

# Care Transition Management and Patient Outcomes in Hospitalized Medicare Beneficiaries

Mariétou H. Ouayogodé, PhD; Brianna Hardy, BS; John Mullahy, PhD; Maureen A. Smith, MD, PhD, MPH; and Ellen Meara, PhD

Transitions of care have emerged as an important gap in health care delivery where adverse events, including hospital readmissions, can occur due to the potential for miscommunications, lapses in quality, and delayed care when patients transition across settings.<sup>1</sup> Inefficient care transitions may also contribute to higher spending. Since 2012, the Hospital Readmissions Reduction Program (HRRP) has imposed financial penalties on hospitals with excess readmissions.<sup>2</sup> In response, hospitals have prioritized strategies to facilitate care transitions, ensure patient safety, and avoid unplanned readmissions. Such care transition activities (CTAs), largely nonbillable, include engaging patients and their caregivers in discharge planning,<sup>3</sup> medication reconciliation,<sup>4</sup> and follow-up appointments<sup>5</sup>; following up with the patient post discharge; transmitting discharge summaries to the patient's posthospital care team<sup>6</sup>; and using dedicated patient navigators, care managers, or health coaches after hospital discharge.<sup>7</sup> Patient navigators facilitate patient interactions with complicated systems to optimize postdischarge care,<sup>7</sup> whereas care/case managers provide discharge planning pre-discharge and arrange for postdischarge outpatient follow-up.<sup>8</sup> Care transition health coaches may provide in-home patient visits soon after discharge to identify doctors, appointments, and medications to coordinate care across providers.<sup>9</sup> Health coaches also discuss medication management and discharge instructions and help coordinate follow-up appointments. Health coaches may use periodic phone calls to assess patients' needs.

To reduce readmission rates, improve quality of care, and reduce costs,<sup>10</sup> in 2013 CMS adopted transitional care management (TCM) payment codes as part of its shift toward value-based care. Specifically, TCM codes aim to improve handoffs between inpatient and community settings. These codes encourage physicians to provide evidence-based TCM services within 30 days after discharge to the community from inpatient settings (eg, hospitals).<sup>11</sup> Such follow-up care, which qualifies for TCM billing and reimbursement, usually occurs post discharge and is delivered by primary care providers in any of 3 places: physician offices, hospital outpatient departments, or at home.<sup>12</sup> To bill for TCM, an eligible provider

## ABSTRACT

**OBJECTIVES:** To assess whether discharging hospitals' self-reported care transition activities (CTAs) were associated with transitional care management (TCM) claims following discharge to the community and whether CTAs and TCM were associated with better patient outcomes.

**STUDY DESIGN:** Cross-sectional study of 424,115 hospitalized Medicare fee-for-service beneficiaries 66 years and older who were discharged to the community in 2017 and attributed to 659 hospitals in the 2017-2018 National Survey of Healthcare Organizations and Systems (response rate, 46.5%). Of these beneficiaries, 76,156 were categorized into a Hospital Readmissions Reduction Program (HRRP) cohort based on admission principal diagnoses.

**METHODS:** Using logistic regression, we examined the association between survey-based hospital-reported CTAs and an attributed beneficiary's TCM claim. We assessed the associations between hospital CTAs and TCM and beneficiary spending, utilization, and mortality in linear (continuous outcomes) and logistic (binary outcomes) regressions.

**RESULTS:** Beneficiaries attributed to hospitals reporting high (top tertile vs bottom tertile) CTA had a higher probability of TCM after discharge by 3 percentage points. TCM was associated with lower 90-day episode spending (−\$2803;  $P < .001$ ) and improved quality (−28.7 30-day readmissions/1000 beneficiaries;  $P < .001$ ; −29.7 deaths/1000 beneficiaries;  $P < .001$ ), and greater use of evaluation and management visits (491/1000 beneficiaries;  $P = .001$ ). Billing for TCM was associated with significantly lower spending, emergency department visits, hospitalizations, readmissions, and 90-day mortality in the HRRP cohort. Significant utilization reductions were estimated for beneficiaries attributed to high-CTA hospitals.

**CONCLUSIONS:** Beyond recent increases in provider TCM compensation and relaxed billing restrictions, hospitals should be encouraged to increase CTA and to enhance care transitions to improve patient outcomes and lower spending.

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must contact the beneficiary or caregiver within 2 business days following discharge and render a follow-up face-to-face visit within 7 or 14 days of discharge based on medical complexity.<sup>13</sup> These primary care providers rely on hospital discharge summaries and likely on all other CTAs to follow up with appropriate care. Providers whose billing for TCM is approved receive enhanced compensation that varies with patients' needs.<sup>14</sup>

Despite evidence supporting transition care,<sup>13,15</sup> TCM use has been low: Only 9.3% of eligible beneficiaries had TCM billing following discharge in 2016.<sup>16</sup> Little is known about whether and to what extent a discharging hospital's nonbillable CTAs may signal provision of reimbursed TCM services. Although individual hospital CTAs (aforementioned) reduced readmission rates in clinical trials,<sup>4,5,7,17</sup> they are likely implemented simultaneously; however, it is unclear whether implementing more-comprehensive CTAs is beneficial for uptake of billable TCM and is associated with better patient outcomes, separately from TCM.

To fill these knowledge gaps, we first estimated the association between hospitals' self-reported CTAs and patients' claims for TCM. Second, we explored whether spending, utilization, and outcomes differ according to receipt of TCM and discharging hospitals' CTAs.

## STUDY DATA AND METHODS

We used 2 primary data sources for this cross-sectional study: hospital responses from the 2017-2018 National Survey of Healthcare Organizations and Systems (NSHOS)<sup>18</sup> that indicated hospitals' self-reported CTAs, and patient outcomes and TCMs drawn from 2017 Medicare claims for beneficiaries discharged to the community from hospitals in the NSHOS. This study was reviewed and approved by the Dartmouth institutional review board.

### NSHOS Survey Data

The NSHOS, conducted between June 2017 and August 2018, is a nationally representative survey of short-term, acute care, and critical access hospitals (response rate, 46.5%) that has been described previously.<sup>18-20</sup> A total of 757 responses were obtained, of which 18 were excluded for not meeting the sampling frame criteria, leaving 739 responses to analyze. The NSHOS included questions on hospital organizational characteristics and several questions relevant to hospitalized patients undergoing hospital-to-community transitions (**eAppendix Table 1** [eAppendix available at [ajmc.com](http://ajmc.com)]). Hospital zip code was utilized to determine urban, suburban (micropolitan), and rural areas as well as US Census Bureau region (Northeast, Midwest, South, and West).<sup>21,22</sup>

One multipart survey question asked about 7 CTAs designed to reduce risks of readmission: medication reconciliation, telephone follow-up, in-home follow-up, standardized processes for follow-up

## TAKEAWAY POINTS

Due to low uptake of Medicare-reimbursed transitional care management (TCM), we assessed the facilitating role of discharging hospitals' reported care transition activities (CTAs) on TCM uptake and whether CTAs and TCM were associated with better patient outcomes.

- ▶ A higher level of hospital-reported CTAs (including medication reconciliation, telephone/in-home follow-up, standardized processes for follow-up with primary/specialty care, timely sharing of discharge summaries, and use of patient navigators/care managers/health coaches following discharge) was associated with a 3-percentage point higher likelihood of TCM.
- ▶ Patients discharged from hospitals with higher CTA (vs lower CTA) and those receiving TCM had lower spending, hospitalization, emergency department visits, 30-day readmissions, and 90-day mortality (TCM only) across different conditions.

with primary/specialty care, discharge summaries, use of patient navigators or care managers in hospital, and use of care managers or health coaches following discharge (**eAppendix Tables 1 and 2**).<sup>20</sup> To form a CTA index, when a hospital reported that a CTA was used for "most" or "all" patients, we assigned each response a value of 1 (vs 0 for "none" or "some"), resulting in a total of 0 to 7 points maximum. This CTA index was highly correlated ( $r = .98$ ), with the first factor score based on these 7 items. We used the simple (0-7) CTA index for ease of interpretation, and hospitals were categorized into tertiles based on their CTA index. In analyses predicting patients' receipt of TCM post discharge, the exposure variable was whether a discharged patient was attributed to a hospital with top- or middle-tertile vs bottom-tertile CTA. In the second part of this study—assessing differences in beneficiary outcomes—both a Medicare claim for TCM and hospital CTAs were the variables of interest.

### Medicare Fee-for-Service Beneficiary Claims

Patients' physician services/carrier (Part B) and Medicare Provider Analysis and Review (MedPAR) claims were used to obtain information on care patterns, diagnoses, utilization, and spending. The Master Beneficiary Summary File captured patient demographics, enrollment status, zip code, and date of death.

### Hospitalized Patient Population

We studied Medicare fee-for-service beneficiaries 66 years and older with Parts A and B coverage throughout 2017 and no managed care who were residing in the 50 states or the District of Columbia. We further limited our sample to beneficiaries with an eligible hospital discharge to the community. Each beneficiary contributed 1 sample observation. To consider whether implementing CTAs and TCM may have different associations within (vs outside) value-based programs, we defined a subpopulation: the HRRP patient cohort ( $n = 76,156$ ) discharged with a principal hospital diagnosis of acute myocardial infarction (AMI),<sup>23</sup> chronic obstructive pulmonary disease (COPD),<sup>24</sup> congestive heart failure (CHF),<sup>25</sup> or pneumonia<sup>26</sup> (**eAppendix Table 3**). We also focused on the subpopulation of HRRP patients because prior transitional care interventions had targeted patients with heart failure or AMI and other higher-risk and chronically ill older patients.<sup>27</sup>

## Patient Attribution to NSHOS Hospitals

NSHOS hospitals were linked to Medicare claims data for hospitalized patients discharged to home in the latest year of Medicare claims available for this study (2017). Patients were attributed to a hospital based on plurality of 2017 admissions.<sup>28</sup> The hospital National Provider Identifier and hospital provider number or the CMS certification number were used to link hospitals in Medicare claims to NSHOS hospitals (2017-2018), resulting in 659 NSHOS hospitals linked with 424,115 attributed patients discharged to home in 2017. Each beneficiary's index stay represented the first hospitalization at their attributed hospital.

## Variable Descriptions

**Outcome variables.** The primary outcomes included claims-based measures of TCM, spending and health care utilization, and quality or mortality outcomes for hospitalized beneficiaries. Because the timing of face-to-face follow-up visits is critical for TCM billing, a TCM claim was identified if either of 2 *Current Procedural Terminology* (CPT) codes (99495, moderate medical complexity requiring a face-to-face visit within 14 days of discharge; or 99496, high medical complexity requiring a face-to-face visit within 7 days of discharge) appeared in claims within 30 days of an index discharge.<sup>29</sup> We used a 30-day window because CMS allowed practitioners to bill for TCM service within 30 days to ensure requirements were met for claims payment.<sup>11</sup> Patients potentially receiving appropriate follow-up calls but no face-to-face follow-up visits within the required time frame and patients with denied TCM claims could not be identified; they would be in the non-TCM group. We measured spending as total claims for 30 days and 90 days post discharge. Quality included unplanned 30-day readmissions per 1000 beneficiaries, and we measured 90-day mortality in 2017. Because transitional care is often initiated to complement primary care for adults with chronic diseases following an acute hospital or emergency department (ED) visit,<sup>28</sup> we also explored differences in other health care utilization encompassing care both within and outside the care transition period, measured by the annual evaluation and management (E&M) visits in ambulatory settings, acute care/critical access hospital hospitalizations, and ED visits not leading to admission (also reported per 1000 beneficiaries).

**Covariates.** Hospitals' self-reported characteristics included CTAs and organizational factors from the NSHOS. Organizational characteristics were measured with binary variables identifying hospital type (acute care, critical access, academic medical center, other)<sup>30</sup> and hospital size (measured by the overall number of physicians). We measured hospital participation in alternative payment models (APMs) with a dichotomous variable for any participation. APMs encourage care management across the continuum and offer financial incentives for improving quality and lowering cost of care, which may increase the use of TCM services. Geography was described by hospitals' urbanicity and census region.

Beneficiary-level covariates comprised demographic characteristics from claims including age, sex, race/ethnicity, residence in a

high-poverty census tract, Medicaid dual eligibility, and residence in a long-term nursing home. Beneficiaries' zip codes were used to identify residence in high-poverty census tracts ( $\geq 20\%$  of residents below the poverty line).<sup>30</sup> Nursing home residents were identified using Part B and MedPAR claims with an eligible place of service and CPT codes identifying use of a nursing facility.<sup>31</sup> We used *International Statistical Classification of Diseases, Tenth Revision* codes to identify patients with multimorbidity, defined as a dichotomous variable equaling 1 if the beneficiary had 2 or more chronic conditions<sup>32</sup> and chosen for their association with mortality and costs (complete conditions' definitions can be viewed in Ouayogodé et al<sup>31</sup>). For each beneficiary in 2017, we also included a Hierarchical Condition Category (HCC) score.<sup>33,34</sup>

## Statistical Analysis

The unit of analysis is the Medicare beneficiary. First, to assess the relationship between TCM services and self-reported CTAs, we employed multivariate logistic regressions estimating the likelihood of any 30-day TCM claim among discharged beneficiaries across the survey-measured hospital CTA index tertiles. For ease of interpretation, we reported the marginal change in probability of any TCM claim associated with CTA tertile. Regression models were estimated for all 424,115 beneficiaries and separately for the subset of 76,156 HRRP patients, controlling for patient and hospital covariates listed earlier.

Second, we modeled beneficiary outcomes as a function of hospital CTA index tertiles, whether the beneficiary received TCM at the individual level, controlling for patient and hospital covariates both overall and in the HRRP cohort. All estimates were weighted for survey sample frame and nonresponse, and SEs were clustered at the hospital level (**eAppendix**). We reestimated separate regression models, assessing the associations between beneficiary outcomes and CTA index tertiles and between beneficiary outcomes and TCM, controlling for the same covariates as in the main model.

# RESULTS

## Sample Hospitals

The hospital sample consisted of 659 hospitals with NSHOS data on CTAs and attributed beneficiaries (**Table 1**). Among those, 63.2% were acute care hospitals, 30.3% were critical access hospitals, 4.6% were academic medical centers, and the remaining 2.0% were identified as other hospital types. Hospitals had a mean of 54 physicians, and 16.0% of hospitals had more than 74 physicians ( $> 75$ th percentile of the number of physicians). Nearly half of hospitals (49.9%) were in urban areas, and 63.8% were in the Midwest and South. Three in 4 hospitals (76.1%) reported APM participation.

Hospitals reported wide variation in CTAs. Some activities were nearly universal. For example, 93.0% of hospitals reported providing medication reconciliation to most of or all their patients after discharge. Other commonly reported activities included

transmission of discharge summaries to clinicians (91.1%), followed by having a standardized process in place to ensure timely follow-up with primary/specialty care (67.6%) and telephone follow-up within 72 hours of discharge (63.4%). Rarer activities included providing in-home follow-up within 72 hours of discharge (10.2%) and using care managers/health coaches post discharge (25.0%). Aside from in-home follow-up post discharge (nearly 50% of top-tertile CTA hospitals), all other activities were reported by more than 91% of top-tertile hospitals (results not shown).

**Sample Medicare Beneficiaries**

We studied 424,115 beneficiaries attributed to NSHOS hospitals based on hospital discharge (Table 2). Of these, 76,156 (18.0% unweighted, 22.6% weighted for sampling frame and nonresponse) were admitted for HRRP conditions. The mean (SD) age was 77.7 (1.9) years in the full sample and 78.5 (2.0) years for beneficiaries admitted for HRRP conditions. Fifty-five percent of patients were female (53.6% in HRRP patients). Racial and ethnic minorities constituted approximately 11.0% of patients (9.1% in HRRP patients). One in 4 beneficiaries lived in high-poverty communities; 18.9% of beneficiaries in the full sample and 22.7% of HRRP patients were dually eligible for Medicare and Medicaid. Nursing home residents represented nearly one-fourth of patients. HRRP patients had relatively more beneficiaries with multimorbidity (63.2% vs 54.1% across all patients) and higher mean (SD) HCC scores (2.7 [0.4] in HRRP patients vs 2.2 [0.34] overall).

Characteristics of beneficiaries attributed to NSHOS respondents (n = 424,115) were generally similar to those attributed to nonrespondents (n = 1,737,227) (eAppendix Table 4).

**Multivariable Analysis**

**Hospital CTA and TCM uptake.** Hospital self-reported CTA was associated with receiving TCM (based on a claim): 3–percentage point higher likelihood (P = .009) for all patients attributed to hospitals in the top vs bottom tertile of CTA and similarly for the HRRP cohort (3–percentage point increase; P = .081) (Figure 1 and eAppendix Table 5, panel A).

**Beneficiary outcomes following hospital CTA and TCM.** Adjusted regressions suggested that higher CTA of discharging hospitals was associated with significantly fewer hospitalizations (–51.3/1000 beneficiaries in the HRRP cohort; P = .003) and fewer ED visits

**TABLE 1.** NSHOS Hospital Characteristics\*

Hospital characteristics	Overall	
	n or mean	% or SD
Number of hospitals responding (with attributed beneficiaries)	659	100.00%
Structural and environmental characteristics of hospitals		
Hospital type		
Acute care hospital	420	63.19%
Critical access hospital	173	30.26%
Academic medical center	52	4.55%
Other	14	2.01%
Hospital size, mean (SD) physicians		
Very small (≤25th percentile; ≤8 physicians)	171	31.32%
Small (> 25th to ≤50th percentile; > 8 to ≤26 physicians)	165	31.91%
Medium (> 50th to ≤75th percentile; > 26 to ≤74 physicians)	160	20.73%
Large (> 75th percentile; > 74 physicians)	163	16.04%
Urban (RUCA code = 1-3)	375	49.92%
Region		
Midwest	226	25.41%
Northeast	100	13.72%
South	207	38.44%
West	126	22.43%
Hospital in system that participates in any alternative payment and delivery models	515	76.05%
Care transition activities (1 = most or all patients)		
Medication reconciliation (how many receive)	624	93.04%
Telephone follow-up within 72 hours of discharge	460	63.43%
In-home follow-up within 72 hours of discharge	75	10.24%
Standardized process in place to ensure timely follow-up with primary/specialty care	459	67.61%
Discharge summaries transmitted to clinicians	591	91.11%
Use of patient navigator or care manager in hospital	373	53.80%
Use of care manager or health coach post discharge	162	24.96%
Care transition activity index (0-1), mean (SD)	0.58	0.21

NSHOS, National Survey of Healthcare Organizations and Systems; RUCA, rural-urban commuting area. \*Statistics are weighted for the NSHOS survey sampling frame and nonresponse. Values are n (%) unless noted.

(–91.2/1000 beneficiaries in the HRRP cohort; P = .019) but slightly higher 90-day mortality (3.6/1000 beneficiaries across all patients) (eAppendix Table 5, panel B).

Spending was lower among patients receiving TCM: –\$1920 for 30-day spending per beneficiary (P < .001) and –\$2803 for 90-day spending per beneficiary (P < .001) (Figure 2 and eAppendix Table 4, panel B). Spending was significantly lower in the HRRP cohort receiving TCM vs not (–\$934 for 30-day spending per beneficiary; P < .001; –\$1648 for 90-day spending per beneficiary; P < .001).

Patients receiving TCM (vs not) had more E&M visits in the full sample (491/1000 beneficiaries; P = .001) and in the HRRP cohort (762/1000 beneficiaries; P = .005) (Figure 2 and eAppendix Table 5, panel B). Patients receiving TCM had fewer hospitalizations (–24/1000 beneficiaries across all patients; P = .004; –29.8/1000 beneficiaries

**TABLE 2.** Beneficiary Characteristics Weighted for Survey Sampling Frame and Nonresponse (2017)<sup>a</sup>

Beneficiary characteristics	Full cohort	HRRP cohort
	n = 424,115 (100.00%)	n = 76,156 (22.56%)
HRRP cohort, <sup>b</sup> %	22.56%	100.00%
Pneumonia, %	8.05%	36.34%
Acute myocardial infarction, %	2.41%	8.81%
Congestive heart failure, %	5.34%	24.68%
Chronic obstructive pulmonary disease, %	6.75%	30.17%
<b>Demographic characteristics</b>		
Age in years, mean (SD)	77.68 (1.87)	78.47 (2.04)
Female, %	55.27%	53.62%
Race and ethnicity, %		
White	89.01%	90.87%
Black	5.51%	4.88%
Hispanic	1.76%	0.94%
Asian	1.03%	0.35%
Other	1.92%	1.45%
Lives in high-poverty (> 20%) zip code, %	23.60%	24.58%
Dual eligibility for Medicaid, %	18.90%	22.66%
Nursing home resident, %	23.88%	23.98%
Multimorbidities, <sup>c</sup> %	54.05%	63.18%
HCC score, mean (SD)	2.21 (0.34)	2.67 (0.43)
Transitional care management, %	12.68%	13.73%

HCC, Hierarchical Condition Category; HRRP, Hospital Readmissions Reduction Program; NSHOS, National Survey of Healthcare Organizations and Systems.

<sup>a</sup>Includes beneficiaries 66 years and older.

<sup>b</sup>Selected HRRP conditions included acute myocardial infarction, chronic obstructive pulmonary disease, congestive heart failure, and pneumonia. Characteristics of beneficiaries attributed to the NSHOS respondent hospitals were weighted for survey sampling frame and nonresponse.

<sup>c</sup>Selected chronic conditions included coronary artery disease, cancer, connective tissue disorders, congestive heart failure, diabetes, dementia, chronic obstructive pulmonary disease, hematologic or thrombotic disease, HIV infection or AIDS, immune disease, liver disease, Parkinson or Huntington disease, paralysis, peripheral vascular disease, renal disease, cerebral hemorrhage or stroke, severe mental illness, and substance use disorder. See eAppendix Table 4 for unweighted descriptive statistics for beneficiaries attributed to NSHOS respondent hospitals and beneficiaries attributed to nonrespondent hospitals.

in the HRRP cohort;  $P = .059$ ) and more ED visits across all patients (93/1000 beneficiaries;  $P < .001$ ) but fewer such visits in the HRRP cohort (−96/1000 beneficiaries;  $P < .001$ ). TCM service receipt was associated with fewer 30-day readmissions (−28.7/1000 beneficiaries across all patients;  $P < .001$ ; −38.5 in the HRRP cohort;  $P < .001$ ) and lower 90-day mortality (−29.7/1000 beneficiaries across all patients;  $P < .001$ ; −42.93/1000 beneficiaries in the HRRP cohort;  $P < .001$ ).

Results were largely robust when estimating the associations between beneficiary outcomes and higher CTA (eAppendix Table 6), except for 90-day mortality where the association became insignificant, and between beneficiary outcomes and TCM (eAppendix Table 7) separately.

## DISCUSSION

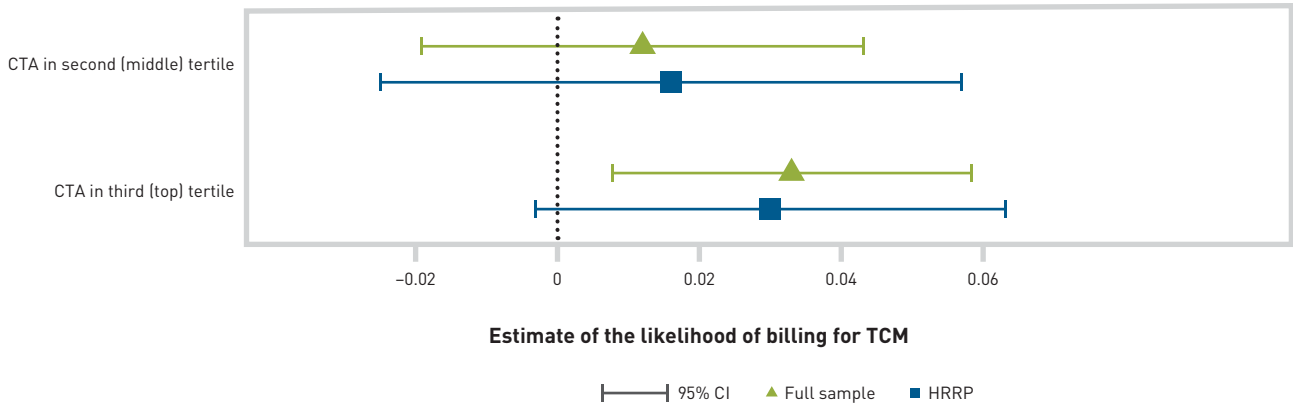
This study's results showed considerable variation in hospitals' self-reported CTAs. In general, beneficiaries discharged from hospitals reporting higher CTAs were more likely to receive TCM. TCM prevalence of 12.7% (13.7% in the HRRP cohort) in 2017 is higher than in previous years.<sup>13,16</sup> Relative to discharged patients without a TCM claim, patients receiving TCM had lower average spending, both overall and in the HRRP cohort. We also found TCM to be associated with more E&M visits, fewer ED visits (in HRRP patients), fewer hospitalizations, and, importantly, lower 30-day readmission and 90-day mortality rates on average across all patients and in HRRP patients. Higher E&M visits among patients with TCM suggest that TCM could be supplementing such services for discharged patients. The difference in magnitudes of spending differences across the full and HRRP samples could also be attributed in part to higher E&M visits in HRRP patients for those with TCM billing. Besides increasing the likelihood of TCM use, the discharging hospitals' higher CTAs were associated with fewer hospitalizations and ED visits in the HRRP cohort but slightly higher 90-day mortality in the full sample.

Our findings of TCM being associated with reductions in 30-day readmissions resemble those of prior studies<sup>35–38</sup> in general and in high-risk patient populations.<sup>39,40</sup> Prior research has shown that timing of follow-up care is essential to the impact of TCM on readmissions.<sup>41</sup> At an average readmission cost of \$15,200,<sup>42</sup> our estimates suggest savings of approximately \$440,800 per 1000 patients (\$592,800/1000 patients in the HRRP cohort). Our findings of fewer ED visits, hospitalizations, and lower mortality with TCM reiterate the value of such services shown in previous research.<sup>13,43</sup>

Although hospitals report efforts to implement CTAs as they work to reduce risk of readmissions and possible HRRP penalties, self-reported CTAs, largely nonbillable, were not previously validated. Our results on CTAs corroborate prior evidence that care transition interventions are associated with fewer hospitalizations.<sup>44–47</sup> The negative association between higher hospital CTA index and patient ED and hospitalizations in HRRP patients suggests that the discharging hospitals' higher CTAs may be beneficial for not only increasing TCM uptake but also facilitating health care continuity and navigation through the complex health care system. However, the positive association between higher hospital CTAs and 90-day mortality may indicate that for higher-risk patients, CTAs may need to be complemented by follow-up visits (TCM).

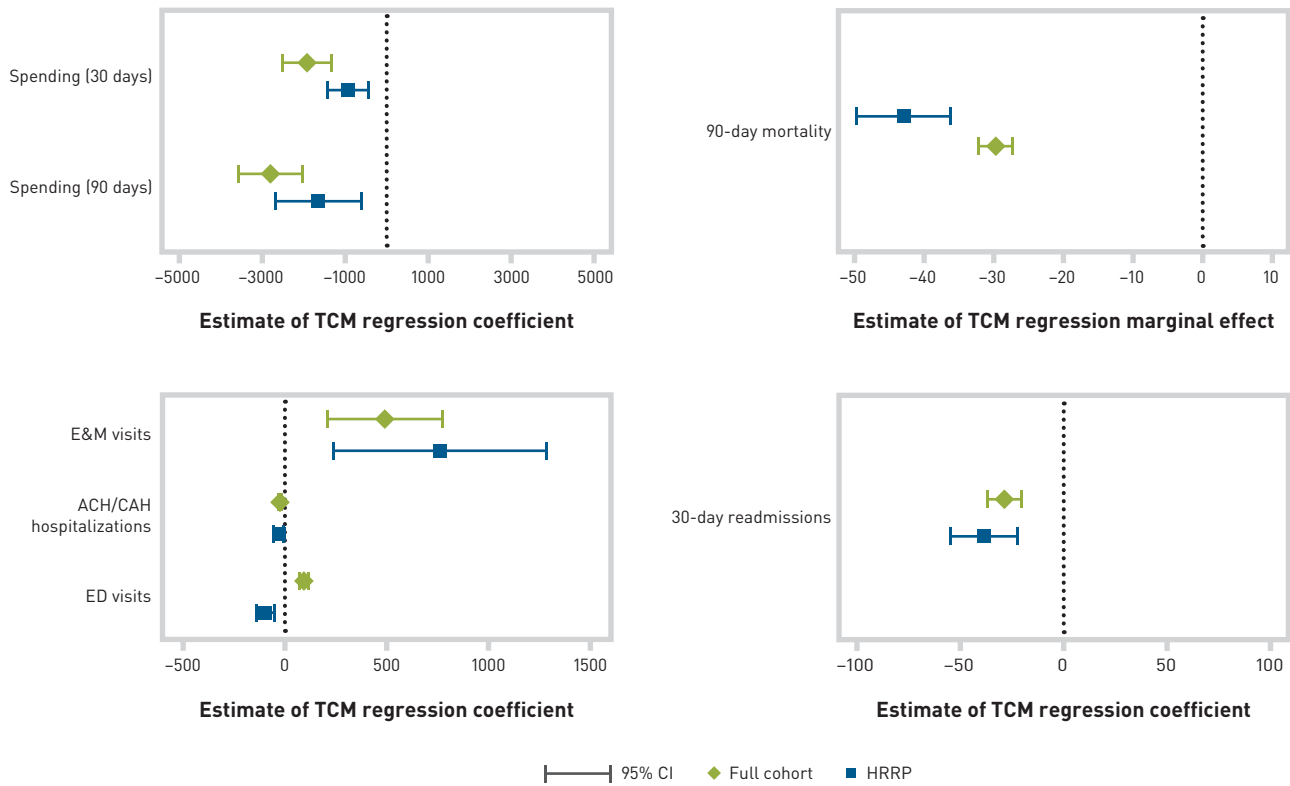
Although more than two-thirds of hospitals reported conducting a telephone follow-up with their patients within 72 hours post discharge, eligibility for TCM billing requires communication within 48 hours post discharge. Hence, some hospitals may provide valuable care transition services outside the time period required for billing for TCM. In fact, previous researchers emphasized that beyond the important resources and changes in workflow needed to ensure successful transitional care across settings, knowledge about the time frame required to bill for TCM is crucial for uptake

**FIGURE 1. Estimates for Association Between Hospital-Reported CTA and TCM Use for Discharged Patients\***



CTA, care transition activity; HRRP, Hospital Readmissions Reduction Program; TCM, transitional care management.  
 \*Full sample: N=424,115. Selected HRRP conditions included acute myocardial infarction, chronic obstructive pulmonary disease, congestive heart failure, and pneumonia (n=76,156). Plot shows marginal effect results identical to those in eAppendix Table 5, panel A.

**FIGURE 2. Estimates for Association Between TCM Use and Discharged Patients' Health Care Spending, Utilization, and Quality Outcomes\***



ACH, acute care hospital; CAH, critical access hospital; E&M, evaluation and management; ED, emergency department; HRRP, Hospital Readmissions Reduction Program; TCM, transitional care management.  
 \*Full sample: N=424,115. Selected HRRP conditions included acute myocardial infarction, chronic obstructive pulmonary disease, congestive heart failure, and pneumonia (n=76,156). Plots show results identical to those in eAppendix Table 5, panel B. Estimates are shown as dots and 95% CIs as bars. Spending was in dollars (US\$), and utilization, quality, and mortality measures were per 1000 beneficiaries.

of TCM.<sup>48</sup> Although TCM's relatively low compensation remains another challenge for adoption,<sup>49</sup> the removal of billing restrictions and increase in provider TCM compensation in 2020 by CMS may help.<sup>50</sup>

Postdischarge home visits may require more resources from hospitals because providers have to travel to the patients' home, likely explaining low report of this CTA. However, hospitals may want to invest in this CTA because recent evidence suggests that in-home follow-up was associated with the most reduction in 30-day readmissions for HRRP conditions relative to telehealth follow-up (also associated with lower readmissions) and no follow-up.<sup>51</sup>

This study helps to fill important research gaps by assessing the association between hospital self-reported CTAs and TCM and how both CTAs and TCM were related to differential performance for discharged Medicare beneficiaries prior to the COVID-19 pandemic and recent TCM policy change. Future studies should explore how our estimated relationships have changed with the 2020 policy change.

### Limitations

The main limitation of our study is that it was cross-sectional, limiting assessment of dynamic and causal relationships. Our estimates did not address confounding from other hospital-level features or features of outpatient settings that may be correlated with TCM use. For comparability across beneficiaries and beneficiary attribution process, we did not include other hospitalizations with/without TCM for beneficiaries with multiple hospitalizations in 2017. Because patient diagnoses and health-related outcomes were measured in claims, our results reflected care-seeking behavior. Nonetheless, evaluation of interventions in Medicare relies on claims-based measures, which are relevant for patients and health care stakeholders. Longitudinal analyses would help assess causal associations between length of exposure to TCM and outcomes.

Both CTA and TCM include activities that occur in varied settings (by definition). The claims and survey data in this study cannot identify in which specific setting a service (eg, medication reconciliation) occurred. We also anticipated that CTAs likely need to occur to facilitate TCM, which is the final face-to-face follow-up visit that needs to take place within the specified time frame as measured in claims. This may explain the higher association estimated between TCM—which “completes” the transitional care process—and the outcomes studied relative to that measured between CTAs and the outcomes.

We measured health care utilization on an annual basis and not strictly post discharge. Nonetheless, 30-day readmission and 90-day mortality were measured following the index hospitalization and provided a more targeted assessment of the impact of TCM services on quality measures. Additionally, we were unable to distinguish readmissions that happened before or after 14 days post discharge (the time limit for an eligible TCM visit post discharge).

We focused on 4 (AMI, CHF, COPD, and pneumonia) of the 6 CMS-designated HRRP conditions because they were the initial conditions targeted by the program in 2013 through 2015.<sup>52</sup>

Finally, the survey information was self-reported by hospital leaders, and we were unable to determine the quantity and quality of hospital-level reports. There may be differences in the execution of the reported activities across hospitals.

## CONCLUSIONS

Beneficiaries discharged from hospitals reporting more CTAs had higher rates of transitional care services. We found that beneficiaries discharged from hospitals with higher CTAs who received TCM services experienced improved quality of care with lower spending. Encouraging hospitals to implement care transitional strategies after patient discharge may further enhance effectiveness of hospital CTAs in boosting TCM use by providers, improving population health, and lowering health care costs. ■

**Author Affiliations:** Department of Population Health Sciences, University of Wisconsin School of Medicine and Public Health (MHO, JM, MAS), Madison, WI; Harvard T.H. Chan School of Public Health (BH, EM), Boston, MA.

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**Address Correspondence to:** Mariétou H. Ouayogodé, PhD, Department of Population Health Sciences, University of Wisconsin School of Medicine and Public Health, 610 Walnut St, Madison, WI 53726. Email: marietou.ouayogode@wisc.edu.

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## Care Transition Management and Patient Outcomes in Hospitalized Medicare Beneficiaries

### eAppendix

**Table 1** presents the National Survey of Healthcare Organizations and Systems (NSHOS)-Hospital question and response options used to construct the care transition activity (CTA) index score.

**Table 2** presents the results from the factor analysis using the survey-based care transition activities.

**Table 3** defines each of the conditions included in our selected cohort (Hospital Readmission Reduction Program (HRRP)) from the full sample of hospitalized Medicare FFS beneficiaries discharged from the hospital to home in 2017.

**Table 4** presents descriptive characteristics of hospitalized Medicare FFS beneficiaries assigned to NSHOS survey respondents in comparison to beneficiaries assigned to non-respondent hospitals.

**Table 5** presents regression results for 1) the association between hospital's self-reported care transition activities (CTAs) and uptake of transitional care management (TCM) services and 2) the association between TCM, hospital care transition activities and beneficiary outcomes.

**Table 6** presents regression results for the association between hospital care transition activities and beneficiary outcomes.

**Table 7** presents regression results for the association between TCM and beneficiary outcomes.

This supplementary appendix expands the discussion of the statistical analysis assessing the association between TCM and beneficiary outcomes, mentioned in the text.

### Least squares (LS) regression

We modeled beneficiary outcomes as a function of TCM service billing (i.e. claim), beneficiary characteristics, hospital care transition activities (CTAs) and attributes following the regression below:

$$G(E(Y_i|\dots)) = \beta_0 + \beta_1 CTA2tle_j + \beta_2 CTA3tle_j + \beta_3 TCM_i + \mathbf{x}'_i \boldsymbol{\delta} + \mathbf{w}'_j \boldsymbol{\gamma} \quad (\text{A1})$$

On the left-hand side,  $G$  denotes a generalized linear model (GLM) link function determined by the distribution of  $Y_i$ , denoting the outcome for beneficiary  $i$ .

On the right-hand side,  $CTA2tle$  and  $CTA3tle$  are indicators for a beneficiary being attributed to a hospital reporting CTA index score in the second and third/top tertiles, respectively, of the

distribution of the index score (see Table.A2 for index definition).  $TCM$  is an indicator (a dichotomous variable equaling 1 in the stated event and 0 otherwise) for beneficiary  $i$ , being discharged from an acute care setting and being provided with transition care management services measured in claims. The coefficients  $\beta_1$ ,  $\beta_2$ , and  $\beta_3$  are the coefficients of interest to be estimated.

Additional covariates on the right-hand side include the vector  $\mathbf{x}_i$ , which represents beneficiary-level characteristics. The vector includes a set of indicators for age interval (66–70 serving as the omitted reference category, as well as the intervals, 71–75, 76–80, 81–85, 86 and above), an indicator for sex (female), indicators for race/ethnicity (White serves as the omitted reference category as well as Black, Hispanic, Asian and Pacific Islander, and Other), an indicator for living in a high-poverty census tract, an indicator for dual eligibility for Medicaid benefits (either full or partial), and an indicator for residing in a nursing facility. The vector also includes an indicator for having at least two of 18 chronic conditions (i.e. multimorbidity) and a hierarchical condition category (HCC) score. Vector  $\boldsymbol{\delta}$  represents coefficients on these variables to be estimated.

The right-hand side of equation (A1) also includes the vector  $\mathbf{w}_j$ , representing hospital-level attributes. The vector includes indicators for location in an urban area, a suite of indicators for census region (Northeast serving as the reference category as well as Midwest, South, and West). Also included in this vector are indicators for the hospital type (acute care hospital serving as the omitted category as well as critical access hospital, academic medical center, and Other hospital type), whether the hospital participates in alternative payment models, and hospital size category (as measured by the number of physicians). Vector  $\boldsymbol{\gamma}$  represents coefficients on these variables to be estimated.

All estimates were weighted for survey sample frame and nonresponse, and standard errors estimated using Huber-White sandwich estimators clustered at hospital level. Equation (A1) were estimated for the entire sample of hospitalized beneficiaries and for the HRRP condition cohort: AMI, CHF, COPD, pneumonia. Table.A3 presents the condition cohort diagnosis codes used in this study. Table.A5, panel B and figure 2 present the results of these regressions.

**eAppendix Table 1.** NSHOS Hospital Survey Question and Response Options used for The Care Transition Activity (CTA) Index Score

**Survey Section: Care Transitions**

“In your hospital, for how many patients undergoing a care transition to a home or a post-acute facility are any of the following strategies used to reduce the risk of readmission?”

	None	Some	Most	All	Don't know
Medication reconciliation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Telephone follow-up (within 72 hours of discharge)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
In-home follow up (within 72 hours of discharge)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Standardized process in place to ensure timely follow-up with primary/specialty care	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discharge summaries are transmitted to clinicians accepting care of the patient	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use of a patient navigator or care manager while patient is in hospital	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use of a care manager or health coach post-discharge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**eAppendix Table 2.** The National Survey of Healthcare Organizations and Systems (NSHOS) Care Transition Activity Index Score.

Question	Response Options	Points Value
For how many of your ACO-attributed hospitalized patients undergoing a care transition to home or a post-acute care facility receive the following services to reduce the risk of readmission?		
a. Medication reconciliation	• Don't Know, None, Some	0
	• Most, All	1
b. Telephone follow-up (within 72 hours of discharge)	• Don't Know, None, Some	0
	• Most, All	1
c. In-home follow-up (within 72 hours of discharge)	• Don't Know, None, Some	0
	• Most, All	1
d. Standardized process in place to ensure timely follow-up with primary or specialty care	• Don't Know, None, Some	0
	• Most, All	1
e. Discharge summaries are transmitted to clinicians accepting care of the patient	• Don't Know, None, Some	0
	• Most, All	1
f. Use of Care Manager or Health Coach Post-Discharge	• Don't Know, None, Some	0
	• Most, All	1
g. Use of Patient Navigator or Care Manager	• Don't Know, None, Some	0
	• Most, All	1

*Notes:* We narrowed the index to incorporate 7 variables from one question stem. Each variable was assigned a point value of 0, 1 for a total of 0-7 points in the index. Our index is also highly correlated with an index based on a factor analysis (non-parametric  $\rho=0.98$ ).

Factor loadings (1 factor retained) and unique variances based on a principal component analysis without rotation for 7 items from the NSHOS: N=659 NSHOS hospital respondents

Variable	Factor 1	Uniqueness
Medication reconciliation (how many receive) (1=Most or all patients)	0.4552	0.7628
Telephone follow-up (within 72 hours of discharge) (1=Most or all patients)	0.6774	0.5412
In-home follow up (within 72 hours of discharge) (1=Most or all patients)	0.5643	0.6816
Standardized process in place to ensure timely follow-up with primary/specialty care (1=Most or all patients)	0.7047	0.5034
Discharge summaries are transmitted to clinicians accepting care of the patient (1=Most or all patients)	0.6469	0.5815
Use of a patient navigator or care manager while patient is in hospital (1=Most or all patients)	0.5514	0.6960
Use of a care manager or health coach post-discharge (1=Most or all patients)	0.7499	0.4376

Abbreviation- NSHOS: The National Survey of Healthcare Organizations and Systems

**eAppendix Table 3: Claims-based Indicators for Cohort Inclusion**

<b>ICD-10 Principal Diagnosis Codes</b>	
<b>Acute Myocardial Infarction (AMI)</b>	I21.01, I21.02, I21.09, I21.11, I21.19, I21.21, I21.29, I21.3, I21.4, I21.9, I21.A1, I21.A9
<b>Chronic obstructive pulmonary disease (COPD)</b>	J41.1, J41.8, J42., J43.0, J43.0, J43.1, J43.2, J43.8, J43.9, J44.0, J44.1, J44.9, J47.0, J47.1, J47.9, J68.4, J68.8, J68.9, Q33.4
<b>Congestive Heart Failure (CHF)</b>	I09.81, I11.0, I13.0, I13.2, I50.1, I50.20, I50.21, I50.22, I50.23, I50.30, I50.31, I50.32, I50.33, I50.40, I50.41, I50.42, I50.43, I50.810, I50.811, I50.812, I50.813, I50.814, I50.82, I50.83, I50.84, I50.89, I50.9, R57.0, R57.9
<b>Pneumonia</b>	B33.0, J09.X1, J09.X2, J10.00, J10.01, J10.08, J10.1, J11.00, J11.08, J12.0, J12.1, J12.2, J12.3, J12.81, J12.89, J12.9, J13, J14, J15.3, J15.4, J15.7, J15.9, J16.0, J16.8, J18.0, J18.1, J18.8, J18.9, J92.0, J92.9, J94.1, J94.9, R09.1

*Notes*- Principal discharge diagnosis codes were adapted from the following sources: AMI from Krumholz et al.(2011);<sup>23</sup> COPD from CMS(2021)<sup>24</sup>; CHF from Keenan et al.(2008);<sup>25</sup> and Pneumonia from Lindenauer et al.(2010).<sup>26</sup>

**eAppendix Table 4:** Beneficiary characteristics by attribution to NSHOS survey respondents, 2017<sup>a</sup>

	<b>Full cohort (Assigned to NSHOS Respondents) (n=424,115)</b>	<b>Full cohort (Assigned to NSHOS Non- Respondents) (n=1,737,227)</b>	<b><i>Test of difference<sup>b</sup></i>  <b>P-value</b></b>
<b>Demographic characteristics, %</b>			
Age, mean (SD), y	76.72 (7.43)	76.96 (7.49)	<0.001
Female	51.79	52.58	<0.001
<i>Race and ethnicity</i>			
White	86.78	86.54	<0.001
Black	8.04	7.57	<0.001
Hispanic	1.07	1.53	<0.001
Asian	1.25	1.34	<0.001
Other	2.41	2.26	<0.001
Lives in high poverty (>20%) ZIP code	19.66	19.72	0.405
Dual eligibility for Medicaid	13.87	15.23	<0.001
Nursing home resident	14.16	14.76	<0.001
Multimorbidities <sup>c</sup>	58.24	57.50	<0.001
HCC Score, mean (SD)	2.31 (1.66)	2.28 (1.65)	<0.001
<b>Cohort, %</b>			
HRRP <sup>d</sup>	17.96	18.68	0.029
Pneumonia	5.13	5.35	0.023
Acute Myocardial Infarction	3.54	3.49	<0.001
Congestive Heart Failure	5.26	5.26	0.145
Chronic Obstructive Pulmonary Disease	4.03	4.58	0.913
Transitional care management, %	14.12	13.95	0.006

**Notes:** Abbreviations- HCC=hierarchical condition category; HRRP=Hospital Readmission Reduction Program; NSHOS=National Survey of Health Care Organizations and Systems; SNF=skilled nursing facility. <sup>a</sup> Includes beneficiaries 66 years or older. <sup>b</sup> Descriptive statistics are not weighted for comparison of beneficiaries that were and were not attributed to NSHOS respondents. *t* tests were conducted for continuous variables and  $\chi^2$  tests were conducted for categorical variables. <sup>c</sup> Selected chronic conditions included coronary artery disease, cancer, connective tissue disorders, congestive heart failure, diabetes, dementia, chronic obstructive pulmonary disease, hematologic or thrombotic disease, HIV infection or AIDS, immune disease, liver disease, Parkinson or Huntington disease, paralysis, peripheral vascular disease, renal disease, cerebral hemorrhage or stroke, severe mental illness, and substance use disorder. <sup>d</sup> HRRP conditions include Acute Myocardial Infarction, Chronic Obstructive Pulmonary Disease, Congestive Heart Failure, and Pneumonia.

**eAppendix Table 5:** Regression estimates of association between beneficiary-level outcomes and hospital care transition activity (CTA) and transition care management (TCM), adjusted for beneficiary and organizational characteristics <sup>a,b</sup>

Dependent variables	Independent variables					
	<u>Full cohort</u> n=424,115			<u>HRRP</u> n=76,156		
	CTA in Second (Middle) Tertile (Survey)	CTA in Third (Top) Tertile (Survey)	TCM (Claims)	CTA in Second (Middle) Tertile (Survey)	CTA in Third (Top) Tertile (Survey)	TCM (Claims)
	Coeff/Marg Eff. (SE)	Coeff/Marg Eff. (SE)	Coeff/Marg Eff. (SE)	Coeff/Marg Eff. (SE)	Coeff/Marg Eff. (SE)	Coeff/Marg Eff. (SE)
<b>Panel-A</b>						
Transitional care management (TCM)	0.01 (0.02)	0.03 (0.01)***	–	0.02 (0.02)	0.03 (0.02)*	–
<b>Panel-B</b>						
<i>Spending,<sup>c</sup></i>						
Medicare spending (30 days)	-408 (458)	-283 (677)	-1,920 (315)*****	28 (330)	108 (547)	-934 (263)*****
Medicare spending (90 days)	-617 (709)	-962 (858)	-2,803 (407)*****	-579 (593)	-880 (851)	-1,648 (549)*****
<i>Utilization (per 1,000 beneficiaries)</i>						
Evaluation and Management visits	-77.88 (295.90)	221.65 (324.35)	490.66 (147.20)***	-193.89 (312.18)	129.16 (380.51)	762.01 (270.06)***
Acute Care/Critical Access Hospital Hospitalizations	-9.34 (10.76)	-18.61 (11.91)	-24.20 (8.28)***	-33.44 (18.67)*	-51.32 (17.43)***	-29.81 (15.79)*
Emergency department visits	39.64 (28.72)	-51.66 (32.49)	93.31 (14.72)*****	10.02 (38.35)	-91.24 (38.90)**	-95.65 (26.61)*****
<i>Outcomes (per 1,000 beneficiaries)</i>						

30-day readmissions <sup>d</sup>	0.97 (4.98)	2.01 (5.43)	-28.70 (4.58)****	-0.31 (8.97)	5.25 (9.74)	-38.53 (8.59)****
90-day Mortality	2.88 (1.73)*	3.55 (2.07)*	-29.71 (1.35)****	6.26 (3.48)*	4.51 (4.42)	-42.93 (3.55)****

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**Notes:** Abbreviations- ACH/CAH acute care hospital/critical access hospital; APM=Alternative Payment Model; ED=emergency department; E&M=evaluation and management; HRRP=Hospital Readmission Reduction Program. HRRP conditions include Acute Myocardial Infarction, Chronic Obstructive Pulmonary Disease, Congestive Heart Failure, and Pneumonia. <sup>a</sup> Includes beneficiaries 66 years or older. <sup>b</sup> Each model represents a single regression for each outcome variable, and all care transition activity index tertiles were jointly estimated. Regression models estimated spending, utilization, or quality outcome as a function of the care transition activity index tertiles, adjusting for 5-year age category, sex, race, dual eligibility for Medicaid status, nursing facility residence status, HCC score, hospital location (rural (RUCA $\geq$ 4)/urban (RUCA $<$ 4) group, census region), hospital type, whether the hospital is affiliated with an academic medical center, whether the hospital participates in alternative payment models, and hospital size category (as measured by the number of physicians). All estimates were weighted for survey sampling frame and nonresponse, and standard errors were estimated using Huber-White sandwich estimators clustered at hospital and system level. <sup>c</sup> Episode spending measures were calculated as the sum of spending starting 2 days prior to the admission date and would include the index stay, instead of using the discharge date that would exclude of the index stay. <sup>d</sup> Readmissions included unplanned only and were only reported for beneficiaries with observable inpatient admissions. <sup>e</sup> Ambulatory care sensitive admissions were defined using prevention quality indicators' methodology. Inference: \*P-value $<$ .10, \*\*P-value $<$ .05, \*\*\*P-value $<$ .01, \*\*\*\*P-value $<$ .001.



**eAppendix Table 6:** Regression estimates of association between beneficiary-level outcomes and hospital care transition activity (CTA), adjusted for beneficiary and organizational characteristics <sup>a,b</sup>

Dependent variables	Independent variables			
	Full cohort N=424,115		HRRP N=76,156	
	CTA in Second (Middle) Tertile (Survey) Coeff/Marg Eff. (SE)	CTA in Third (Top) Tertile (Survey) Coeff/Marg Eff. (SE)	CTA in Second (Middle) Tertile (Survey) Coeff/Marg Eff. (SE)	CTA in Third (Top) Tertile (Survey) Coeff/Marg Eff. (SE)
<i>Spending,<sup>c</sup></i>				
Medicare spending (30 days)	-426 (468)	-349 (670)	13 (332)	78 (546)
Medicare spending (90 days)	-648 (724)	-1,060 (849)	-604 (598)	-931 (849)
<i>Utilization (per 1,000 beneficiaries)</i>				
Evaluation and Management visits	-72.48 (295.96)	238.71 (322.05)	-181.89 (313.59)	153.11 (375.49)
Acute Care/Critical Access Hospital Hospitalizations	-9.60 (10.78)	-19.45 (11.87)	-33.91 (18.69)*	-52.26 (17.36)***
Emergency department visits	40.66 (29.11)	-48.42 (32.28)	8.52 (38.11)	-94.25 (39.12)**
<i>Outcomes (per 1,000 beneficiaries)</i>				
30-day readmissions <sup>d</sup>	0.65 (4.96)	1.02 (5.38)	-0.92 (8.73)	4.04 (9.65)
90-day Mortality	2.62 (1.64)	2.67 (2.03)	5.76 (3.41)*	3.42 (4.28)

**Notes:** Abbreviations- ACH/CAH acute care hospital/critical access hospital; APM=Alternative Payment Model; ED=emergency department; E&M=evaluation and management; HRRP=Hospital Readmission Reduction Program. Full Sample (N=424,115). HRRP conditions include Acute Myocardial Infarction, Chronic Obstructive Pulmonary Disease, Congestive Heart Failure, and Pneumonia (N=76,156). <sup>a</sup>Includes beneficiaries 66 years or older. <sup>b</sup>Each model represents a single regression for each outcome variable, and all care transition activity index tertiles were jointly estimated. Regression models estimated spending, utilization, or quality outcome as a function of the care transition activity index tertiles, adjusting for 5-year age category, sex, race, dual eligibility for Medicaid status, nursing facility, rural (RUCA>=4)/urban (RUCA<4) group, region, HCC score, hospital type, whether the hospital is affiliated with an

academic medical center, whether the hospital participates in alternative payment models, and hospital size category (as measured by the number of physicians). All estimates were weighted for survey sampling frame and nonresponse, and standard errors were estimated using Huber-White sandwich estimators clustered at hospital and system level. <sup>c</sup> Episode spending measures were calculated as the sum of spending starting 2 days prior to the admission date and would include the index stay, instead of using the discharge date that would exclude of the index stay. <sup>d</sup> Readmissions included unplanned only and were only reported for beneficiaries with observable inpatient admissions. Inference: \*P-value<.10, \*\*P-value<.05, \*\*\*P-value<.01, \*\*\*\*P-value<.001.

**eAppendix Table 7:** Regression estimates of association between beneficiary-level outcomes and transition care management (TCM), adjusted for beneficiary and organizational characteristics <sup>a,b</sup>

<b>Dependent variables</b>	<b>Independent variables</b>	
	<b>Full cohort</b> <b>N=424,115</b> TCM (Claims) Coeff/Marg Eff. (SE)	<b>HRRP</b> <b>N=76,156</b> TCM (Claims) Coeff/Marg Eff. (SE)
<i>Spending,<sup>c</sup></i>		
Medicare spending (30 days)	-1,931 (309)****	-932 (264)****
Medicare spending (90 days)	-2,835 (394)****	-1,672 (549)****
<i>Utilization (per 1,000 beneficiaries)</i>		
Evaluation and Management visits	496.52 (147.01)***	762.59 (270.06)***
Acute Care/Critical Access Hospital Hospitalizations	-24.79 (8.30)***	-31.19 (15.92)*
Emergency department visits	92.08 (14.71)****	-97.38 (26.76)****
<i>Outcomes (per 1,000 beneficiaries)</i>		
30-day readmissions <sup>d</sup>	-28.64 (4.54)****	-38.43 (8.60)****
90-day Mortality	-29.59 (1.36)****	-42.78 (3.60)****

**Notes:** Abbreviations- ACH/CAH acute care hospital/critical access hospital; APM=Alternative Payment Model; ED=emergency department; E&M=evaluation and management; HRRP=Hospital Readmission Reduction Program. Full Sample (N=424,115). HRRP conditions include Acute Myocardial Infarction, Chronic Obstructive Pulmonary Disease, Congestive Heart Failure, and Pneumonia (N=76,156). <sup>a</sup>Includes beneficiaries 66 years or older. <sup>b</sup>Each model represents a single regression for each outcome variable, and all care transition activity index tertiles were jointly estimated. Regression models estimated spending, utilization, or quality outcome as a function of the care transition activity index tertiles, adjusting for 5-year age category, sex, race, dual eligibility for Medicaid status, nursing facility, rural (RUCA $\geq$ 4)/urban (RUCA $<$ 4) group, region, HCC score, hospital type, whether the hospital is affiliated with an academic medical center, whether the hospital participates in alternative payment models, and hospital size category (as measured by the number of physicians). All estimates were weighted for survey sampling frame and nonresponse, and standard errors were estimated using Huber-White sandwich estimators clustered at hospital and system level. <sup>c</sup> Episode spending measures were calculated as the sum of spending starting 2 days prior to the admission date and would include the index stay, instead of using the discharge date that would exclude of the index stay. <sup>d</sup> Readmissions included unplanned only and were only reported for beneficiaries with observable inpatient admissions. Inference: \*P-value $<$ .10, \*\*P-value $<$ .05, \*\*\*P-value $<$ .01, \*\*\*\*P-value $<$ .001.