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Timing of Home Health Care Initiation and 30-Day Rehospitalizations Among Medicare Beneficiaries with Diabetes by Race and Ethnicity

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Abstract: Older adults with diabetes are at elevated risk of complications following hospitalization. Home health care services mitigate the risk of adverse events and facilitate a safe transition home. In the United States, when home health care services are prescribed, federal guidelines require they begin within two days of hospital discharge. This study examined the association between timing of home health care initiation and 30-day rehospitalization outcomes in a cohort of 786,734 Medicare beneficiaries following a diabetes-related index hospitalization. Of these patients, 26.6% were discharged to home health care. To evaluate the association between timing of home health care initiation and 30-day rehospitalizations, multivariate logistic regression models including patient demographics, clinical, geographic variables, and neighborhood socio-economic variables were used. Inverse probability-weighted propensity scores were incorporated into the analysis to account for potential confounding between the timing of home health care initiation and the outcome in the cohort. Compared to patients who received home health care within the recommended first two days, patients who received delayed services (3-7 days after discharge) had higher odds of rehospitalization (*OR* 1.28, *95% CI* 1.25-1.32). Among patients who received late services (8-14 days after discharge), the odds of rehospitalization were four times greater than for patients receiving services within 2 days (*OR* 4.12, *95% CI* 3.97-4.28). Timely initiation of home health care following diabetes-related hospitalizations is one strategy to improve outcomes.

Keywords: chronic conditions; diabetes; older adults; race or ethnicity; social determinants of health; inequalities or inequities; policy; health care access; home health care; rehospitalization

1. Introduction

In the United States, nearly one in four older adults are living with diabetes, a condition associated with increased morbidity, mortality, and healthcare utilization [1-3]. Adults with diabetes accounted for approximately 21% of home health care spending in the United States in 2017 [4] and experience higher rehospitalization rates than patients without diabetes [2]. Increased rehospitalization risk may be due to more complicated transitions from hospital to home, complex medication regimens, and co-existing conditions that impact functional or cognitive status [5,6]. With prompt clinical assessment to address deterioration in condition and medication reconciliation, effective post-acute home health care services can mitigate the risks of adverse events, including rehospitalization [5,7,8]. Furthermore, skilled home health care services can support patients with

diabetes by evaluating and reinforcing diabetes self-management skills, medication management, nutritional support, and glucose monitoring to prevent complications [9-11].

Facilitating a safe return home following hospitalization should be a collaboration between the patient, their families, and acute and outpatient providers. This involves both the identification of patients who might benefit from home health care and coordination of the referral to ensure timely initiation of services and prompt outpatient follow-up [12-15]. This collaborative process relies on numerous people, structures, and processes to create, communicate, and enact the discharge plan. Institutional and structural barriers can cause delayed or missed care. In recent studies of Medicare patients discharged to home health care in 2015-2016, 54% of all hospitalizations [16] and 73% of patients with a diabetes-related stay [17] received home health care within two weeks of discharge. Racial/ethnic disparities in post-acute referral and utilization of home health care were observed in both studies for non-Hispanic Black, Asian American/Pacific Islander (AAPI), American Indian/Alaska Native (AIAN), and Hispanic patients compared to (non-Hispanic) white patients [16,17]. Efforts to standardize institutional processes using clinical decision tools are ongoing for referral decisions during the discharge planning and prioritize home health visits at the agency level [12,18].

Directly building on our earlier paper [17] examining predictors of hospital discharge to home health care and post-acute home health care use among Medicare beneficiaries with diabetes, this paper explores the question, what is the relationship between delayed, late, or missed home health care and 30-day all-cause rehospitalizations.

2. Materials and Methods

2.1. Study Design and Conceptual Framework

This was a retrospective analysis of Medicare fee-for-service and Medicare Advantage beneficiaries who experienced a diabetes-related hospitalization in 2015 that ended in discharge to home with a home health care referral or self-care [17]. Linked datasets utilized for this project include 2014-2016 100% Medicare Beneficiary Summary File (MBSF), the inpatient Medicare Provider and Analysis Review (MedPAR) file, and home health Outcome and Assessment Information Set (OASIS). The study design, variable selection, and interpretation of results were guided by our adaptation [17] of Andersen and Newman's Framework for Viewing Health Services Utilization (Figure 1) [19].

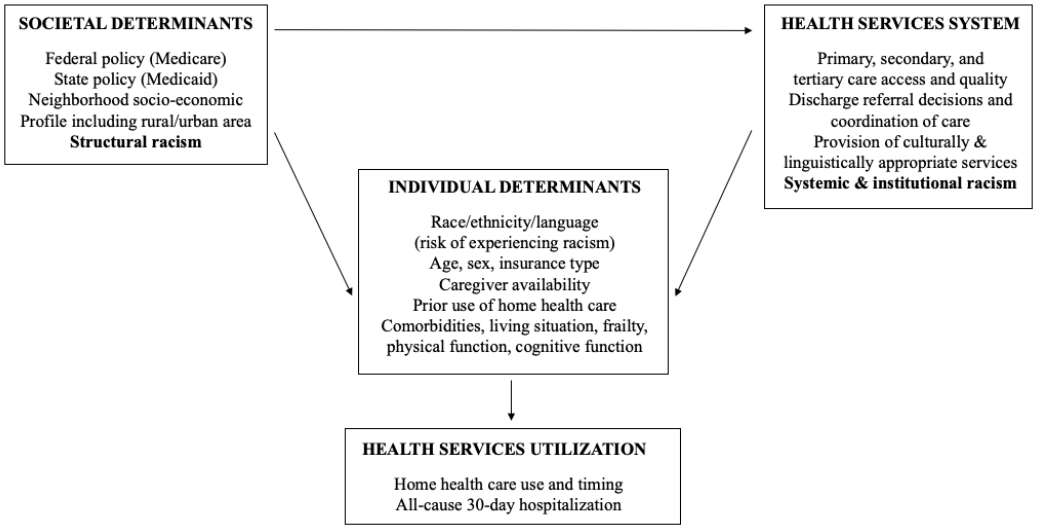

Figure 1. Conceptual model based on Andersen and Newman's Framework for Viewing Health Services Utilization [17].

From this lens, societal determinants, including federal and state policy, neighborhood socio-economic and geographic factors, and structural racism exert direct and indirect effects on individuals' access to and utilization of primary care. Examples of health

system resources and services that vary by geography encompass availability and type of primary care including home health care, secondary care including endocrinologists and insulin-pump providers, and tertiary care including potentially avoidable hospital stays.

2.2. Study Population

The study sample was constructed by identifying all unique, diabetes-related hospital admissions during 2015 among the national Medicare and Medicare Advantage population (100%) living within the United States (including Puerto Rico) (n = 1,270,929) [17]. We took into consideration the racial/ethnic, socioeconomic, and age disparities associated with diabetes onset, progression, and risk of serious complications (e.g., blindness, renal failure, infection, and amputation). The average age of non-Hispanic white patients with diabetes is older than non-Hispanic Black, Asian, and Hispanic patients [20]. Therefore, we included Medicare beneficiaries aged 50 and older in our study population [17]. Diabetes-related hospitalizations were defined as either (1) a primary admitting diagnosis of diabetes or (2) a secondary diagnosis of diabetes and a diabetes-related condition including cardiovascular, renal, lower extremity, or eye diseases [21]. The list of ICD-9 and ICD-10 diagnosis codes used to identify diabetes-related hospitalizations in this study was previously reported [17]. The study population was restricted to patients continuously enrolled in Medicare for at least 12 months prior to the index hospitalization and were hospitalized during the 120-days prior to the index hospitalization [17]. Finally, we limited the sample to patients with a hospital discharge destination of home with home health care or home with self-care, resulting in a cohort of 786,734 Medicare beneficiaries [17].

2.3. Data Sources and Variables

The primary outcome was 30-day, all-cause rehospitalization, identified from the Medicare Provider and Analysis Review File (MedPAR). The primary independent variable was the timing of post-acute home health care initiation, categorized as prompt (0-2 days), delayed (days 3-7), late (days 8-14), or not received. This variable was defined as the days from index hospital discharge (MedPAR) to the first post-acute home health assessment (OASIS).

We measured individual-level characteristics including age, sex, race/ethnicity, insurance, comorbidities, hospital length of stay, and use of home health care during the 120-days prior to index hospitalization [17]. To minimize the frequency of unknown/other race and misclassification error the imputed Research Triangle Institute (RTI) race variable contained in the Medicare Beneficiary Summary File (MBSF) was augmented with patients' self-reported race/ethnicity from home health care assessment (OASIS) data [22, 23]. We used six mutually exclusive racial/ethnic categories: non-Hispanic white, Black, Hispanic, Asian American/Pacific Islander (AAPI), American Indian/Alaska Native (AIAN), and unknown/other. Flags for end stage renal disease and dementia [17] supplemented the comorbidities from the Elixhauser Index [24]. Geographic variables included patients' state of residence for which we used a dummy variable for each state to minimize error associated with between-state variation in Medicare Advantage and Medicaid programs.

The neighborhood profile variable was created by combining socioeconomic disadvantage and urban-rural classification into a four-category variable: a) rural-advantaged, b) rural-disadvantaged, c) urban-advantaged, d) urban-disadvantaged [17]. Socioeconomic disadvantage was defined as living in a census tract classified at the 85th percentile or above on the 2015 Area Deprivation Index 2.0 composite of 17 socioeconomic indicators from the 2011-2015 U.S. Census American Community Survey [25]. Zip codes were classified as rural or urban using the 2013 Economic Research Service's Rural-Urban Continuum Codes (RUCC) for 5-digit zip codes [26]. Binary indicators for these two variables were linked to patients' 9-digit zip codes using source data crosswalks [25,26].

2.4. Analytic Approach

In our cohort, home health care utilization and timing of services are influenced by individual patient need, as well as institutional and societal factors that impact discharge planning and availability of culturally and linguistically appropriate services. Historically, propensity score methods have been used to account for potential selection bias in observational studies and were first proposed by Rosenbaum & Rubin (1983) to balance the treatment groups on risk factors [27]. Constructing and incorporating a propensity score rather than adding additional risk factors directly to the outcome model has both conceptual and technical advantages. Conceptually propensity scores can account for potentially confounding factors that may not be used to account for differences in the outcome such as neighborhood socioeconomic profile and unmeasured state differences in health policy. Technically, when there are large numbers of predictors, complex interactions and/or nonlinear relationships with the treatment groups may also be present that make them difficult to be directly included in the outcome model [28].

A multinomial logit model for the four categories of home health care timing was used to estimate the propensity scores. We included the variables associated with the timing of home health care and some interaction terms including prior home health care use, race/ethnicity [racism], insurance type, neighborhood profile, and selected comorbidities. Due to the high skewness of length of stay, we included the log-transformation of it as a predictor in the propensity score model. Additional covariates used in the propensity score were hospital discharge destination, prior use of home health care, age group, sex, race/ethnicity, insurance type, state of residence, neighborhood socio-economic profile, Elixhauser comorbidity index score, and comorbidities.

After propensity scores were estimated, a patient was weighted by the inverse probability of the patient receiving the treatment they actually received based on observed predictors in the analysis of outcomes including the stratified analyses based on race. To maintain the sample size we use the proportion of the treatment in the entire cohort as the numerator of the patient's weight, which also serves to numerically stabilize the weight in case the probability is small. Inverse probability weighting approach uses all patients in the dataset and reweights patients to increase the weights of those with probabilities lower than expected under proportional assignment to the four home health care timing groups. The reweighted data set created a pseudo-population for which there is no confounding due to the included predictors, although unobserved confounding may still exist. The inverse probability weighting approach is attempting to mimic a situation in which treatment is randomly allocated to individuals and is the most suitable one for our purpose. Inverse probability weighting estimation results in estimates that can be interpreted as the average treatment effect (ATE) for the entire cohort being studied.

All analyses were performed using SAS software, version (9.4) (SAS Institute, Inc., Cary, NC). The threshold for statistical significance was set at $p < .05$. These analyses are part of a larger study titled, Comparative Effectiveness of Home Care for Diverse Elders' Outcomes, approved by the Institutional Review Board of Rutgers, The State University of New Jersey and the Centers for Medicare and Medicaid Services privacy review board.

3. Results

3.1. Patient Characteristics by Timing of First Home Health Care Visit

In our cohort, 26.6% (213,766) of total patients (786,734) received post-acute home health care [17], and 71.6% (153,132) of these patients received prompt services that started within two days of hospital discharge. The patients who received prompt and delayed services had longer hospital length of stays than those patients who received late or no services. While the Elixhauser comorbidity index scores were similar, there were some differences in comorbity diagnosis across the groups. The patients who received prompt and delayed services had higher rates of chronic pulmonary disease, congestive heart failure, complicated diabetes, and peripheral vascular diseases. A larger portion of patients who received late care had end-stage renal disease. Patients with dementia received more prompt, delayed, and late home health care. A smaller portion of

Hispanic, American Indian/Alaska Native, and Asian American/ Pacific Islander patients received prompt services. Greater proportions of fee-for-service/Medicaid beneficiaries received prompt, delayed, and late care. Among the patients who did not received home health services, there were higher proportions of Medicare Advantage beneficiaries, and patients who were Hispanic, American Indian/Alaska Native, or Asian American/ Pacific Islander. Patients with recent use of home health care received more more services, nearly half of them received a prompt visit following hospitalization.

The 30-day all-cause rehospitalization rate for the entire cohort (n = 122,743) was 15.6%. Patients referred for home health care services have a need for skilled nursing care and are at higher risk of rehospitalization. Among patients who received home health care that started promptly (days 0-2 after discharge) or was delayed (days 3-8), 20% were rehospitalized (Table 1). In contrast, 40% of patients were rehospitalized when services started late (days 8-14). Additional descriptive results are presented in Table 1 stratified by timing of home health care initiation.

3.2. Balance of Predictors after Propensity Score Weighting

All pairwise Standardized Mean differences after inverse probability weighting between the four home health care timings are within the recommended limits of |0.25| except for prior home health care use, indicating all but one variable achieved satisfactory balance after inverse probability weighting. Even when a strict range such as |0.1| is used, we still achieved satisfactory balance except for prior home health care use and discharge destination. To account for potential imbalance prior home health care use and index hospitalization discharge destination were included in the final logistic models for the outcomes.

Table 1. Sample characteristics and outcome by timing of first home health care visit, row percentage displayed

	Timing of First Home Health Care Visit				
	Total n = 786,734	Day 0-2 153,132 (19.5)	Day 3-7 46,659 (5.9)	Day 8-14 13,975 (1.8)	Not Received 572,968 (72.8)
Race/Ethnicity					
white	534,725	108,661 (20.3)	29,450 (5.5)	8,806 (1.6)	387,808 (72.5)
Black	134,246	26,321 (19.6)	10,443 (7.8)	3,045 (2.3)	94,437 (70.3)
Hispanic	86,824	13,897 (16.0)	5,233 (6.0)	1,665 (1.9)	66,029 (76.0)
Asian American/Pacific Islander	19,888	3,409 (17.1)	1,234 (6.2)	365 (1.8)	14,880 (74.8)
American Indian/Alaska Native	5,859	834 (14.2)	299 (5.1)	94 (1.6)	4,632 (79.1)
Unknown	5,192	-	-	-	5,192 (100)
Sex, Male	402,779	70,416 (17.5)	20,060 (5.0)	6,283 (1.6)	306,020 (76.0)
Sex, Female	383,955	82,716 (21.5)	26,599 (6.9)	7,692 (2.0)	266,948 (69.5)
Age ($\bar{x}$, *SD*)	73.1 (9.7)	75.50 (10.1)	75.14 (10.1)	74.54 (10.2)	72.30 (9.4)
Insurance					
Fee-for-service (FFS)	363,675	70,665 (19.4)	19,692 (5.4)	5,882 (1.6)	267,436 (73.6)
FFS + Medicaid	143,162	36,078 (25.2)	10,664 (7.4)	3,312 (2.3)	93,108 (65.0)
Medicare Advantage (MA)	189,393	29,665 (15.7)	10,289 (5.4)	2,923 (1.5)	146,516 (77.4)
MA + Medicaid	90,504	16,724 (18.5)	6,014 (6.6)	1,858 (2.1)	65,908 (72.8)
Neighborhood Profile					
Urban, Advantaged	549,157	107,109 (19.5)	32,822 (6.0)	9,558 (1.7)	399,668 (72.8)
Urban, Disadvantaged	98,567	19,162 (19.4)	6,777 (6.9)	2,057 (2.1)	70,571 (71.6)
Rural, Advantaged	106,827	20,191 (18.9)	5,144 (4.8)	1,682 (1.6)	79,810 (74.7)
Rural, Disadvantaged	32,183	6,670 (20.7)	1,916 (6.0)	678 (2.1)	22,919 (71.2)
Elixhauser CI ($\bar{x}$, *SD*)	30.0 (16.5)	31.61 (16.5)	32.22 (16.6)	31.93 (16.6)	26.53 (16.3)
Common Comorbidities					
Chronic pulmonary	206,479	45,509 (22.0)	13,890 (6.7)	4,117 (2.0)	142,963 (69.2)
Congestive heart	294,105	68,420 (23.2)	20,965 (7.1)	6,011 (2.0)	198,709 (67.6)
Dementia	128,668	39,060 (30.4)	12,055 (9.4)	3,507 (2.7)	74,046 (57.5)
Depression	89,824	19,688 (21.9)	6,188 (6.9)	1,726 (1.9)	62,222 (69.3)
Diabetes, complicated	231,299	52,197 (22.6)	15,738 (6.8)	4,626 (2.0)	158,738 (68.6)
End stage renal disease	62,900	10,960 (17.4)	4,609 (7.3)	1,468 (2.3)	45,863 (72.9)
Fluid/electrolyte	273,619	60,449 (22.1)	18,910 (6.9)	5,518 (2.0)	188,742 (69.0)

Hypertension	706,560	136,437 (19.3)	41,964 (5.9)	12,549 (1.8)	515,610 (73.0)
Peripheral vascular	135,577	29,913 (22.1)	8,559 (6.3)	2,652 (2.0)	94,453 (69.7)
Prior HHC (120-days)	120,823	58,908 (48.8)	16,149 (13.4)	3,866 (3.2)	41,900 (34.7)
Length of Stay in Days ($\bar{x}$, *SD*)	3.9 (3.4)	5.17 (4.1)	4.62 (4.2)	4.33 (3.6)	3.44 (3.0)
Discharged to Home Health Care	209,150	120,193 (57.5)	27,979 (13.4)	4,029 (1.9)	56,949 (27.2)
Discharged to Home with Self Care	577,584	32,939 (5.7)	18,680 (3.2)	9,946 (1.7)	516,019 (89.3)
30-day Rehospitalization (outcome)	122,740	30,126 (24.5)	9,314 (7.6)	5,626 (4.6)	77,674 (63.3)

Note: Not Received = no evidence of home health care starting within 14-days of index hospitalization; Elixhauser CI = Elixhauser comorbidity index score with hospital readmission weights.

3.3. Home Health Care Timing and Rehospitalization

Overall, delayed initiation of home health care (days 3-7) was associated with greater odds of 30-day rehospitalization compared to prompt initiation (*OR* 1.28, 95% *CI* 1.24-1.32). When home health care was initiated late, during days 8-14, patients were four times more likely to be rehospitalized than those who received prompt care (*OR* 4.12, 95% *CI* 3.96-4.27). Stratified analyses by hospital discharge destination provide more nuanced results and highlight the influence of patients who were discharged to self-care on overall results (Table 2). Among patients discharged to home health care, there was no significant difference in odds of 30-day rehospitalization between patients with a delayed compared to prompt initiation of home health care, but greater odds of rehospitalization were observed among patients receiving services late (*OR* 2.53, 95% *CI* 2.36-2.72) or not at all (*OR* 1.19, 95% *CI* 1.15-1.22).

Across all the racial/ethnic groups, the overall results mirrored those above, i.e., patients receiving delayed or late home health care were significantly more likely to be rehospitalized compared to patients receiving prompt home health care (Table 3). The relationship between timing of home health care initiation and rehospitalization was significant across all racial/ethnic groups but most pronounced among Asian American/Pacific Islander and American Indian/Alaska Native patients. Rehospitalization was 50% more likely when home health care was delayed, and 4.7 times higher when care was late, compared to standard care ($P < 0.001$). In comparison, white, Black, and Hispanic patients had significant, but lower odds of hospitalization ($P < 0.001$). Table 2 presents additional logistic regression results stratified by discharge destination.

Table 2. Results of logistic regression predicting 30-day all-cause rehospitalization, stratified by discharge destination and race/ethnicity.

Home Health Care Timing	Overall	Discharged to Self-Care	Discharged to Home Health Care
Full Cohort (reference = day 0-2)	*OR, 95% CI*	*OR, 95% CI*	*OR, 95% CI*
Delayed (day 3-7)	1.28, 1.25-1.32**	1.39, 1.34-1.43**	1.00, 0.95-1.06
Late (day 8-14)	4.12, 3.97-4.28**	4.71, 4.51-4.92**	2.53, 2.36-2.72**
No Home Health Care Received	0.98, 0.97-1.00	0.85, 0.83-0.87**	1.19, 1.15-1.22**
White patients only (reference = day 0-2)	*OR, 95% CI*	*OR, 95% CI*	*OR, 95% CI*
Delayed (day 3-7)	1.33, 1.29-1.38**	1.44, 1.38-1.50**	1.04, 0.98-1.11
Late (day 8-14)	4.53, 4.34-4.75**	5.16, 1.89-5.44**	2.76, 2.53-3.01**
No Home Health Care Received	0.98, 0.96-1.00	0.83, 0.81-0.85**	1.20, 1.16-1.24**
Black patients only (reference = day 0-2)	*OR, 95% CI*	*OR, 95% CI*	*OR, 95% CI*
Delayed (day 3-7)	1.16, 1.08-1.24**	1.27, 1.17-1.38**	0.94, 0.83-1.06
Late (day 8-14)	3.32, 3.03-3.64**	3.93, 3.52-4.39**	2.11, 1.78-2.52**
No Home Health Care Received	1.00, 0.96-1.04	0.89, 0.84-0.93**	1.21, 1.13-1.29**
Hispanic patients only (reference = day 0-2)	*OR, 95% CI*	*OR, 95% CI*	*OR, 95% CI*
Delayed (day 3-7)	1.11, 1.02-1.21*	1.18, 1.07-1.31**	0.89, 0.75-1.06
Late (day 8-14)	3.04, 2.70-3.41**	3.30, 2.89-3.77**	2.20, 1.73-2.80**
No Home Health Care Received	0.94, 0.90-0.99*	0.88, 0.83-0.93**	1.07, 0.97-1.17
AAPI patients only (reference = day 0-2)	*OR, 95% CI*	*OR, 95% CI*	*OR, 95% CI*
Delayed (day 3-7)	1.53, 1.27-1.83**	1.94, 1.56-2.42**	0.93, 0.66-1.31

Late (day 8-14)	4.72, 3.69-6.03**	6.88, 5.14-9.21**	1.91, 1.16-3.14**
No Home Health Care Received	1.09, 0.98-1.22	1.19, 1.03-1.37*	0.93, 0.78-1.12
AIAN patients only (reference = day 0-2)	*OR, 95% CI*	*OR, 95% CI*	*OR, 95% CI*
Delayed (day 3-7)	1.50, 1.08-2.09*	1.83, 1.24-2.70**	0.49, 0.21-1.16
Late (day 8-14)	4.69, 2.95-7.44**	5.97, 3.48-10.25**	1.35, 0.40-4.54
No Home Health Care Received	0.94, 0.77-1.16	0.74, 0.57-0.96**	1.52, 0.99-2.33

Notes: * $p < 0.05$ ** $p < 0.001$; AAPI = Asian American/Pacific Islander; AIAN = American Indian/Alaska Native.

4. Discussion

This study explored the relationship between the timing of home health care initiation and 30-day rehospitalization risk among Medicare and Medicare Advantage beneficiaries following a diabetes-related hospitalization. We found when post-acute home health care started after the standard two days following hospital discharge; patients were more likely to be rehospitalized than those who received prompt services. Our findings support the standard of care set by the Centers for Medicare and Medicaid Services that a home health visit is made within 48 hours of hospital discharge [30]. This is especially important among patients who were not referred to home health care at the time of discharge but were eligible for services and had a skilled need for services, highlighting the importance of early identification of patients that may benefit or require home health care prior to hospital discharge.

Our study findings suggest that prompt home health care initiation mitigates some of the post-acute period risks, leading to reduced rehospitalization for patients with diabetes. In other studies, the combination of early home health care and outpatient provider follow-up has been associated with reduced readmissions in patients with heart failure [15] and sepsis [31]. A possible explanation for the reduced rehospitalizations with early home health care found in this study could be specific to the patient's needs following diabetes-related hospitalization. For example, escalation in medication treatments during hospital stay was a significant predictor of 30-day readmission in a sample of patients with diabetes [32]. Post-acute home health care reduces risk of adverse events through medication reconciliation, patient and caregiver education, coordinating and scheduling follow-up care, transportation, and deliveries of supplies and social services if needed.

Diabetes disproportionally burdens racial/ethnic minority groups [33-36]. Prior research found home health care services were underutilized by Asian American/Pacific Islander (AAPI) patients [37,38]. We are unaware of any literature describing home health care use and outcomes among American Indian/Alaska Native (AIAN) patients, who, despite having a high prevalence of diabetes [39], are infrequently included in research due to relatively small numbers. In this study, AIAN and AAPI patients were 20% less likely to receive post-acute home health care compared to their white counterparts [17] and were at greatest risk of being rehospitalized overall when home health care was delayed or late.

Structural determinants and institutional factors may contribute to the differences in the effects of home health care timing on rehospitalization risk across racial/ethnic groups. Although we accounted for neighborhood socioeconomic advantage, other unmeasured determinants could be contributing to these outcomes. Other teams found racial residential segregation [40] and residence in food swamps [41] contribute to increased rehospitalization risk among patients with diabetes. These societal determinants are examples of structural racism embedded in the community's infrastructure, compounding the impact of unequal health care resource distribution/access [42-44]. Communities with concentrated poverty, higher crime rates, and ethnic enclaves requiring utilization of interpreter services may directly or indirectly contribute to a home health agency's ability and willingness to provide timely care. When home health agency nurses require security escorts or interpreter services there is no adjustment for this in the payment provided by Medicare and Medicaid, leaving these costs to be absorbed by the agency. Home health agencies reported administrative challenges with managed care plans, such as complicated authorization processes that delay start of care, lower payment rates, increase administrative costs, and deny services, creating barriers to post-acute care [45].

While efforts to standardize discharge planning and visit prioritization are ongoing, most decisions are still subjective and rely on a provider's decision-making and communication. Qualitative work has suggested the contribution of community demographics and lack of workforce diversity has affected home health care services for racial/ethnically diverse patients [46]. In a study of discharge planners, time constraints and insurance concerns were reported as barriers contributing to a 20% difference in referrals between white and Hispanic patients [47]. Patients' prior experiences with inpatient and community care may positively or negatively impact acceptance of a discharge plan that includes home health care [48,49]. Health care organizations must engage with the communities they serve and collaborate interventions that can best improve equitable care delivery [50]. Further, they must assess institutional policies and practices to assess for biases and audit compliance with the National Culturally and Linguistically Appropriate Services Standards [50,51]. Future research should center on fully understand the post-acute process for the patient and family, including their priorities and experiences [52].

The study had several limitations. First, given the observational study design using data available from the CMS Chronic Conditions Warehouse, we do not know why some patients received services late and do not have information about patient's preferences, home environment, marital status, or caregiver availability. Second, we did not utilize outpatient claims data and thus did not account for outpatient follow-up visits, reducing the risk of rehospitalization [15,31,53]. Third, there may be unmeasured individual, health care system, or geographic factors that we did not include in the models. Fourth, we did not account for differences between Medicare Advantage plans, some of which charge a co-pay for home health care services, in contrast to fee-for-service Medicare, which have no co-pay for home health care or limits on medically necessary services.

5. Conclusions

This paper provides evidence for the value of home health care services as a strategy to reduce 30-day hospital readmissions among adults Medicare beneficiaries with diabetes. This is particularly significant given a recent study finding no evidence that the Centers for Medicare and Medicaid Services (CMS) State Innovation Models (SIM) Initiative was effective in reducing readmission rates among adults with diabetes, even among CMS beneficiaries [54]. Early initiation of home health care after hospital discharge was associated with the lowest risk of 30-day rehospitalization. Our overall finding that timely initiation of home health care was associated with lower risks of 30-day rehospitalization supports the CMS requirement that home health care services be required within two days of hospital discharge when ordered, and the exception when a physician/provider authorizes a delay in initiation of services due to an outpatient visit or patient or family request. Furthermore, the patients who benefited the most from receiving home health care services within 2 days of discharge were those who were at risk for falling between the cracks, who were discharged home to self-care—yet received a timely home health care visit anyway. These findings support health care providers' and discharge planners' efforts to identify patients early who may need home health services and whose discharge plan and referral may require extra time, including patients who have recently utilized home health care or who may need insurance pre-authorization.

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