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# Discharge home health services referral and 30-day all-cause readmission in older adults with heart failure

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## Abstract

**Introduction:** Heart failure (HF) is the leading cause of hospital readmission. Medicare home health services provide intermittent skilled nursing care to homebound Medicare beneficiaries. We examined whether discharge home health referral is associated with a lower risk of 30-day all-cause readmission in HF.

**Material and methods:** Of the 8049 Medicare beneficiaries hospitalized for acute HF and discharged alive from 106 Alabama hospitals, 6406 (76%) patients were not admitted from nursing homes and were discharged home without discharge hospice referrals. Of these, 1369 (21%) received a discharge home health referral. Using propensity scores for home health referral, we assembled a matched cohort of 1253 pairs of patients receiving and not receiving home health referrals, balanced on 33 baseline characteristics.

**Results:** The 2506 matched patients had a mean age of 78 years, 61% were women, and 27% were African American. Thirty-day all-cause readmission occurred in 28% and 19% of matched patients receiving and not receiving home health referrals, respectively (hazard ratio (HR) = 1.52; 95% confidence interval (CI): 1.29–1.80;  $p < 0.001$ ). Home health referral was also associated with a higher risk of 30-day all-cause mortality (HR = 2.32; 95% CI: 1.58–3.41;  $p < 0.001$ ) but not with 30-day HF readmission (HR = 1.28; 95% CI: 0.99–1.64;  $p = 0.056$ ). HRs (95% CIs) for 1-year all-cause readmission, all-cause mortality, and HF readmission are 1.24 (1.13–1.36;  $p < 0.001$ ), 1.37 (1.20–1.57;  $p < 0.001$ ) and 1.09 (0.95–1.24;  $p = 0.216$ ), respectively.

**Conclusions:** Hospitalized HF patients who received discharge home health services referral had a higher risk of 30-day and 1-year all-cause readmission and all-cause mortality, but not of HF readmission.

**Key words:** home health care, 30-day all-cause readmission, mortality, Medicare, heart failure.

## Introduction

Heart failure (HF) is a leading cause of 30-day all-cause readmission, a metric used in the U.S. healthcare system to reduce readmission to lower Medicare costs [1, 2]. Few transitional care interventions have been shown to be consistently associated with a lower risk of 30-day all-

cause readmission in HF [3–5]. While some of the evidence-based HF drugs are effective in lowering the risk of 30-day all-cause readmission [6–12], none are effective in HF patients with preserved ejection fraction (HFpEF), who constitute over half of all older HF patients [13]. We have previously demonstrated that a discharge hospice referral is associated with a lower risk of 30-day all-cause readmission in patients with HF regardless of EF [14]. However, less is known about the association between home health care and 30-day all-cause readmission in HF [15, 16]. In the current analysis we examined the association between discharge home health referral and 30-day all-cause readmission in a propensity score-matched balanced cohort of HF patients.

## Material and methods

### Data source and study patients

The Alabama HF Project is a Medicare quality improvement project, the details of which have been previously described [8, 17, 18]. Briefly, med-

ical records of 9649 fee-for-service Medicare beneficiaries who had a principal discharge diagnosis of HF based on International Classification of Diseases 9 codes were abstracted by trained abstractors. These patients were admitted for acute HF to 106 Alabama hospitals between July 1, 1998 and October 31, 2001. The 9649 hospitalizations occurred in 8555 unique patients, of whom 8049 were discharged alive. We restricted our analysis to the 6406 patients who were not admitted from nursing homes, who were discharged home, and who did not receive a discharge hospice referral. Of these, 1369 (21%) patients received a discharge referral for home health services (Figure 1).

### Retrospective assembly of a balanced cohort

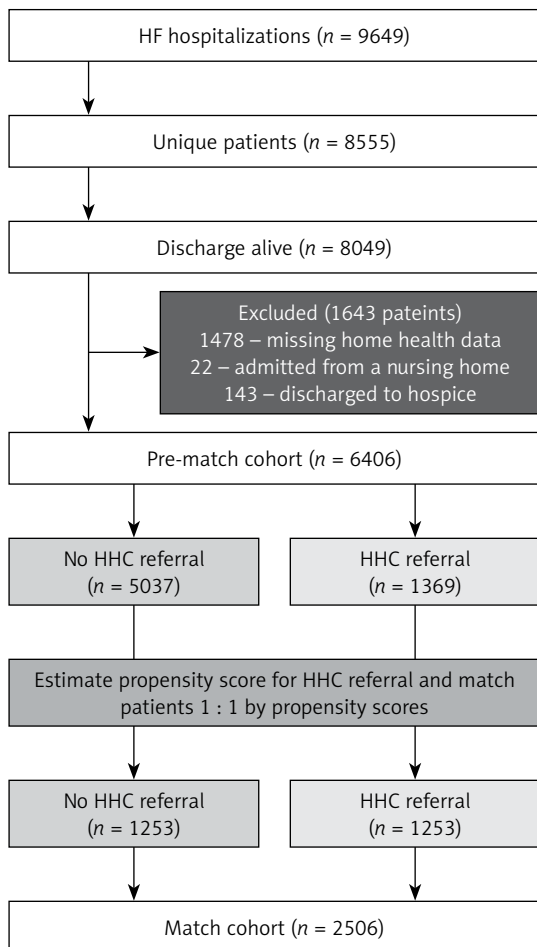
We used a non-parsimonious logistic regression model to estimate propensity scores for home health services referral for each of the 6406 patients [19–22]. In the model, home health services referral was the dependent variable and 33 measured baseline characteristics displayed in Figure 1 were used as covariates. The propensity score for home health referral is the conditional probability of receiving a home health referral based on these 33 baseline characteristics. We then used the propensity scores to assemble a matched cohort of 1253 pairs of patients receiving and not receiving home health referrals and examined between-group post-match balances for all 33 baseline characteristics using absolute standardized differences [23].

### Outcomes data

Our primary outcome of interest was 30-day all-cause readmission. Other outcomes studied included 30-day all-cause mortality, 30-day HF readmissions, and a combined end-point of all-cause mortality or all-cause readmission at 30 days. All outcomes were examined at 12 months. Data on outcomes and time to events were obtained from Medicare claims data [17].

### Statistical analyses

Descriptive analyses included Pearson’s  $\chi^2$  and Wilcoxon rank-sum tests as appropriate. Association analysis included Cox regression models among matched patients. Kaplan-Meier survival analysis was used to generate plots for 1-year all-cause readmissions by home health services referral. Formal sensitivity analyses were performed to determine the confounding impact of a potentially unmeasured baseline characteristic on our observed outcomes [24]. We also examined the association of home health services use with the primary outcome among the 6406 pre-match pa-



**Figure 1.** Flow chart displaying assembly of a balanced matched cohort for hospitalized heart failure (HF) patients receiving and not receiving discharge home health care (HHC) referrals

tients using Cox regression models, unadjusted and separately adjusting for propensity scores and the 33 variables used to estimate propensity scores. All statistical tests were two-tailed with a  $p$ -value  $< 0.05$  considered significant. IBM SPSS Statistics for Windows, Version 23 Armonk, NY: IBM Corp. was used for data analyses.

## Results

### Baseline characteristics

The 2506 matched patients had a mean age of 78 years, 61% were women, and 27% were African American. Before matching, patients receiving referrals for home health services were generally older and more likely to be female. More patients in the home health services group had prior HF, chronic obstructive pulmonary disease (COPD), or stroke, and fewer patients received discharge prescriptions for angiotensin-converting enzyme (ACE) inhibitors or angiotensin-receptor blockers (ARBs), and  $\beta$ -blockers (Table I). These along with other imbalances were balanced in the matched cohort (Table I, Figure 2).

### Associations with 30-day outcomes

Among matched patients, 30-day all-cause readmission occurred in 28% and 19% of matched patients receiving and not receiving home health services referrals, respectively (hazard ratio (HR) = 1.52; 95% confidence interval (CI): 1.29–1.80; Table II). Among pre-match patients, unadjusted, propensity score-adjusted, and multivariable-adjusted HRs for 30-day all-cause readmission associated with home health referrals were 1.59 (1.42–1.80), 1.46 (1.28–1.67), and 1.45 (1.27–1.65), respectively. Associations of home health referral with other 30-day outcomes are displayed in Table II.

Of the 1253 matched pairs of patients receiving and not receiving a home health referral, in 509 pairs we were able to identify patients who clearly had longer readmission-free 30-day survival than their matched counterparts. In the absence of a hidden bias, a sign-score test for matched data with censoring demonstrated that in 60% (303 pairs of the 509 pairs), the home health referral group had shorter event-free survival time than their matched counterparts without a home health referral ( $p < 0.001$ ). A hidden covariate that is a near-perfect predictor of 30-day all-cause readmission could explain away this association if it increased the odds of home health referral by 19%.

### Associations with 12-month outcomes

Twelve-month all-cause readmission occurred in 73% and 69% of matched patients receiving

and not receiving home health care referrals, respectively (HR = 1.24; 95% CI: 1.13–1.36; Table II and Figure 3). Home health services referral was associated with a borderline significantly higher risk of HF readmission at 1 month but not at 12 months. Associations of home health services with other 12-month outcomes are displayed in Table II.

## Discussion

Findings from our current analysis demonstrate that hospitalized older patients with HF who were discharged home with home health services had a significantly higher risk of both 30-day all-cause readmission and all-cause mortality, which persisted during 12 months of follow-up. The association with 30-day HF readmission was modest and of borderline significance, and disappeared during 12-month follow-up. To the best of our knowledge, this is the first propensity score-matched study to demonstrate that Medicare beneficiaries hospitalized for HF who were discharged home with home health services, a Medicare benefit, had a higher risk of 30-day all-cause readmission, the reduction of which is a goal of the Medicare Hospital Readmission Reduction Program [2].

Patients eligible for Medicare home health services must be homebound and need intermittent skilled nursing care, both of which must be certified by a physician, who must also establish a plan of care and regularly review it. Thus, home health care services that involve intermittent skilled nursing care under supervision of a physician are unlikely to have any causal association with poor outcomes in these patients. A higher risk of mortality in patients receiving home health services is likely explained by selection or indication bias, akin to higher mortality in patients receiving insulin, where the indication bias would be diabetes [25]. Because matched patients in our study were balanced on 33 key baseline characteristics, balanced unmodifiable baseline characteristics such as age or sex are unlikely to act as confounders. However, balanced modifiable baseline characteristic such as diabetes, chronic obstructive pulmonary disease, stroke, dementia, pneumonia, and pressure ulcer may act as confounders. If these conditions were more severe or advanced in the home health group, that may in part explain the higher mortality in the home health group, as matching cannot balance disease severity or incidence of new complications during follow-up. Bias due to unmeasured or unmeasurable confounders is also possible. Finally, lower ACE inhibitor and  $\beta$ -blocker use in the home health group may also contribute to the higher mortality in that group [9, 11]. Although the use of these drugs was balanced after matching, if the causes of underuse at baseline (e.g., low blood pressure) continued during

**Table I.** Baseline characteristics of patients with heart failure, by home health referral, before and after propensity matching

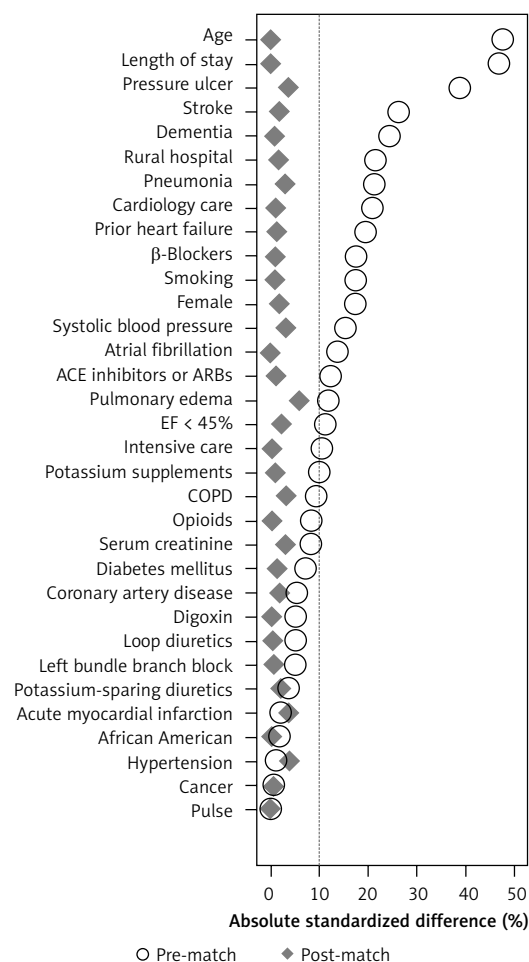
Parameter n (%) or mean ± SD	Before propensity score matching			After propensity score matching		
	Discharge home health referral (n = 6406)		P-value	Discharge home health referral (n = 2506)		P-value
	No (n = 5037)	Yes (n = 1369)		No (n = 1253)	Yes (n = 1253)	
Age [years]	73 ±11	78 ±10	< 0.001	78 ±9	78 ±10	0.762
Female	2695 (54)	850 (62)	< 0.001	766 (61)	775 (62)	0.743
African American	1317 (26)	369 (27)	0.556	332 (27)	333 (27)	1.000
Left ventricular ejection fraction:						
< 45%	2070 (41)	487 (36)	< 0.001	469 (37)	455 (36)	0.759
≥ 45%	1561 (31)	364 (27)		350 (28)	347 (28)	
Unknown	1406 (28)	518 (38)		434 (35)	451 (36)	
Past medical history:						
Smoking history	685 (14)	112 (8)	< 0.001	105 (8)	108 (9)	0.886
Prior heart failure	3511 (70)	1071 (78)	< 0.001	968 (77)	971 (78)	0.924
Hypertension	3530 (70)	966 (71)	0.739	861 (69)	882 (70)	0.385
Coronary artery disease	2848 (57)	738 (54)	0.086	693 (55)	680 (54)	0.630
Diabetes mellitus	2169 (43)	638 (47)	0.020	583 (47)	575 (46)	0.779
Stroke	807 (16)	365 (27)	< 0.001	315 (25)	305 (24)	0.677
Chronic obstructive pulmonary disease	1763 (35)	540 (39)	0.003	471 (38)	490 (39)	0.460
Dementia	197 (4)	138 (10)	< 0.001	113 (9)	110 (9)	0.888
Cancer	101 (2)	26 (2)	0.913	24 (2)	23 (2)	1.000
Atrial fibrillation	1213 (24)	413 (30)	< 0.001	367 (29)	367 (29)	1.000
Left bundle branch block	708 (14)	169 (12)	0.110	154 (12)	157 (13)	0.904
Clinical and laboratory findings:						
Pulse [beats/minute]	89 ±22	89 ±22	0.950	90 ±22	90 ±23	0.793
Systolic blood pressure [mm Hg]	151 ±32	146 ±33	< 0.001	148 ±31	147 ±33	0.718
Pulmonary edema by chest X-ray	3261 (65)	962 (70)	< 0.001	905 (72)	872 (70)	0.159
Serum creatinine [mEq/l]	1.6 ±1.4	1.5 ±1.0	0.094	1.58 ±1.0	1.55 ±1.0	0.526
In-hospital events:						
Pneumonia	1047 (21)	411 (30)	< 0.001	367 (29)	350 (28)	0.479
Acute myocardial infarction	186 (4)	56 (4)	0.473	62 (5)	52 (4)	0.388
Pressure ulcer	152 (3)	185 (14)	< 0.001	110 (9)	123 (10)	0.409
Hospital and care characteristics:						
Rural hospital	1426 (28)	526 (38)	< 0.001	464 (37)	474 (38)	0.710
Cardiology care	2817 (56)	623 (46)	< 0.001	575 (46)	582 (46)	0.810
Intensive care	140 (3)	65 (5)	< 0.001	50 (4)	49 (4)	1.000
Length of stay	5.6 ±3.3	7.9 ±6.1	< 0.001	7.2 ±4.5	7.2 ±4.0	0.762
Discharge medications:						
ACE inhibitors or ARB	3209 (64)	771 (56)	< 0.001	723 (58)	716 (57)	0.808
β-Blockers	1716 (34)	356 (26)	< 0.001	331 (26)	336 (27)	0.857
Loop diuretics	4165 (83)	1158 (85)	0.104	1062 (85)	1064 (85)	0.956
Digoxin	2148 (43)	619 (45)	0.091	560 (45)	562 (45)	0.968
Potassium-sparing diuretics	732 (15)	217 (16)	0.230	207 (17)	198 (16)	0.664
Potassium supplements	2265 (47)	683 (50)	0.055	620 (50)	626 (50)	0.842
Opioids	201 (4)	79 (6)	0.006	65 (5)	66 (5)	1.000

ACE – angiotensin converting enzyme, ARB – angiotensin receptor blocker.

follow-up, then these drugs may be discontinued in more home health patients during follow-up.

Physician-supervised intermittent skilled nursing care received by home health patients is not likely to be causally associated with a higher risk of all-cause readmission, and bias by indication may explain the higher readmission in these patients. However, skilled nursing care, ironically, may also lead to a higher rate of hospital readmission due to frequent and prompt identification and reporting of the warning symptoms and signs to patients' primary care physicians, who may perceive them to be more objective than those reported by patients and/or family [26]. Unlike hospice agencies, home health care agencies do not have provisions for paid in-house medical directors, and early warning signs need to be discussed with patients' primary care physicians, which may lead to delays, worsening symptoms, and readmission [26]. Finally, the heterogeneity of care across home health teams, the lack of nursing staff specifically trained to manage HF patients, and unstructured communication during transition from hospital to home health care may also contribute [27, 28].

Interestingly, most of the 30-day all-cause readmissions associated with a home health referral was due to non-HF related causes. Of the 1253 pairs of matched patients, those in the home health group had 106 (346–240) more 30-day all-cause readmissions, but only 27 (137–110) of those were due to HF (Table II). Therefore, about 75% of all 30-day all-cause readmissions were non-HF related. The association of home health referral with HF readmission is weak and likely complex. The slightly higher 30-day HF readmission in the home health group, of borderline significance, disappeared during longer follow-up. It is possible that patients were referred to home



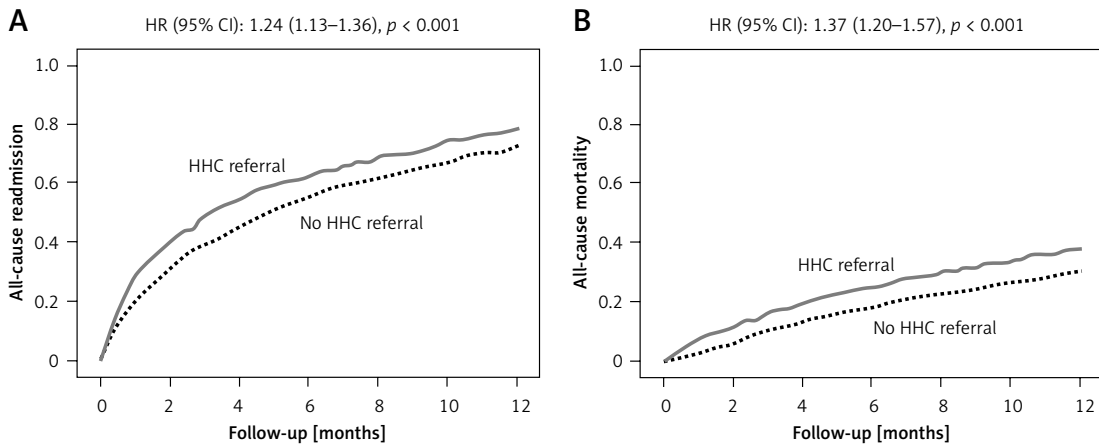
**Figure 2.** Love plot displaying absolute standardized differences for 33 baseline characteristics between patients receiving and not receiving home health care referrals, before and after propensity score matching

ACE – angiotensin converting enzyme, ARB – angiotensin receptor blocker, COPD – chronic obstructive lung disease, EF – ejection fraction.

**Table II.** Discharge home health referral and outcomes in propensity score-matched cohort of patients with heart failure

Variable	Discharge home health referral		Hazard ratios (95% confidence intervals) P-value
	No (n = 1253)	Yes (n = 1253)	
30-day outcomes:			
All-cause readmission	19% (240)	28% (346)	1.52 (1.29–1.80); p < 0.001
Heart failure readmission	9% (110)	11% (137)	1.28 (0.99–1.64); p = 0.056
All-cause mortality	3% (37)	7% (84)	2.32 (1.58–3.41); p < 0.001
All-cause readmission or all-cause mortality	21% (257)	31% (387)	1.59 (1.36–1.86); p < 0.001
12-month outcomes:			
All-cause readmission	69% (866)	73% (914)	1.24 (1.13–1.36); p < 0.001
Heart failure readmission	36% (449)	36% (450)	1.09 (0.95–1.24); p = 0.216
All-cause mortality	30% (376)	38% (478)	1.37 (1.20–1.57); p < 0.001
All-cause readmission or all-cause mortality	88% (1101)	93% (1160)	1.27 (1.17–1.38); p < 0.001

\*Hazard ratios comparing patients with a home health referral.



**Figure 3.** Kaplan-Meier plots for all-cause readmission (A) and all-cause mortality (B) at 1 year by discharge home health referral (HHC) in a propensity-matched cohort of older heart failure patients (HR – hazard ratio, CI – confidence interval)

health services for reasons other than HF, such as dementia and pressure ulcer. This notion is also supported by the observation that there was no between-group difference in HF severity as indicated by similar use of digoxin and diuretics. It is possible that the incidence of worsening HF symptoms was similar in both groups, but was identified and reported at a higher rate in home health patients [26]. For example, an older HF patient may respond to worsening shortness of breath and weight gain by limiting physical activity and mobility, but may be identified by a visiting home health team. This association disappears during 1-year follow-up as the average duration of home health services is about 3 months [29].

Several studies have examined the role of home health care in readmission in HF patients. In one study that compared home health care with three home visits by a nurse versus one outpatient visit to a physician during the first post-discharge week, neither approach was found to be associated with a significant reduction in 30-day all-cause readmission [16]. However, when both approaches were combined, there was evidence of a modest reduction in the risk of readmission that was significant. Findings from two small studies suggest that programs involving home visits by nurses or pharmacists to educate or reconcile medications may have a modest association with a lower risk of 30-day all-cause readmission, but HF readmission was not reported [4]. To the best of our knowledge, this is the first report of an association of home health care with poor outcomes in a propensity score-matched cohort of HF patients.

The Veterans Health Administration (VHA) Home Based Primary Care (HBPC) program that provides comprehensive multidisciplinary services to veterans with complex health care needs has been shown to be associated with a lower readmission rate in selected veterans with medically complex diabetes mellitus [30]. Hospitalized HF

patients receiving discharge hospice referral are also sick and have a higher mortality but lower readmission [14]. Hospice patients forgo aggressive medical care in favor of palliative care, which in part may explain the lower readmission rates. However, it has also been suggested that the presence of a hospice medical director and standing orders may also contribute to the lower risk of readmission. Future randomized controlled trials need to examine whether these and other strategies such as improving physical activity and mobility incorporated into the home health services program would improve outcomes, thus providing evidence of cost effectiveness of a program that often allows hospitalized frail patients to go home [31, 32].

Our study has several limitations. We had no data on patient mobility, frailty, health literacy, social support, and need for skilled nursing care for patients not receiving home health services to determine their eligibility. As mentioned above, bias from unmeasured confounders and residual bias from measured confounders are possible. We had no data on compliance, and post-discharge crossover of home health use may result in misclassification and regression dilution [33]. Our analysis is based on fee-for-service Medicare beneficiaries from a single state in an earlier era of HF management, which may limit its generalizability. Additionally, our study cannot account for changes in Medicare payment policies that affect home health utilization and services. Despite these limitations, we hope that these data highlight the need and provide incentives for randomized controlled trials that can demonstrate the beneficial effect of home health care on mortality and readmission.

In conclusion, among hospitalized older HF patients, a discharge referral for home health services was associated with higher risks for 30-day and 1-year all-cause readmission and mortality but not with HF readmission. Future studies need

to replicate these intriguing findings and explain the underlying reasons for the poor outcomes among patients referred to home health care.

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### Conflict of interest

Dr. Fonarow reports consulting with Amgen, Novartis, Medtronic, and St Jude Medical and was the Principle Investigator of OPTIMIZE-HF. None of the other authors report any conflicts of interest related to this manuscript.

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