JAMA Internal Medicine | **Original Investigation**

Patient Outcomes After Hospital Discharge to Home With Home Health Care vs to a Skilled Nursing Facility

Rachel M. Werner, MD, PhD; Norma B. Coe, PhD; Mingyu Qi, MS; R. Tamara Konetzka, PhD

IMPORTANCE Use of postacute care is common and costly in the United States, but there is significant uncertainty about whether the choice of postacute care setting matters. Understanding these tradeoffs is particularly important as new alternative payment models push patients toward lower-cost settings for care.

OBJECTIVE To investigate the association of patient outcomes and Medicare costs of discharge to home with home health care vs discharge to a skilled nursing facility.

DESIGN, SETTING, AND PARTICIPANTS A retrospective cohort study used Medicare claims data from short-term acute-care hospitals in the United States and skilled nursing facility and home health assessment data from January 1, 2010, to December 31, 2016, on Medicare beneficiaries who were discharged from the hospital to home with home health care or to a skilled nursing facility. To address the endogeneity of treatment choice, an instrumental variables approach used the differential distance between the beneficiary's home zip code and the closest home health agency and the closest skilled nursing facility as an instrument.

EXPOSURES Receipt of postacute care at home vs in a skilled nursing facility.

MAIN OUTCOMES AND MEASURES Readmission within 30 days of hospital discharge, death within 30 days of hospital discharge, improvement in functional status during the postacute care episode, and Medicare payment for postacute care and total payment for the 60-day episode.

RESULTS A total of 17 235 854 hospitalizations (62.2% women and 37.8% men; mean [SD] age, 80.5 [7.9] years) were discharged either to home with home health care (38.8%) or to a skilled nursing facility (61.2%) during the study period. Discharge to home was associated with a 5.6-percentage point higher rate of readmission at 30 days compared with discharge to a skilled nursing facility (95% CI, 0.8-10.3; P = .02). There were no significant differences in 30-day mortality rates (−2.0 percentage points; 95% CI, 0.8-10.3; P = .12) or improved functional status (−1.9 percentage points; 95% CI, −12.0 to 8.2; P = .71). Medicare payment for postacute care was significantly lower for those discharged to home compared with those discharged to a skilled nursing facility (−$5384; 95% CI, −$6932 to −$3837; P < .001), as was total Medicare payment within the first 60 days after admission (−$4514; 95% CI, −$6932 to −$3837; P < .001).

CONCLUSIONS AND RELEVANCE Among Medicare beneficiaries eligible for postacute care at home or in a skilled nursing facility, discharge to home with home health care was associated with higher rates of readmission, no detectable differences in mortality or functional outcomes, and lower Medicare payments.

[+] Invited Commentary

[+] Supplemental content

Author Affiliations: Division of General Internal Medicine, University of Pennsylvania, Philadelphia (Werner, Qi); Corporal Michael J. Crescenz VA Medical Center, Philadelphia, Pennsylvania (Werner); Department of Medical Ethics and Health Policy, University of Pennsylvania, Philadelphia (Coe); Department of Public Health Sciences, University of Chicago, Chicago, Illinois (Konetzka).

Corresponding Author: Rachel M. Werner, MD, PhD, Division of General Internal Medicine, University of Pennsylvania, 423 Guardian Dr, Blockley Hall, Room 1314, Philadelphia, PA 19104 (rwerner @upenn.edu).

The use of postacute care has grown substantially during the past several decades.[1] More than 40% of Medicare beneficiaries receive postacute care after a hospital discharge; 90% of those patients go either to a skilled nursing facility (SNF) or home with care from a home health agency.[2] In 2015, Medicare spent more than $60 billion on postacute care,[3] an amount that has been rapidly increasing.[4]

Despite this proliferation, it is uncertain whether the choice of setting for postacute care matters in terms of patient outcomes and costs. There are likely tradeoffs in patient outcomes and costs between postacute care delivered in institutional settings, such as SNFs, and at home by home health agencies, given the differences in intensity of care. Understanding these tradeoffs is particularly important as new alternative payment models push patients toward lower-cost settings for care.[5-7]

However, surprisingly little is known about these tradeoffs. Studies have produced inconsistent results and have been small[8-10] and examined few conditions,[8-12] and most have inadequately controlled for the substantial differences in patient characteristics across settings.[8,9,11] One large observational study of patients undergoing joint replacement found favorable outcomes among patients discharged to home compared with those discharged to an SNF.[11] However, observational studies are likely subject to confounding by indication because healthier patients are more likely to be discharged to home rather than to an institutional postacute care setting. One small randomized trial showed no difference in patient outcomes between patients randomized to discharge to home vs to inpatient rehabilitation after total joint replacement.[10]

With the proliferation of use of postacute care and changing patterns of use under alternative payment models, it is important to assess the tradeoffs between care settings. Our objective was to investigate differences in rates of 30-day readmission, 30-day mortality, functional outcomes, and Medicare payment in a very large national sample of Medicare beneficiaries discharged to home with home health care vs to an SNF. We do so using a quasi-experimental instrumental variable method to plausibly control for confounding by indication.

Methods

Data

Our methods are described in more detail in the eAppendix in the Supplement. We used Medicare data to observe all Medicare-reimbursed hospitalizations and use of postacute care in the United States between January 1, 2010, and December 31, 2016. These data include hospital claims for all fee-for-service Medicare beneficiaries as well as information-only claims for Medicare Advantage enrollees from hospitals that received disproportionate-share hospital or medical education payments from Medicare. Prior work has shown that these claims include 92% of all Medicare discharges.[13] These data were supplemented with (1) the Medicare Beneficiary Summary File, which contains information on beneficiary enrollment in Medicare; (2) Medicare assessment data for both fee-for-service and Medicare Advantage enrollees from home

Key Points

Question How are patient outcomes and Medicare spending affected by the decision to discharge patients to home with home health care vs to a skilled nursing facility for postacute care?

Findings In a cohort study of Medicare data of more than 17 million hospitalizations using instrumental variable methods to account for confounding by indication, compared with discharging patients to skilled nursing facilities, discharging patients to home with home health care was associated with a higher 30-day rate of readmission but a significantly lower Medicare payment for initial postacute care and for the total 60-day episode of care including hospitalization, all postacute care, and subsequent readmissions. There were no significant differences in 30-day mortality rates or improved functional status.

Meaning Among Medicare beneficiaries eligible for postacute care at home or in a skilled nursing facility, discharge to home with home health care was associated with higher rates of readmission, no detectable differences in mortality or functional outcomes, and lower Medicare payments.

health care and SNF (using the Outcome and Assessment Information Set for home health care and Minimum Data Set for SNF) to measure patients' use of home health care and SNF after hospital discharge, as well as functional improvement during their postacute care episode; and (3) fee-for-service claims for SNF and home health care to measure Medicare payment in those settings. This study was approved by the Institutional Review Board of the University of Pennsylvania. There was no informed consent because we received a Health Insurance Portability and Accountability Act waiver.

Study Sample

We included all patients discharged from a hospital to home with visits from a home health agency or discharged from a hospital to SNF. We excluded beneficiaries younger than 66 years, those who had been in a nursing home in the 30 days prior to hospitalization (as they are more likely to go back to the nursing home independent of other factors), those whose length of hospital stay was less than 3 days (the minimum stay required for an SNF admission to be covered by fee-for-service Medicare), and those discharged to hospice.

Study Variables

Outcome Measures

Our primary outcome was readmission within 30 days of hospital discharge. We followed Medicare's definition of hospital-wide readmission from the Hospital Readmissions Reduction Program,[14] which includes unplanned readmissions to any acute care hospital within 30 days of discharge.

We included as additional outcomes mortality within 30 days of hospital discharge, improvement in functional status during the postacute care episode based on clinical assessment data from home health care and SNFs using a 6-point activities of daily living scale on admission to and discharge from postacute care,[15] and the following 3 versions of Medicare payment (among fee-for-service enrollees): (1) payment for the index hospitalization, (2) payment for home health care or SNF for the first episode of

use of postacute care after hospital discharge, and (3) total payment in the first 60 days after hospital admission, including payment for hospitalization, use of postacute care, and any readmission or subsequent use of postacute care within 60 days from admission for the index hospitalization.

Covariates

We included patient-level covariates in all regressions, including age, sex, race/ethnicity, and 31 indicators of comorbidities based on Centers for Medicare & Medicaid Services Hospital Readmission Reduction Program specifications.[16] We also adjusted for the diagnosis related group (DRG) of each discharge, year fixed effects, and hospital fixed effects. For regressions of 30-day readmission we accounted for censoring by patient death by adjusting for the number of days each person is alive in that 30-day period. For regressions of functional status, we adjusted for the level of functional status on admission to postacute care and the number of days in the episode of postacute care.

Instrumental Variable

In instrumental variables analyses, the instrument approximates random assignment of patients to treatment groups, in our case to home health care vs SNF. We used differential distance as our instrument, a commonly used approach. Distances were calculated using linear arc distances, which measures the number of miles between the centroids of 2 zip codes. We calculate differential distance as the difference between the distance from a patient's zip code of residence to the nearest home health agency and the distance from a patient's zip code of residence to the nearest SNF (see eTable 1 in the Supplement for a summary of differential distance). We used differential distance to create a dichotomous measure that equals 1 if the beneficiary lives closer to a home health agency than an SNF and zero if the beneficiary lives equidistant between a home health agency and SNF or closer to an SNF than to a home health agency (eTable 2 in the Supplement). We dichotomized differential distance because the relationship between choice of home health care vs SNF and distance is not linear and the dichotomous version was more likely to meet the monotonicity assumption of the instrumental variable model.[17]

We first tested whether the instrument was correlated with the treatment of interest, in this case treatment by a home health agency (rather than an SNF). We found that living closer to a home health agency was associated with discharge to a home health agency ($F = 263.4$; eTable 3 in the Supplement). F statistics greater than 10 are generally considered strong.[18] The probability of receiving care from a home health agency is 3.6 percentage points higher among patients who live closer to a home health agency than to an SNF.

Although we cannot directly assess the association between the instrument and unmeasured confounders, we next examined the association between the instrument and measured confounders. We found that most patient covariates were balanced across values of the instrument (eTable 4 in the Supplement). We accounted for residual imbalances by adjusting for them in the instrumental variable model, as the instrumental variable is valid if it is uncorrelated with unobserved confounders, conditional on observable confounders.

We conducted a falsification test of our instrument, examining its association with treatment choice among Medicare beneficiaries who were hospitalized far from home (ie, "vacationers").[19,20] As expected, in this subsample the first stage was weak and the association between the instrument and the treatment choice was close to zero.

Statistical Analysis

We first tested for differences in patient outcomes between discharge to home health care vs to SNF using ordinary least-squares regression, adjusting for the covariates described above. Then, in the instrumental variable analysis, 2-stage least-squares regressions were performed in which the first stage predicted the likelihood of discharge to home with home health after hospital discharge based on the value of the instrument and the second stage estimated the association between predicted admission to home health from the first stage and the outcomes of interest. Both stages adjusted for covariates as described above and adjusted the standard errors for clustering within hospital. All P values were from 2-sided tests and results were deemed statistically significant at $P < .05$.

Additional Analyses

To test the robustness of the estimated difference in rates of readmission between home health care and SNF, we reestimated the 2-stage least squares regressions in the following subgroups of readmissions. First, we categorized readmissions as those that were for nondiscretionary diagnoses and those that were for potentially discretionary diagnoses.[21] Conceptually, we define potentially discretionary hospitalizations as those resulting from conditions with greater uncertainty regarding the optimal treatment and thus greater variation in the use of hospital admission, whereas nondiscretionary hospitalizations are those resulting from conditions or events for which a hospital admission is almost always advised, as no other setting would typically have the required resources to address the patient's acute needs. We expected any difference in rates of readmission between those discharged to home health care and those discharged to SNF to be concentrated in the discretionary readmissions.

Then, we tested the robustness of the results in the following subgroups: (1) among patients with the 20 most common DRGs being discharged to postacute care, grouping DRGs into those for medical conditions vs surgical or rehabilitation (a full list of these DRGs is available in eTable 5 in the Supplement); (2) fee-for-service enrollees; (3) Medicare Advantage enrollees; (4) patients in urban areas; and (5) patients in hospitals that were not vertically integrated with an SNF or a home health agency. In addition, because the outcome of readmission is censored at death, we reestimated our main models using a combined outcome of readmission or death within 30 days.

Finally, because the results from instrumental variable analyses apply only to the marginal patient—that is, those discharged to home with home health care solely because of their closer proximity to a home health agency than to an SNF—we describe the characteristics of these marginal patients using the method described by Baiocchi et al.[22]

Table 1. Characteristics of Patients Discharged From the Hospital
in Study Cohort

	Patients, No. (%)	
Characteristic	Home Health Care (n = 6 687 339)	SNF (n = 10 548 515)
Age, mean (SD), y	78.7 (7.7)	81.5 (7.9)
Female sex	3 918 245 (58.6)	6 809 443 (64.6)
Race/ethnicity		
White	5 706 387 (85.3)	9 163 361 (86.9)
Black	657 929 (9.8)	959 701 (9.1)
Hispanic	128 577 (1.9)	159 732 (1.5)
Dually enrolled in Medicare and Medicaid	863 159 (12.9)	2 179 823 (20.7)
Enrolled in Medicare Advantage	1 633 387 (24.4)	2 602 358 (24.7)
No. of comorbidities, mean (SD)	3.2 (2.7)	3.3 (2.8)
5 Most common DRGs		
Total knee or hip replacement	856 617 (12.8)	1 178 668 (11.2)
Sepsis	313 046 (4.7)	667 208 (6.3)
Congestive heart failure	456 418 (6.8)	460 914 (4.4)
Pneumonia	293 392 (4.4)	406 087 (3.8)
Urinary tract infection	170 681 (2.6)	434 723 (4.1)

Abbreviations: DRG, diagnosis related group; SNF, skilled nursing facility.

Results

From 2010 to 2016, there were 17 235 854 discharges among
Medicare beneficiaries in our cohort: 6 687 339 to home health
(38.8%) and 10 548 515 to an SNF (61.2%). Compared with patients
discharged to an SNF, those discharged to home health care were
younger (mean [SD] age, 78.7 [7.7] vs 81.5 [7.9] years) less likely
to be female (58.6% vs 64.6%), and less likely to be dually enrolled
in Medicare and Medicaid (12.9% vs 20.7%) (Table 1). Patients dis-
charged to home health care and SNFs had a similar mean (SD)
total number of comorbidities (3.2 [2.7] vs 3.3 [2.8]) (Table 1) and
a lower prevalence of most measured comorbidities (eTable 6 in
the Supplement). Discharges to home health care vs SNFs did vary
by DRG, with discharge to home health care more common than
discharge to an SNF after hospitalizations for total knee or hip
replacement (12.8% vs 11.2%), congestive heart failure (6.8% vs
4.4%), and pneumonia (4.4% vs 3.8%), but less common after
hospitalizations for sepsis (4.7% vs 6.3%) and urinary tract in-
fection (2.6% vs 4.1%).

Unadjusted patient outcomes were significantly better
among patients discharged to home health care: 15.8% were re-
admitted to the hospital within 30 days, vs 17.8% of those dis-
charged to an SNF; 2.3% died within 30 days, compared with
6.9% of those discharged to an SNF; and 80.2% had an improve-
ment in activities of daily living, vs 29.3% of those discharged to
an SNF (Table 2). Medicare payments were also significantly lower
among patients discharged to home health care than those dis-
charged to an SNF. In multivariable regression, these differences
persisted, although the magnitude of the difference in patient
outcomes generally decreased (Table 3). After covariate adjust-
ment, patients discharged to home health care had lower rates
of readmission by 1.6 percentage points (95% CI, 1.6-1.7; P < .001),
lower rates of mortality by 4.0 percentage points (95% CI,

3.9-4.0; P < .001), and higher rates of improvement in functional
status by 57.1 percentage points (95% CI, 56.5-57.5; P < .001).
Patients discharged to home health care also had lower Medicare
payments for hospitalization (−$698; 95% CI, −$740 to −$655;
P < .001), postacute care (−$8145; 95% CI, −$8244 to −$8045;
P < .001), and total payment within 60 days after admission
(−$9195; 95% CI, −$9309 to -$9081; P < .001).

In instrumental variables regression, these differences in pa-
tient outcomes disappeared and, in the case of readmissions,
changed direction to favor discharge to an SNF (Table 3). Patients
discharged to home health care had a higher rate of readmission
by 5.6 percentage points (95% CI, 0.8-10.3; P = .02). There were
no statistically significant differences in mortality rates (−2.0 per-
centage points; 95% CI, 0.8-10.3; P = .12) or improved functional
status (−1.9 percentage points; 95% CI, -12.0 to 8.2; P = .71) among
patients discharged to home health care. Among fee-for-service
discharges, Medicare payment for hospitalization was not sta-
tistically different for patients discharged to home with home
health care compared with those discharged to an SNF (−$1766;
95% CI, -$3621 to $89; P = .06), but Medicare payment for post-
acute care was statistically significantly lower (−$5384; 95% CI,
-$6932 to -$3837; P < .001). Total Medicare payment within the
first 60 days after admission was also lower for discharges to
home health care compared with those discharged to an SNF, but
the magnitude decreased compared with that seen in multivari-
able regression (−$4514; 95% CI, -$6932 to -$3837; P < .001).

The association of discharge to home health care with read-
mission to the hospital was further investigated in sensitivity
analyses using instrumental variable analyses (Table 4). There was
no difference in readmission associated with discharge to home
health care vs discharge to an SNF for nondiscretionary readmis-
sions (−0.8 percentage points; P = .49), but discharge to home
health care was associated with a higher rate of readmission for
discretionary readmissions compared with discharge to an SNF
(6.3 percentage points; P = .005). There was a higher rate of re-
admission for patients discharged to home health care compared
with those discharged to an SNF for both medical and surgical or
rehabilitation DRGs, but neither reached statistical significance.
The results held for fee-for-service enrollees (5.7 percentage
points; P = .02), did not achieve significance for Medicare Advan-
tage enrollees (5.3 percentage points; P = .48), but held in urban
areas (6.8 percentage points; P = .005) and in hospitals that were
not vertically integrated with an SNF or home health agency (7.3
percentage points; P = .008). Results for other outcomes are dis-
played in eTable 7 and eTable 8 in the Supplement.

When using a combined end point of readmission or death,
the results from instrumental variable analysis were similar to
the main outcome (eTable 9 in the Supplement). These re-
sults were strongest in the fee-for-service population, consis-
tent with the main result examining the association of dis-
charge to home health care with readmission alone.

Finally, we compared the characteristics of patients to whom
the results apply (ie, the marginal patient) with those of the full
sample (Table 5). We found that the marginal patient was less
likely than the average patient in the full sample to be older than
80 years (47.2% vs 54.2%), less likely to be white (78.3% vs 86.3%),
more likely to be dually enrolled in Medicare and Medicaid (22.2%
vs 17.7%), and less likely to be enrolled in Medicare Advantage

Table 2. Unadjusted Patient Outcomes and Medicare Payments Among Patients Discharged to Home Health Care and to SNFs

Outcome	Discharge to Home Health Care	Discharge to SNFs	Difference Between Discharge to Home Health Care (vs SNF)
Patient outcomes (all discharges [N = 17 235 854]), %			
Readmission within 30 d	15.8	17.8	−2.0
Death within 30 d	2.3	6.9	−4.6
Improvement in activities of daily living[a]	80.2	29.3	50.9
Medicare payment (fee-for-service Medicare discharges [n = 13 000 109]), mean (SD), $			
Medicare payment to hospital	11 240 (11 231)	11 549 (12 195)	−309
Medicare payment to HHA or SNF	2459 (1520)	11 073 (9414)	−8614
Total Medicare payment in first 60 d after hospital admission	17 088 (14 525)	26 101 (16 426)	−9013

Abbreviations: HHA, home health agency; SNF, skilled nursing facility.

[a] A total of 10 315 669 discharges for the outcome of improvement in activities of daily living because of missing assessments at discharge from postacute care for some patients.

Table 3. Differences in Outcome for Discharge to Home Health vs Skilled Nursing Facility

Outcome	Multivariable Regression		Instrumental Variable Regression	
	Difference (95% CI)	P Value	Difference (95% CI)	P Value
Patient outcomes (all discharges [N = 17 235 854]), percentage points				
Readmission within 30 d	−1.6 (−1.7 to −1.6)	<.001	5.6 (0.8 to 10.3)	.02
Death within 30 d	−4.0 (−4.0 to −3.9)	<.001	−2.0 (−4.5 to 0.5)	.12
Improvement in activities of daily living[a]	57.1 (56.6 to 57.5)	<.001	−1.9 (−12.0 to 8.2)	.71
Medicare payment (fee-for-service Medicare discharges [n = 13 000 109]), $				
Medicare payment to hospital	−698 (−740 to −655)	<.001	−1766 (−3621 to 89)	.06
Medicare payment to HHA or SNF	−8145 (−8244 to −8045)	<.001	−5384 (−6932 to −3837)	<.001
Total Medicare payment in first 60 d after hospital admission	−9195 (−9309 to −9081)	<.001	−4514 (−7150 to −1879)	<.001

Abbreviations: HHA, home health agency; SNF, skilled nursing facility.

[a] A total of 10 315 669 discharges for the outcome of improvement in activities of daily living because of missing assessments at discharge from postacute care for some patients.

Table 4. Percentage Point Difference in Readmission Rates for Patients Discharged to Home Health vs Skilled Nursing Facility

Outcome	Difference (95% CI)	P Value
Nondiscretionary readmissions (n = 17 235 854)	-0.8 (-3.0 to 1.4)	.49
Discretionary readmissions (n = 17 235 854)	6.3 (1.9 to 10.8)	.005
Admission for medical DRGs (n = 4 644 667)	6.5 (-1.1 to 14.1)	.10
Admission for surgical or rehabilitation DRGs (n = 2 710 607)	14.5 (-8.8 to 37.7)	.22
Fee-for-service enrollees (n = 13 000 109)	5.7 (1.1 to 10.4)	.02
Medicare Advantage enrollees (n = 4 235 745)	5.3 (-9.2 to 19.7)	.48
Urban location (n = 13 959 495)	6.8 (2.0 to 11.6)	.005
Hospitals without vertically integrated postacute care (n = 10 700 167)	7.3 (1.9 to 12.7)	.008

Abbreviation: DRG, diagnosis related group.

(21.8% vs 24.6%) or to have 6 or more comorbidities (16.6% vs 20.6%). When comparing the reason for hospitalization, we find that the marginal patients are similar to the full sample with respect to their DRGs.

Discussion

Among hospitalized patients discharged either to home with home health care or to an SNF, discharge to home was associated with a 5.6-percentage point higher rate of readmission at 30 days, concentrated among discretionary hospitalizations. There were no significant differences in 30-day mortality or functional outcomes. Medicare payments were significantly lower among patients discharged to home.

Prior observational studies have found better outcomes among patients discharged to home health care, but most have not accounted for confounding by indication and unobserved differences between the 2 groups[11] and, in the 1 study that uses similar methods, examined a much earlier time period.[12] One prior trial randomized 234 patients to home health care vs inpatient rehabilitation after total joint replacement and found that postoperative complications and functional improvement were similar across the groups, with higher costs associated with inpatient rehabilitation compared with home-based rehabilitation.[10] To our knowledge, our study provides the first large-scale and recent estimates of the differences in patient outcomes and Medicare payment between patients discharged to home with home health care compared with those discharged to an SNF and that addresses confounding by indication. Our study also provides the first es-

Table 5. Characteristics of Marginal Patients Compared With Patients in the Full Study Cohort[a]

Characteristic	Marginal Patients, %	Full Sample, %
Aged ≥80 y	47.2	54.2
Female sex	61.5	62.2
Race/ethnicity		
White	78.3	86.3
Black	8.6	9.4
Hispanic	1.3	1.7
Dually enrolled in Medicare and Medicaid	22.2	17.7
Enrolled in Medicare Advantage	21.8	24.6
High risk (having ≥6 comorbidities)	16.6	20.6
20 Most common DRG codes		
65: Intracranial hemorrhage or cerebral infarction with CC or tPA in 24 h	1.6	1.5
190: Chronic obstructive pulmonary disease with MCC	1.3	1.4
191: Chronic obstructive pulmonary disease with CC	1.0	1.0
193: Simple pneumonia and pleurisy with MCC	1.6	1.5
194: Simple pneumonia and pleurisy with CC	2.1	1.8
291: Heart failure and shock with MCC	2.3	2.3
292: Heart failure and shock with CC	2.5	2.3
312: Syncope and collapse	1.1	1.1
470: Major joint replacement or reattachment of lower extremity without MCC	12.2	11.2
481: Hip and femur procedures except major joint with CC	2.1	2.0
392: Esophagitis, gastroenterological, and miscellaneous digestive disorders without MCC	1.2	1.1
552: Medical back problems without MCC	1.2	1.1
603: Cellulitis without MCC	1.5	1.3
641: Miscellaneous disorders of nutrition, metabolism, fluids/electrolytes without MCC	1.4	1.3
682: Renal failure with MCC	1.1	1.2
683: Renal failure with CC	1.5	1.6
689: Kidney and urinary tract infections with MCC	0.9	1.2
690: Kidney and urinary tract infections without MCC	2.5	2.4
871: Septicemia or severe sepsis without MV≥96 h with MCC	3.7	4.1
872: Septicemia or severe sepsis without MV≥96 h without MCC	1.7	1.4

Abbreviations: CC, complication or comorbidity; DRG, diagnosis related group; MCC, major complication or comorbidity; MV, mechanical ventilation; tPA, tissue plasminogen activator.

[a] Marginal patients are those who could use either home health care or a skilled nursing facility but whose choice is determined by whether they live closer to a home health agency or not. The instrumental variables estimate is derived from these patients.

timate in this context that includes both Medicare fee-for-service and Medicare Advantage patients.

When interpreting these results, it is important to understand the population to whom they apply. In contrast to results from standard multivariable regression analyses in which the estimated effect for discharge to home represents the adjusted treatment effect for the average patient, the results of instrumental variable analyses apply to the so-called marginal patients.[23] The marginal patients in this study are those discharged to home with home health care solely because of their closer proximity to a home health agency than to an SNF, conditional on health character-

istics. In this context, these marginal patients may be interpreted as those whose need for home health vs SNF is borderline and either setting would be reasonable. Not surprisingly, these patients are younger and healthier on average. Perhaps more surprisingly, our treatment group includes patients with many reasons for hospitalization, increasing the generalizability and importance of these results.

There are several reasons why discharge to an SNF may prevent readmissions in these marginal patients. First, in providing institutional care, SNFs are able to provide 24-hour monitoring of patients, which may be effective at recognizing complications early and preventing unnecessary readmissions. Skilled nursing facilities are also able to provide a higher level of treatment intensity compared with home health care visits and can thus effectively treat patients who might require hospitalization if they were at home. Our finding that the lower readmission rates from SNFs are concentrated among readmissions that are potentially discretionary supports this hypothesis.

The reduction in readmissions comes at a cost for Medicare, as institutional postacute care is associated with higher Medicare payments than is providing postacute care at home. Even after accounting for the lower costs from fewer readmissions from SNFs, the total amount paid by Medicare for hospitalizations and postacute care during the 60-day posthospital period is lower for patients discharged to home compared with those discharged to an SNF.

These results have important implications. Since the Patient Protection and Affordable Care Act passed in 2010, Medicare has implemented payment reforms designed to reduce rates of readmission, such as the Hospital Readmission Reduction Program, and evidence suggests that rates of readmission have declined.[24] These incentives may push hospitals to favor the use of high-acuity settings such as SNFs, and our results suggest that this strategy may be effective at reducing readmissions. At the same time, alternative payment models such as accountable care organizations and bundled payments hold providers accountable for costs of care across settings and clinicians, an incentive that may push patients toward lower-cost care. Recent studies have found that the use of accountable care organizations and bundled payments are associated with lower rates of institutional postacute care, such as SNFs.[5-7] As payment incentives are refined to optimize provider response, balancing incentives to reduce costs with incentives to improve patient outcomes will be important.

Limitations

Our study has several limitations. First, while our instrumental variable approach provides a higher level of evidence than most prior studies of how outcomes differ between home and SNF settings, this approach may not fully address unobserved confounding. Second, as noted, these results apply only to the marginal patient; however, the marginal patient is the one most likely to be affected by current policies that may encourage substitution among settings. Although our instrument is strongly predictive of treatment choice, the effect size is small, suggesting that the number of marginal patients our estimates apply to is also small. However, as we show, marginal patients look very similar to the average patient. Third, our results also apply only to Medicare beneficiaries. Al-

though Medicare is the largest payer of postacute care, outcomes among younger patients may differ.

Conclusions

Despite these limitations, these findings provide important and novel estimates of the differences in patient outcomes and Medicare spending between home health care and SNFs. Among Medicare beneficiaries who are eligible for either home health care or SNF after hospital discharge, discharge to home with home health care was associated with higher rates of readmission but lower total payments. These results warrant further investigation of these postacute care settings and others given the common use and high costs associated with postacute care.

REFERENCES

1. Werner RM, Konetzka RT. Trends in post–acute care use among Medicare beneficiaries. *JAMA*. 2018;319(15):1616-1617. doi:10.1001/jama.2018.2408

2. Healthcare Cost and Utilization Project. Tian W. An all-payer view of hospital discharge to post-acute care, 2013. https://www.hcup-us.ahrq.gov/reports/statbriefs/sb205-Hospital-Discharge-Postacute-Care.jsp. Accessed February 3, 2019.

3. Medicare Payment Advisory Commission. A data book: health care spending and the Medicare program. http://www.medpac.gov/docs/default-source/data-book/jun17_databookentirereport_sec.pdf?sfvrsn=0. Accessed February 3, 2019.

4. Chandra A, Dalton MA, Holmes J. Large increases in spending on postacute care in Medicare point to the potential for cost savings in these settings. *Health Aff (Millwood)*. 2013;32(5):864-872. doi:10.1377/hlthaff.2012.1262

5. Navathe AS, Troxel AB, Liao JM, et al. Cost of joint replacement using bundled payment models. *JAMA Intern Med*. 2017;177(2):214-222. doi:10.1001/jamainternmed.2016.8263

6. Dummit LA, Kahvecioglu D, Marrufo G, et al. Association between hospital participation in a Medicare bundled payment initiative and payments and quality outcomes for lower extremity joint replacement episodes. *JAMA*. 2016;316(12):1267-1278. doi:10.1001/jama.2016.12717

7. McWilliams JM, Gilstrap LG, Stevenson DG, Chernew ME, Huskamp HA, Grabowski DC. Changes in postacute care in the Medicare shared savings program. *JAMA Intern Med*. 2017;177(4):518-526. doi:10.1001/jamainternmed.2016.9115

8. Chan L, Sandel ME, Jette AM, et al. Does postacute care site matter? *Arch Phys Med Rehabil*. 2013;94(4):622-629.

9. Mallinson T, Deutsch A, Bateman J, et al. Comparison of discharge functional status after rehabilitation in skilled nursing, home health, and medical rehabilitation settings for patients after hip fracture repair. *Arch Phys Med Rehabil*. 2014;95(2):209-217. doi:10.1016/j.apmr.2013.05.031

10. Mahomed NN, Davis AM, Hawker G, et al. Inpatient compared with home-based rehabilitation following primary unilateral total hip or knee replacement. *J Bone Joint Surg Am*. 2008;90(8):1673-1680.

11. Keswani A, Tasi MC, Fields A, Lovy AJ, Moucha CS, Bozic KJ. Discharge destination after total joint arthroplasty. *J Arthroplasty*. 2016;31(6):1155-1162.

12. Buntin MB, Garten AD, Paddock S, Saliba D, Totten M, Escarce JJ. How much is postacute care use affected by its availability? *Health Serv Res*. 2005;40(2):413-434.

13. Huckfeldt PJ, Escarce JJ, Rabideau B, Karaca-Mandic P, Sood N. Less intense postacute care, better outcomes for enrollees in Medicare Advantage than those in fee-for-service. *Health Aff (Millwood)*. 2017;36(1):91-100.

14. Centers for Medicare & Medicaid Services. Hospital Readmissions Reduction Program (HRRP). https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html. Accessed September 27, 2013.

15. Katz S, Downs TD, Cash HR, Grotz RC. Progress in development of the index of ADL. *Gerontologist*. 1970;10(1):20-30. doi:10.1093/geront/10.1_Part_1.20

16. Horwitz LI, Partovian C, Lin Z, et al. Hospital-wide all-cause unplanned readmission measure: final technical report. report. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Measure-Methodology.html. Published July 2012. Accessed February 4, 2019.

17. Fiorini M, Stevens K. Assessing the monotonicity assumption in IV and fuzzy RD designs. http://econ-wpseries.com/2014/201413.pdf. Published October 29, 2014. Accessed June 4, 2018.

18. Staiger D, Stock JH. Instrumental variables regression with weak instruments. *Econometrica*. 1997;65(3):557-586. doi:10.2307/2171753

19. Rahman M, Norton EC, Grabowski DC. Do hospital-owned skilled nursing facilities provide better post-acute care quality? *J Health Econ*. 2016;50:36-46. doi:10.1016/j.jhealeco.2016.08.004

20. Doyle JJ Jr. Returns to local-area health care spending: evidence from health shocks to patients far from home. *Am Econ J Appl Econ*. 2011;3(3):221-243. doi:10.1257/app.3.3.221

21. Konetzka RT, Polsky D, Werner RM. Shipping out instead of shaping up. *J Health Econ*. 2013;32(2):341-352.

22. Baiocchi M, Cheng J, Small DS. Instrumental variable methods for causal inference. *Stat Med*. 2014;33(13):2297-2340. doi:10.1002/sim.6128

23. Harris KM, Remler DK. Who is the marginal patient? *Health Serv Res*. 1998;33(5, pt 1):1337-1360.

24. Zuckerman RB, Sheingold SH, Orav EJ, Ruhter J, Epstein AM. Readmissions, observation, and the hospital readmissions reduction program. *N Engl J Med*. 2016;374(16):1543-1551.