with magnitudes such that there was lower overall PAC use. This is similar to the individual fixed-effects results in exhibiting an absolute shift toward home health, but with the addition of decreased overall PAC use. On the other hand, among individuals who received joint replacement during their index hospitalization, the use of HCBS was associated with lower home health use and higher SNF use. This somewhat surprising result is further discussed in the Section 5 and in Appendix Table 7 and Figure 3. The results from sensitivity analysis with alternative modeling specifications were generally consistent with the main analysis (Appendix Table 6).

5 | DISCUSSION

Growing trends in Medicare spending on PAC, expansions of Medicaid HCBS, and general shifts toward home-based models of care beg the question of how these programs interact in the PAC space. Specifically, the use of Medicaid HCBS is likely to influence the choices of Medicare PAC setting. In this article, we aimed to empirically assess how Medicaid-funded HCBS influence the utilization of Medicare-funded PAC, specifically in terms of choices between SNF and home health services among dually enrolled beneficiaries. Consistent with our hypotheses, we found that the use of Medicaid HCBS was

TABLE 1 Individual characteristics by HCBS use, unadjusted and unweighted.

	Dual HCBS existing user	Dual non-HCBS user
	N = 495,385 (55.8%)	N = 392,213 (44.2%)
Demographics		
Age (mean)	77.9	75.3
Male	30.8	40.4
Race		
Non-Hispanic White	50.3	48.9
Black	20.4	19.1
Asian/Pacific Islander	8.5	6.7
American Indian/Alaska Native	0.9	1.2
Hispanic	18.2	22.2
Other	1.1	0.9
Missing	0.7	0.9
Insurance coverage		
Medicare original reason (old age)	67.5	76.2
Medicaid managed care	46.4	37.1
Medicare advantage	31.3	38.8
Hospitalization		
Hospitalization in the past year		
No hospitalization	69.3	78.1
Once	16.9	13.1
More than one	13.7	8.8
Institutional PAC use in the past year		
No use	88.5	92.4
Once	1.7	1.1
More than one	9.8	6.5
Index surgical (ref: medical)	22.1	29.0
Index elective (ref: emergency/urgent)	10.0	12.3
Index length of stay (mean)	5.9	6.0
Index DRG Weights (mean)	1.6	1.7
Health condition		
Total Elixhauser groups per record (mean)	4.6	4.1
Congestive heart failure	32.1	24.4
Cardiac arrhythmia	32.3	28.6
Valvular disease	10.0	9.5
Pulmonary circulation disorders	7.4	6.1
Peripheral vascular disorders	11.0	10.8
Hypertension uncomplicated	43.6	48.6
Hypertension complicated	40.7	32.0
Paralysis	2.7	2.6

(Continues)

TABLE 1 (Continued)

	Dual HCBS existing user	Dual non-HCBS user
	N = 495,385 (55.8%)	N = 392,213 (44.2%)
Other neurological disorders	18.8	14.3
Chronic pulmonary disease	36.6	30.1
Diabetes uncomplicated	19.5	18.3
Diabetes complicated	28.2	22.2
Hypothyroidism	19.8	15.9
Renal failure	30.6	23.9
Liver disease	4.4	5.7
Peptic ulcer disease excluding bleeding	1.1	1.3
AIDS/HIV	0.2	0.3
Lymphoma	0.8	0.9
Metastatic cancer	2.1	2.9
Solid tumor without metastasis	5.3	7.2
Rheumatoid arthritis/collagen	4.2	3.2
Coagulopathy	7.2	7.5
Obesity	17.7	14.6
Weight loss	8.9	9.2
Fluid and electrolyte disorders	42.1	40.2
Blood loss anemia	1.3	1.3
Deficiency anemia	6.1	5.7
Alcohol abuse	2.6	5.4
Drug abuse	2.4	3.5
Psychoses	3.4	3.0
Depression	16.7	13.2
Outcome—PAC use		
1. No PAC	41.9	51.1
2. Institutional	31.2	31.3
3. Home health	26.9	17.6

Abbreviations: DRG, diagnosis-related group; HCBS, home- and community-based services; HIV/AIDS, human immunodeficiency virus/acquired immunodeficiency syndrome; PAC, post-acute care.

associated with a significant shift toward Medicare home health and away from SNF. More specifically, we found HCBS use was associated with a 9 percentage-point increase in the use of home health relative to SNF, conditional on using PAC, and a meaningful reduction in length of stay for those using SNF. In our secondary analysis, which examined the subset of individuals with multiple hospitalizations but arguably controlled better for unmeasured individual attributes, the shift toward home-based care was absolute as well as relative, with no overall change in PAC use. Reflecting on the Andersen Behavioral Model, our analysis suggests that the availability of Medicaid HCBS is closely associated with a choice for home-based over institutional
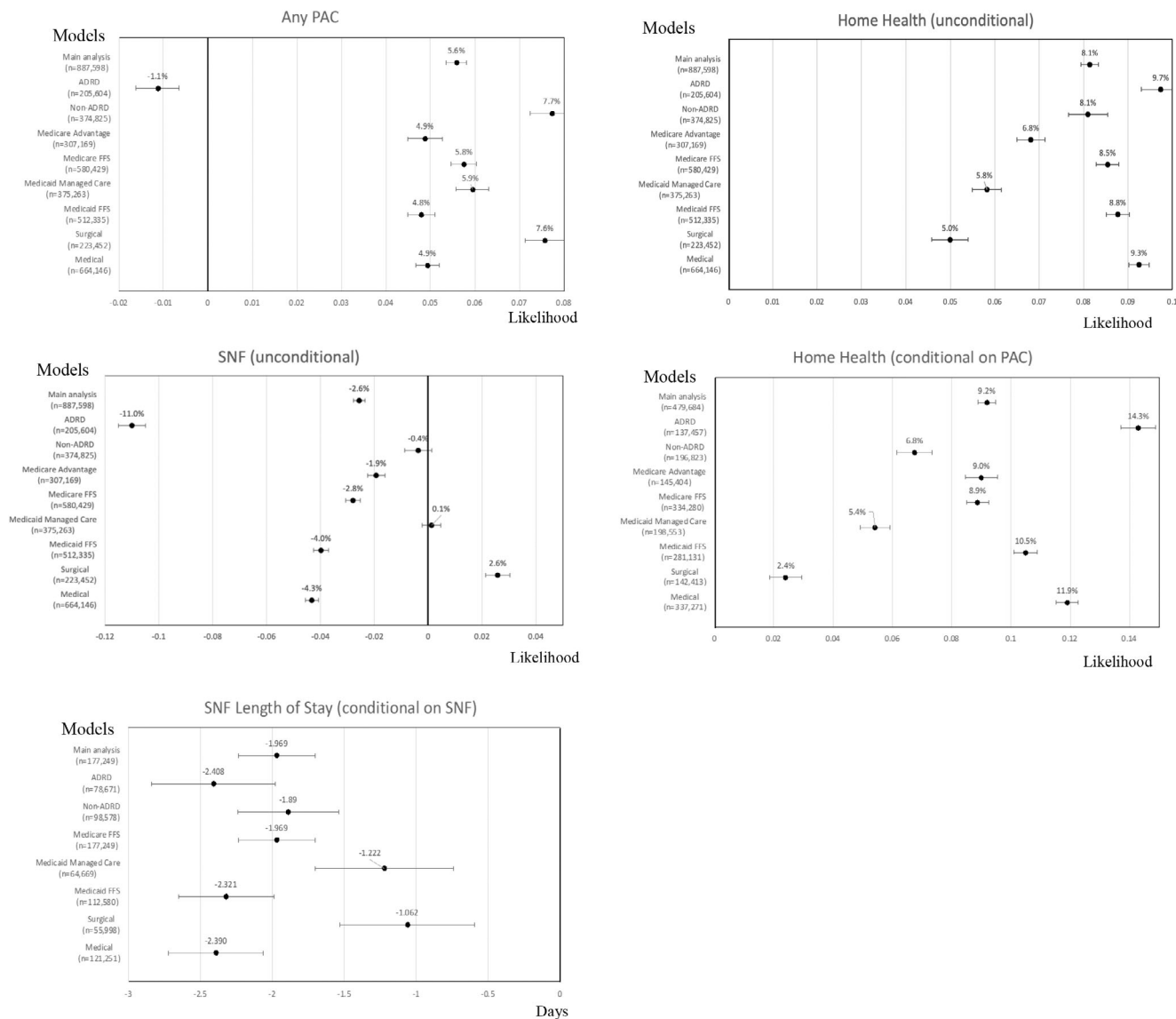
FIGURE 1 Effects of prior Medicaid HCBS use on Medicare PAC utilization: Results from main model and selected subgroups. For each line, the point and the number above indicate the point estimate, and the line indicates 95% confidence interval. ADRD, Alzheimer's decease and related dementias; FFS, fee-for-service; HCBS, home- and community-based services; PAC, post-acute care; SNF, skilled nursing facilities.

PAC. This association reflects the interplay between individual predispositions and the resources available, aligning with the model's framework for understanding PAC decisions.

The trajectory of our findings aligns with previous research, underscoring the observed decline in SNF utilization under various alternative payment models. However, our study sheds new light by pinpointing an uptick in Medicare home health use that can be tied directly to Medicaid HCBS use. This suggests that beyond merely steering beneficiaries away from institutional PAC, Medicaid HCBS plays a pivotal role in bolstering home-based Medicare PAC options. Such insights underscore the nuanced and multifaceted role of Medicaid HCBS in shaping PAC decisions.

Our findings suggest several potential synergies between Medicaid HCBS and Medicare home health. First, we find an absolute decrease in the use of SNF associated with Medicaid HCBS use,

which suggests a potential substitution between home health and SNF among HCBS users. As HCBS users have confirmed access to supportive care in the community, they may be more able to return home after being hospitalized and may be more confident in choosing to receive home health over SNF. Second, although our results indicating an absolute increase in overall PAC were weaker in that they emerged from our main model and not the individual fixed-effects model, they may also suggest a complementary relationship between Medicare PAC and Medicaid HCBS. Patients and families with prior HCBS use are likely to have existing connections with care providers and familiarity with seeking care, connections that may serve to enable Medicare PAC access after being hospitalized.

While most previous studies limited their samples to duals with Medicare and Medicaid FFS coverage, we took advantage of our multiple data sources to include beneficiaries enrolled in MA and Medicaid

TABLE 2 Effects of prior Medicaid HCBS use on Medicare PAC utilization: Regression results from main analysis.

Variables	(1) Any PAC	(2) Home health unconditional	(3) SNF unconditional	(4) Home health conditional on PAC	(5) SNF LOS
HCBS user	0.0558***	0.0814***	−0.0256***	0.0919***	−1.969***
	(0.00116)	(0.00101)	(0.00109)	(0.00156)	(0.136)
Age	0.0119***	0.000944***	0.0110***	−0.00758***	0.180***
	(7.01e-05)	(6.23e-05)	(6.77e-05)	(9.40e-05)	(0.00843)
Sex	−0.0357***	−0.0215***	−0.0142***	−0.0111***	0.120
	(0.00117)	(0.00101)	(0.00108)	(0.00159)	(0.141)
Rural	−0.0190***	−0.00180	−0.0172***	0.0107***	1.208***
	(0.00234)	(0.00200)	(0.00221)	(0.00307)	(0.262)
Medicare original reason: old age	−0.0234***	−0.00572***	−0.0177***	0.0138***	−0.863***
	(0.00131)	(0.00113)	(0.00122)	(0.00178)	(0.158)
Medicaid managed care	−0.00578***	0.0254***	−0.0312***	0.0435***	−1.786***
	(0.00150)	(0.00127)	(0.00140)	(0.00208)	(0.212)
Medicare advantage	−0.107***	−0.0711***	−0.0359***	−0.0407***	
	(0.00123)	(0.00105)	(0.00114)	(0.00168)	
Hospitalization in the past year, more than one	−0.0333***	0.0209***	−0.0541***	0.0654***	−1.621***
	(0.00220)	(0.00198)	(0.00199)	(0.00298)	(0.258)
Hospitalization in the past year, none	0.0330***	−0.0211***	0.0541***	−0.0715***	1.927***
	(0.00159)	(0.00142)	(0.00146)	(0.00220)	(0.191)
Institutional PAC in the past year, more than one	0.0468***	−0.0439***	0.0907***	−0.0972***	0.327
	(0.00509)	(0.00456)	(0.00521)	(0.00611)	(0.509)
Institutional PAC in the past year, none	−0.111***	0.0163***	−0.128***	0.114***	−3.342***
	(0.00476)	(0.00428)	(0.00484)	(0.00575)	(0.483)
Index hospitalization: DRG weights	−0.00409***	0.00977***	−0.0139***	0.0177***	−0.434***
	(0.000610)	(0.000513)	(0.000586)	(0.000698)	(0.0709)
Index hospitalization: Surgical	0.143***	−0.0151***	0.158***	−0.128***	2.459***
	(0.00171)	(0.00147)	(0.00168)	(0.00213)	(0.199)
Index hospitalization: Elective	0.0646***	0.0525***	0.0121***	0.0287***	−8.311***
	(0.00197)	(0.00178)	(0.00191)	(0.00258)	(0.211)
Index hospitalization: Length of stay	0.0150***	−0.00112***	0.0162***	−0.0120***	0.0792***
	(0.000156)	(0.000104)	(0.000159)	(0.000164)	(0.0151)
Constant	−0.418***	0.0909***	−0.508***	0.953***	22.57***
	(0.00741)	(0.00656)	(0.00725)	(0.00970)	(0.852)
Observations	887,598	887,598	887,598	479,684	177,249
R-squared	0.154	0.057	0.166	0.152	0.112

Note: All models are with propensity score weighting and hospital fixed effects. All models also have controlled for 31 health conditions, and the full results for all covariates are shown in Appendix Table 1. ***$p < 0.01$; **$p < 0.05$.

Abbreviations: DRG, diagnosis-related groups; HCBS, home- and community-based services; PAC, post-acute care.

managed care. Similar to FFS beneficiaries, analysis of MA enrollees and Medicaid managed care enrollees respectively showed a relative increase in home health use relative to SNF. It should be noted that our analysis indicated a smaller effect size among Medicaid managed care enrollees compared with the general dual-eligible population. This finding prompts further investigation into how integrated managed care models, such as Fully Integrated Dual Eligible Special Needs Plan (FIDE-SNP) and Program of All-Inclusive Care for the Elderly (PACE)

programs, influence post-acute care decisions. These models, designed to integrate care for dual-eligible individuals, may offer insights into optimizing HCBS to reduce reliance on institutional care, aligning financial incentives with patient-centered outcomes. As the shift from institutional PAC to more home-based care facilitated by Medicaid HCBS may be influenced not only by patient preferences but also by the availability of adequate supports for individuals with functional dependencies, this distinction is crucial for policymakers and program designers,

TABLE 3 Effects of prior Medicaid HCBS use on Medicare PAC utilization: Results from main analysis with individual fixed effects among a subgroup of duals who had multiple index hospitalizations.

Variables	(1) Any PAC	(2) Home health unconditional	(3) SNF unconditional	(4) Home health conditional on PAC	(5) SNF LOS
HCBS user	0.00432	0.0267***	−0.0223***	0.0380***	−0.946
	(0.00418)	(0.00394)	(0.00352)	(0.00828)	(1.083)
Observations	474,929	474,929	474,929	240,278	78,158
R-squared	0.685	0.630	0.710	0.823	0.860

Note: ***$p < 0.01$; **$p < 0.05$.

Abbreviations: HCBS, home- and community-based services; PAC, post-acute care; SNF, skilled nursing facilities.

TABLE 4 Effects of prior Medicaid HCBS use on Medicare PAC utilization: Results from the stratified analysis of Medicare fee-for-service beneficiaries with ADRD.

Variables	(1) Any PAC	(2) Home health unconditional	(3) SNF unconditional	(4) Home health conditional on PAC	(5) SNF LOS
HCBS user	−0.0130***	0.0974***	−0.110***	0.143***	−2.408***
	(0.00248)	(0.00226)	(0.00258)	(0.00302)	(0.219)
Observations	205,604	205,604	205,604	137,457	78,671
R-squared	0.126	0.085	0.170	0.175	0.128

Note: ***$p < 0.01$; **$p < 0.05$.

Abbreviations: ADRD, Alzheimer's decease and related dementias; HCBS, home- and community-based services; PAC, post-acute care; SNF, skilled nursing facilities.

especially for programs such as FIDE-SNPs and ACOs, where integrating specific types of HCBS supports could further encourage this shift. The emergence of "SNF at Home" programs underscores the necessity of providing comprehensive home health aide support alongside skilled services to meet the functional needs of patients, which may improve the availability of in-home supports.

Our results suggest that the role of HCBS may be different for specific subgroups of duals. For example, for older duals with ADRD, HCBS was not only associated with a shift toward home health and away from SNF but also an absolute and large decrease in institutional and overall PAC use. As people with ADRD often rely on caregivers for supervision and for help with daily activities, having access to HCBS may enable avoidance of PAC altogether and to choose home health over SNF if PAC is necessary. The larger reduction in SNF length of stay is also consistent with this explanation. For people in the joint replacement subgroup, our study found an unusual relationship between HCBS use and PAC utilization. Existing HCBS users showed less home health use and more SNF use, deviating from our primary findings. One possible explanation is that as Medicare introduced alternative payment models between 2006 and 2015 to encourage home health substitution for institutional PAC, relatively healthy Medicare beneficiaries may have become the target for this SNF-to-home shift.[22,23] Dually eligible HCBS users, being a particularly vulnerable group, may be less affected by such practices, thus exhibiting higher use of SNF as PAC compared with their healthier counterparts.

This study has several potential limitations. The most important concern is that the relationship between the use of Medicaid HCBS and the use of Medicare PAC is subject to potential selection bias, given our observational data. For example, individuals who use Medicaid HCBS may have more severe disabilities, thus requiring more intensive care than those who do not use HCBS. Also, the prior use of HCBS may reflect the preference of returning home and use home health after hospitalization. To minimize the selection bias, this study employed several strategies. First, we applied propensity score weighting to balance HCBS users and nonusers on their observable characteristics. While the use of propensity scores does not eliminate all threats to causality, especially unobserved heterogeneity and potential model misspecification, it does significantly mitigate some confounding related to observable variables and measured covariates. Second, we included hospital fixed effects in the analysis for all older duals to account for time-invariant factors at hospital and greater geographic level, and included individual fixed effects in the analysis for duals with multiple hospitalizations to account for time-invariant personal characteristics. It should be noted that evolving aspects of individual circumstances, including changes in family support, could impact HCBS use in ways not fully captured by our model. Third, our findings showed that HCBS use was associated with more home health relative to SNF. As these findings are in the opposite direction of any selection bias by indication, our results are more likely an underestimate than an overestimate. Additionally, while the study examined HCBS as a whole, different types of HCBS

may have varying impacts on PAC use, which could be explored in future research.

Given recent policy priorities to reduce Medicare PAC spending and the tremendous growth in Medicaid HCBS in the past few decades, research examining synergies between Medicaid HCBS use and Medicare PAC use is important and timely. We find that these synergies are significant, and that Medicaid HCBS use serves to enable more home-based care and avoidance of institutions for Medicare PAC. This constitutes a significant unmeasured benefit of HCBS expansion in a time when such expansions are being considered by policymakers. It may also inform current and future Medicare–Medicaid coordination initiatives and payment models targeted at reducing frictions and increasing synergies across the two programs for the critical population enrolled in both.

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SUPPORTING INFORMATION
Additional supporting information can be found online in the Supporting Information section at the end of this article.