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Article

Racial Disparities in Post-Acute Home Health Care Referral and Utilization Among Older Adults with Diabetes

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Abstract: Racial and ethnic disparities exist in diabetes prevalence, health services utilization, and outcomes including disabling and life-threatening complications. Home health care may especially benefit older adults with diabetes through individualized education, advocacy, care coordination, and psychosocial support for patients and their caregivers. This study examined factors associated with hospital discharge to home health care and subsequent utilization of home health care among a cohort of Medicare beneficiaries with diabetes, age 50 and older, living in the United States. The cohort (n=786,758) was followed for 14 days after a diabetes-related index hospitalization, using linked Medicare administrative, claims, and assessment data (2014-2016). Multivariate logistic regression models included patient demographics, comorbidities, hospital length of stay, geographic region, neighborhood area deprivation, and rural/urban setting. In fully adjusted models, hospital discharge to home health care was significantly less likely among Hispanic (OR 0.8, 95% CI 0.8-0.8) and American Indian (OR 0.8, CI 0.8-0.8) compared to white patients. Among those discharged to home health care, all racial/ethnic minority patients were less likely to receive services within 14-days. Further work should focus on eliminating systemic racism in home health care referral and systemic barriers to receiving home health care services.

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

1. Introduction

In the United States, an estimated 28% of older adults live with diabetes, a chronic condition associated with macro- and microvascular complications [1]. Diabetes is associated with more frequent use of emergency and acute care, higher mortality [2, 3], longer hospitalizations, and more frequent rehospitalizations [4, 5]. For older adults with multiple chronic conditions, post-acute care transitions are a particularly high-risk period for adverse events and rehospitalization [6, 7]. Home health care visits are one important aid to effective transition from hospital to home and may reduce adverse events among high-risk patients [8-10]. For patients with diabetes, home visits can be used to individualize teaching and support of patients with management of complex medications and dietary guidelines to optimize glycemic control and prevent complications [11, 12]. The American Diabetes Association recommends diabetes self-management education and support at multiple times including when transitions in care occur [13]. Post-acute home health care visits provide opportunities to assess for the presence of complicating factors and engage patients and their caregivers in individualized education and

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support with blood glucose monitoring, insulin administration, nutritional support, diabetic foot care, wound care, and management of other chronic conditions.

Racial and ethnic disparities in post-acute home health care referral and utilization highlight opportunities to improve health equity and care coordination. Patients may decline home care services due to individual preferences, including previous poor experiences related to cultural bias and racism. Black, Hispanic, Asian American, and Native American adults are more likely to report experiencing discrimination in health care and will avoid using health care out of concern for discrimination or poor treatment compared to white adults. Patients' acceptance of home health care associated with quality of communication regarding hospital discharge planning and prior positive or negative experiences with post-acute care [14, 15]. Efforts to improve hospital discharge decision-making through clinical decision support may help to better align referral/receipt of services [8, 16]. However, any efforts must also consider and address systemic barriers that contribute ongoing racial/ethnic disparities in current home health care referrals and utilization patterns. Residence in socioeconomically disadvantaged neighborhoods often poses barriers to health-promoting resources and services [17, 18]. Characterized by area-level poverty, high unemployment, and decreased educational attainment [19], neighborhood disadvantage, is associated with increased rehospitalizations [19-21], and poor glucose control in older adults with diabetes [22]. However, the inverse may be true in the case of home health care, due to its inclusion as a core benefit under Medicaid's community-based long-term services and supports (LTSS).

Differences in insurance coverage for Medicare beneficiaries may impact hospital discharge planning and referral and utilization of home health care services. In the United States Medicare is the national hospital and medical insurance for older adults and people with long-standing disability and may reimburse for services under a fee-for-service or managed care plan. Medicaid is the state hospital and medical insurance for people with very low income or disabilities. Both Medicaid and fee-for-service (FFS) Medicare programs cover intermittent skilled home health care as a core benefit with no co-pay, deductible, or limits on the service utilization. Until 2020 Medicare required patients to be home bound (unable to safely leave their home on a regular basis without assistance) to receive home health services. In contrast, Medicaid may cover skilled home health care for patients who are able to leave their home but have unreliable transportation or caregiver responsibilities limiting their ability to attend frequent primary care appointments for disease monitoring and management. Medicare Advantage (managed care) differs from FFS Medicare in that the private plans may have a co-pay for home health care and may have a restricted network of home health agency providers, in addition to reimbursing home health agencies for services at a lower rate relative to FFS Medicare [23]. Many older adults can choose between fee-for-service Medicare or a private Medicare Advantage plan, however dual-eligible Medicare/Medicaid beneficiaries in some states are exclusively enrolled Medicare Advantage. This study includes patients enrolled in both FFS Medicare and Medicare Advantage, including patients dual-eligible for Medicaid.

To improve post-acute care outcomes among Medicare beneficiaries with diabetes, it is important to understand not only that disparities, but why they exist. The fundamental causes of inequity and missed opportunities for referral and utilization of needed home health care must be examined. Thus, this study investigates the individual, neighborhood, and regional factors associated with racial and ethnic disparities in post-acute home health care referral and utilization during the first two weeks following a diabetes-related hospital admission among all Medicare beneficiaries age 50 and older.

2. Materials and Methods

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2.1. Study Design and Data Sources

We performed a retrospective analysis of Medicare fee-for-service and Medicare Advantage beneficiaries with an index hospitalization related to diabetes in 2015. The primary datasets used in this study were complete for both Medicare fee-for-service (FFS) and Medicare Advantage population. The study design and variable selection were informed by Andersen's Framework for Viewing Health Services Utilization [24]. From this lens, societal determinants including neighborhood poverty, and government-sponsored health insurance programs influence individual determinants directly or indirectly through the health service system.

2.2. Study Population

To create the study sample (Figure 1), we identified all Medicare beneficiaries aged 50 or older who experienced a diabetes-related hospital admission in 2015 (n = 1,270,929). Diabetes-related hospitalizations were identified by a primary admitting diagnosis of diabetes or a secondary diagnosis of diabetes combined with a diabetes-related comorbidity [25]. Table 1 includes the list of ICD-9 and ICD-10 diagnoses used to identify diabetes-associated hospitalizations. Index hospitalizations were restricted to patients discharged to home health care or home with self-care, who were continuously enrolled in Medicare for at least 12 months (Figure 1). To minimize the possibility of the index stay itself being a readmission we additionally excluded patients hospitalized during the 120-days prior to the index hospitalization. Hospital discharge, home health admission, and rehospitalization outcomes (reported in a separate paper) extended into 2016.

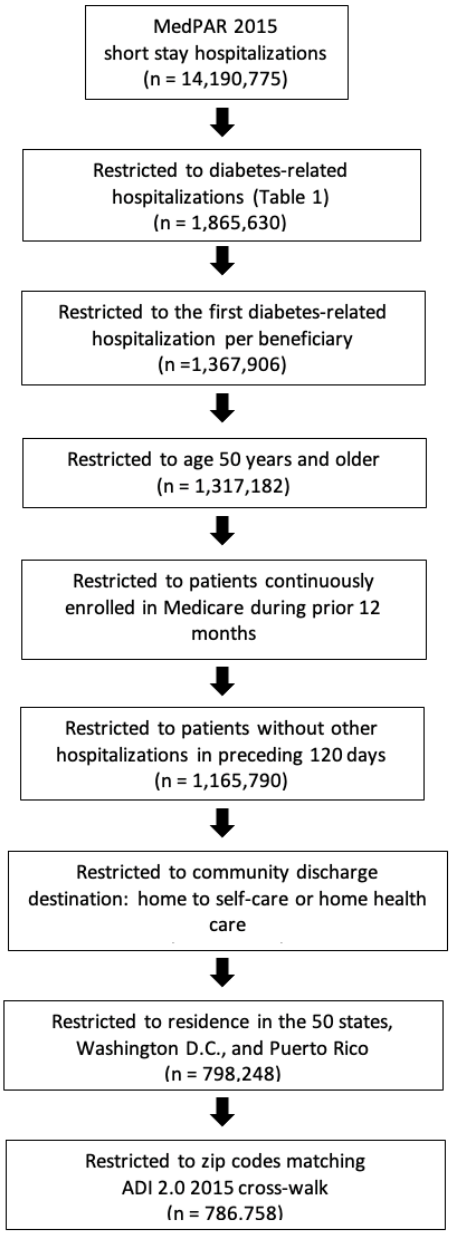

Figure 1. Delimitation of Index Hospitalizations and Study Sample.

Table 1. International Classification of Diseases (ICD) Codes Used to Identify Diabetes-Related Hospitalizations

Ninth Revision, Clinical Modification (ICD-9-CM)	Tenth Revision, Clinical Modification (ICD-10-CM)

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Diabetes mellitus: 250xx	Diabetes mellitus: E11xx
Cardiovascular diseases: 410-414, 39891, 426-428, 7850, 7851, 430–438, 401–405, 4372, 415–417, 429, 440–444, 446–448, 451–453, 458-459, 557, 7859, 7865, 7943, 7962	Cardiovascular diseases: G45, 58; I09-13,15, 20-21, 23-28, 44-45, 47-51, 62-63, 65-67, 70-75, 77-78, 80-82, 87, 69, 95, 97, 99; K55; M30-31; R00, 03, 07, 09, 58, 94
Renal diseases: 580–586, 590, 595, 597, 59800, 59801, 5990	Renal diseases: N00-05, 08, 10, 11, 16-19, 30, 34-35, 37, 39
Lower extremity diseases and complications: 0201, 0210, 0220, 0311, 03285, 035, 0390, 337, 342–344, 354, 355, 3568, 3569, 3572, 3581, 4402, 4423, 4438, 4439, 44422, 44502, 4510, 4512, 454, 680–682, 684–686, 690, 694–698, 700–703, 707, 709, 711, 7184, 7271, 730, 735, 736, 7396, 7854	Lower extremity diseases and complications: A20, 21, 31, 36; E08-11, 13, 83; G56-60, 73, 80-83, 90; I83, 96; L00-03, 05, 08-13, 20-21, 26, 28-30, 40, 42-44, 49, 51-53, 57, 60, 66, 71, 80-85, 87, 89-95, 97-98; M00-02, 20-21, 24, 46, 57, 66, 83, 85-87, 89-92
Eye diseases and vision defects: 361, 362, 365–369	Eye diseases and vision defects: E113, 09-11, 13; H26, 28, 36, 250-252, 258-262, 311, 330-334, 338, 340-2, 348-359, 400-406, 408-9, 520, 523-527, 530-536, 538-548; Q150
Mycoses: 110–112, 1141, 1143, 1149, 115-118	Mycoses: B35-49
Fluid and electrolytes: 276	Fluid and electrolytes: E86-87

Note: As of October 1, 2015, the United States transitioned to the ICD-10-CM coding system. Diabetes-related hospitalizations were defined by a primary admitting diagnosis of diabetes or a secondary diagnosis of diabetes combined with a diabetes-related condition including cardiovascular, renal, lower extremity, or eye diseases [25].

2.3. Outcomes

The primary outcomes were hospital referral to home health care at the time of discharge, and home health care usage within two weeks after the index hospitalization. The Medicare Provider and Analysis Review (MedPAR) file was used to identify hospitalizations, diagnoses, and hospital discharge disposition. Home health care utilization dates relative to the index hospitalization (14 days after) was calculated from the home health care Outcome and Assessment Information Set (OASIS) assessments (2015-2016).

2.4. Individual-Level Variables

The Elixhauser Comorbidity Index Score with readmission weights calculated from index hospital admission diagnosis codes contained in MedPAR was used to calculate clinical complexity [26]. We supplemented the list of Elixhauser comorbidities used in descriptive and multivariate analyses with two additional dummy variables for end-stage renal disease and Alzheimer's disease and related dementias utilizing chronic condition flags from the Medicare Beneficiary Summary File (MBSF). Demographic data including age, sex, insurance type, and Medicare enrollment status were also obtained from the MBSF. Home health care use during the 120 days prior to index hospitalization was calculated from OASIS assessments (2014-2015). Self-reported race/ethnicity data from OASIS assessments (2013-2016) augmented the imputed Research Triangle Institute (RTI) race variable in the MBSF, minimizing misclassification errors and instances of other/unknown race [27].

2.5. Geographic-Level Variables

Neighborhood socioeconomic advantage, rural-urban designation, and region of the country were examined as part of societal determinants of home health care referral and use [20, 28]. Socioeconomic advantage was measured with the 2015 Area Deprivation Index 2.0 (ADI 2.0) [29], a composite index of 17 socioeconomic indicators from the

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2011-2015 U.S. Census American Community Survey, linked to patient's 9-digit zip code [20]. A binary variable was created to classify disadvantaged neighborhoods using the 85th percentile (national ranking) of the ADI 2.0 [20]. We then split the neighborhood variable into four categories to distinguish between disadvantaged neighborhoods located in rural or urban areas using the most recent version of the Rural-Urban Continuum Codes (RUCC) [30]. The RUCC codes 4-9 are typically considered to be rural [30]. A four-category RUCC-ADI combination variable was then created: a) rural-advantaged, b) rural-disadvantaged, c) urban-advantaged, d) urban-disadvantaged. Finally, we created dummy codes for the nine U.S. Census Division regions and Puerto Rico, linked to patients' state of residence at the end of 2015.

2.6. Analytic Approach

First, we explored patients' clinical and socio-demographic characteristics overall, by hospital discharge destination (home health care vs. home to self-care), and by subsequent utilization of home health care. Descriptive results were then stratified by race/ethnicity, neighborhood profiles (rural-advantaged, rural-disadvantaged, urban-advantaged, and urban-disadvantaged), and insurance (Medicare fee-for-service or Medicare Advantage alone or in combination with Medicaid). We then used multivariable logistic regression models to evaluate predictors of the primary outcomes: hospital discharge to home health care, and utilization of home health care during the initial 14-day post-acute hospital period. The area under the receiver operator curve (c-statistic) was used to estimate model performance. All analyses were performed using SAS software, version (9.4) (SAS Institute Inc., Cary, NC).

3. Results

3.1. Study Population

We identified 786,758 Medicare beneficiaries with a diagnosis of diabetes who experienced a diabetes-related hospitalization and were discharged to home or home health care services in 2015. The median age of the sample was 73.1 years (IQR = 67-80). The racial/ethnic composition of the sample was two-thirds (68%) (non-Hispanic) white, 17% Black, 11% Hispanic, 2.5% Asian American/Pacific Islander (AAPI), and 1% American Indian/Alaska Native (AIAN). Greater than one-third (36%) of the sample was enrolled in a Medicare Advantage plan, and 30% were dual-eligible for Medicaid. All patients had a diagnosis of diabetes, and 29% had diabetes with chronic complications. Other common comorbidities included hypertension (90%), congestive heart failure (37%), renal failure (37%), fluid and electrolyte disorders (35%), and chronic pulmonary disease (26%). During the 120 days prior to the index hospitalization, 15% of the sample had used home health care. Additional descriptive results are presented in Table S1.

3.2. Sample Characteristics Stratified by Race, Neighborhood Profile, and Insurance

Table 2 presents the descriptive results stratified by race and ethnicity. One of the most striking differences is the age distribution by race, with 35% of Black, 33% of AIAN, and 27% of Hispanic patients in the sample under the age of 66, compared to 19% of AAPI, and 18% of white beneficiaries. Residence in a socioeconomically disadvantaged zip code (ADI 2.0 national ranking at or above 85th percentile) was more prevalent among Black (32%), AIAN (29%), and Hispanic (26%) patients, compared to white (12%) and AAPI (7%) patients. Slightly more than one-third (36%) of the sample was enrolled in a Medicare Advantage plan, with greater enrollment among Hispanic patients (52%), and lower enrollment among AIAN patients (17%). Medicaid eligibility also differed by race/ethnicity, ranging from 54% of both Hispanic and AAPI patients, to 47% of Black patients, 43% of AIAN patients, and 20% of white patients. Enrollment in Medicare Advantage was less common in rural (24%) compared to urban areas, where enrollment reached 46% in disadvantaged neighborhoods. See Supplemental Table S2 for additional

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detail on sample characteristics stratified by neighborhood profiles and Supplemental Table S3 for additional detail on sample characteristics stratified by insurance.

Table 2. Sample Characteristics by Race/Ethnicity, column percentage unless otherwise noted

	White	Black	Hispanic	AAPI	AIAN
	n=534,733	n=134,250	n=86,834	n=19,888	n=5,859
Sex, Male %	53.8	41.7	49.1	50.1	48.0
Age[1], %					
50-65	17.6	34.9	26.5	18.9	32.8
66-75	39.3	34.5	35.6	34.7	37.1
76-85	31.0	22.7	28.0	31.9	23.8
86+	12.1	8.0	9.9	14.5	6.3
Insurance, %					
Medicare FFS	54.6	32.1	20.2	27.1	47.0
FFS + Medicaid	13.7	27.3	27.6	34.0	35.8
Medicare Advantage (MA)	25.0	20.8	25.5	19.2	10.1
MA + Medicaid	6.7	19.8	26.7	19.7	7.1
RUCC-ADI 2.0, %					
Rural-Advantaged	17.4	6.0	3.6	2.9	26.8
Rural-Disadvantaged	4.0	5.4	2.5	0.4	17.7
Urban-Advantaged	71.1	61.8	70.7	89.9	44.3
Urban-Disadvantaged	7.5	26.7	23.2	6.8	11.2
Elixhauser score[2] (mean)	27.4	30.7	27.0	29.7	29.1
Common Comorbidities, %					
Chronic pulmonary	28.4	24.6	18.2	18.2	25.8
Congestive heart	37.8	40.3	31.5	35.8	35.0
Dementia	15.8	18.0	17.5	19.1	15.7
Depression	13.0	7.8	9.1	5.7	11.3
Diabetes complication	27.5	32.6	35.0	34.0	35.7
Fluid/electrolyte	33.6	38.3	34.9	42.6	38.6
Hypertension	88.3	94.3	91.4	92.4	88.0
Hypothyroidism	20.4	10.0	16.2	14.0	18.3
Peripheral vascular	17.7	15.7	17.6	15.4	16.3
Renal failure	34.6	45.9	38.5	45.6	42.4
Prior HHC (120-days), %	14.6	18.7	16.5	12.6	13.2
Hospital LoS[3] (mean)	3.8	4.0	4.2	3.9	3.9

Note: AAPI = Asian American/Pacific Islander; AIAN = American Indian/Alaska Native, FFS = fee for service.
[1] Age (median years, IQR): 74, 68-81; 70, 64-77; 72, 65-79; 74, 68-82; 70, 65-77.
[2] Elixhauser score (median, IQR): 26, 14-39; 30, 18-42; 25, 13-39; 28, 15-42; 28, 15-41.
[3] Hospital length of stay (median days, IQR): 3, 2-5; 3, 2-5; 3, 2-5; 3, 2-5; 3, 2-5.

3.3. Intermediate and Primary Outcomes

Figure 2 shows 209,152 patients (27%) were discharged from the hospital to home health care and 213,766 (27%) received home health care services within 14-days. However, these are not necessarily the same patients, as among those discharged to home health

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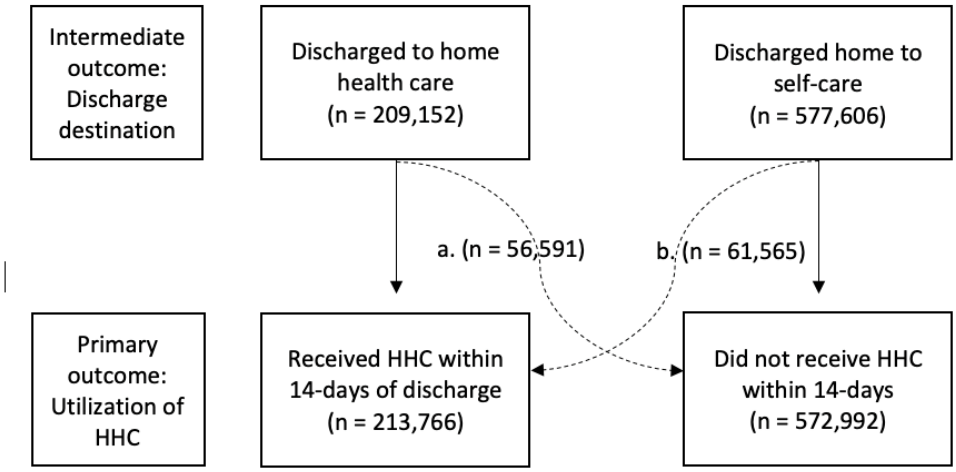
care only 73% received services within 14-days. Additionally, among patients discharged home to self-care 11% received home health care within 14-days.



Note: solid lines represent expected patterns; dashed lines represent unexpected patterns;
a. 56,152 (27%) of patients who were discharged to HHC did not receive services;
b. 61,565 (11%) of patients who were discharged home to self-care also received HHC services.

Figure 2. Discharge destination and 14-day home health care (HHC) utilization outcomes for sample (N= 786,758)

4. Discussion

3.4. Predictors of Hospital Discharge to Home Health Care

Of the total sample, 209,152 patients were referred to home health care services at hospital discharge. Unadjusted (bivariate) and adjusted logistic regression models were estimated to assess the influence of study variables on discharge destination to home with a referral for home health care services, models are shown in Table 3. In bivariate models, relative to white patients (reference), hospital discharge/referral to home health care was similar for AAPI patients (OR 1.0, 95% CI 1.0-1.0), greater for Black patients (OR 1.1, 95% CI 1.1-1.1), and lower for Hispanic (OR 0.8, 95% CI 0.8-0.8) and AIAN patients (OR 0.7, 95% CI 0.7-0.7). Additional bivariate models show more frequent hospital discharge/referral to home health care among patients with prior home health care use (OR 3.7, 95% CI 3.7-3.8), age greater than 86 years (OR 2.4, 95% CI 2.4-2.5), dual-eligible (OR 1.3, 95% CI 1.3-1.4), diagnosis of dementia (OR 2.0, 95% CI 1.9-2.0), and residence in urban or rural, socioeconomically disadvantaged zip codes (OR 1.2, 95% CI 1.2-1.2).

In the adjusted model, we controlled for age, sex, insurance type, race/ethnicity, presence of comorbidities, length of stay, recent use of home health, neighborhood socioeconomic advantage, rural-urban designation, and geographic region. In the adjusted model, Black patients had similar odds of hospital discharge/referral to home health care (OR = 0.98, 95% CI 0.97, 1.00) relative to white patients (reference), while discharge to home health care was less likely for AAPI (OR 0.91, 95% CI 0.88-0.95), Hispanic (OR 0.81, 95% CI 0.79-0.83), and AIAN patients (OR 0.79, 95% CI 0.74-0.85). Use of home health services during the 120 days prior to the index hospitalization was the strongest predictor of receiving a referral for home health care (OR 3.12, 95% CI 3.08-3.17). Discharge to home health care was less likely for men compared to women (OR 0.86, 95% CI 0.85-0.87). Patients aged 86 and older were more than two and a half times more likely to receive a referral (OR 2.61, 95% CI 2.55-2.67) than patients aged 50 to 65 years old. Patients enrolled in Medicare Advantage, Medicare Advantage/Medicaid, or fee-for-service/Medicaid had greater odds of hospital discharge to home health care than patients with Medicare fee-for-service alone. Patients with a residential 9-digit zip code

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(neighborhood) classified as socioeconomically disadvantaged were more likely to have a hospital discharge/referral to home health care in both urban (OR 1.13, 95% CI 1.10-1.15) and rural areas (OR 1.11, 95% CI 1.09-1.13) relative to their counterparts living in socioeconomically advantaged neighborhoods. The empirical c-statistic of the multivariable logistic model predicting hospital discharge to home health care was 0.754 (Table 3, Model 1).

Table 3. Logistic models predicting hospital discharge to home health care (HHC), and use of HHC within 14-days

	Discharge to HHC		**Utilization of HHC**	
	Unadjusted	Model 1	Model 2a Discharged to home health care	Model 2b Discharged to self-care
		c = 0.754	c = 0.674	c = 0.797
	OR, 95% CI	OR, 95% CI	OR, 95% CI	OR, 95% CI
Race/ethnicity (ref = white)				
Black	1.1, 1.1-1.1	1.0, 1.0-1.0	0.9, 0.8-0.9	1.2, 1.2-1.2
Hispanic	0.8, 0.8-0.8	0.8, 0.8-0.8	0.7, 0.6-0.7	1.0, 1.0-1.0
AAPI	1.0, 1.0-1.0	0.9, 0.9-1.0	0.8, 0.8-0.9	1.0, 0.9-1.0
AIAN	0.7, 0.6-0.7	0.8, 0.7-0.9	0.8, 0.7-0.9	0.8, 0.7-0.9
Sex (ref = female)				
Male	0.8, 0.8-0.8	0.9, 0.9-0.9	1.0, 0.9-1.0	0.8, 0.8-0.9
Age (ref = 50-65 years)				
66-75	1.0, 1.0-1.0	1.2, 1.2-1.2	1.0, 1.0-1.1	1.2, 1.1-1.2
76-85	1.5, 1.5-1.5	1.7, 1.7-1.7	1.3, 1.2-1.3	1.7, 1.7-1.8
86+	2.4, 2.4-2.5	2.6, 2.6-2.7	1.4, 1.3-1.4	2.5, 2.4-2.6
Insurance (ref = FFS only)				
Medicare FFS + Medicaid	1.3, 1.3-1.4	1.2, 1.2-1.2	1.0, 1.0-1.0	1.4, 1.4-1.4
Medicare Advantage (MA)	1.0, 1.0-1.1	1.2, 1.2-1.2	0.5, 0.5-0.5	1.1, 1.0-1.1
MA + Medicaid	1.3, 1.3-1.3	1.3, 1.3-1.3	0.5, 0.5-0.5	1.1, 1.1-1.2
RUCC-ADI 2.0 (ref = Rural-Advantaged)				
Rural-Disadvantaged	1.2, 1.2-1.2	1.1, 1.1-1.1	1.1, 1.0-1.1	1.2, 1.1-1.2
Urban-Advantaged	1.1, 1.0-1.1	1.1, 1.0-1.1	0.9, 0.8-0.9	1.1, 1.0-1.1
Urban-Disadvantaged	1.2, 1.2-1.2	1.1, 1.1-1.2	0.9, 0.8-0.9	1.1, 1.1-1.2

Note: FFS = fee for service.
Models 1, 2a and 2b are adjusted for prior home health care utilization, comorbidities, and census region.

3.5. Predictors of Home Health Care Use After Index Hospital Discharge (First 14-Days)

We estimated logistic regression models to examine predictors of home health care utilization for patients discharged to home health care (Table 3, Model 2a), and patients discharged to home with self-care (Model 2b). In bivariate models (not shown), relative to white patients (reference), home health care utilization was greater for Black patients (OR 1.1, 95% CI 1.1-1.1), and lower for AAPI (OR 0.9, 95% CI 0.9-0.9), Hispanic (OR 0.8, 95% CI 0.8-0.8) and AIAN patients (OR 0.7, 95% CI 0.7-0.7). Both models 2a and 2b were adjusted for age, sex, insurance type, race/ethnicity, presence of comorbidities, length of stay, recent use of home health, neighborhood socioeconomic advantage, rural-urban designation, and geographic region. The models had acceptable performance predicting home health utilization with an empirical c-statistics of 0.674 for Model 2a (patients discharged to home health care) and 0.797 for Model 2b (discharged to self-care) [31].

Among patients discharged from the hospital to home health care (Model 2a), patients with a history of home health care use during the 120 days prior to the index hospitalization were two and half times more likely to receive home health care within 14

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days of hospital discharge compared to patients without recent home health care use. Among the patients discharged to home health care, enrollment in Medicare Advantage was associated with lower home health care use compared to Medicare fee-for-service, including patients dual-eligible for Medicaid (OR 0.48, 95% CI 0.47-0.51) as well as those with Medicare Advantage alone (OR 0.52, 95% CI 0.50-0.53). Racial/ethnic minority patient groups were also less likely to receive home health care services compared to white patients, with the greatest disparity for Hispanic patients (OR 0.66, 95% CI 0.64-0.69).

Among patients discharged from the hospital to home with self-care (Table 3, Model 2b), a history of home health care use during the 4 months prior to the index hospitalization was the strongest predictor of post-acute home health care utilization. These patients were nine times more likely to receive home health care during the first two weeks after hospital discharge compared to patients who had no recent use of home health care services (OR 9.02, 95% CI 8.83-9.21). Advanced age was the next strongest predictor of home health care utilization among patients discharged from the hospital without a home health referral, followed by Medicaid dual-eligibility, and a diagnosis of Alzheimer's disease and related dementias. In this group, Black patients were more likely to receive home health care compared to white patients.

4. Discussion

This research aimed to examine relationships between societal and individual-level characteristics, home health care referral, and utilization following diabetes-related hospitalizations among Medicare beneficiaries. Among high-risk patients, early initiation of home health care services is a critical factor in a patient's safe transition from hospital to home, enabling timely assessments, care planning [8], and reducing rehospitalization [9]. Our findings suggest that prior use of home health care, advanced age, race/ethnicity, and insurance type are predictors of both home health care referrals and service use. The strong association between recent home health care use, referral at hospital discharge, and utilization suggest adequate coordination of care for existing home health care patients. However, concerning differences in referral and utilization were observed by race/ethnicity and insurance type.

Overall, we found that patients from all ethnoracial minority groups other than Black were less likely to be discharged to home health care than white patients in models adjusted for individual, neighborhood, and regional variables (Table 3). Of patients discharged to home health care, patients from all ethnoracial minority groups were less likely to receive home health care than white patients (Table 3). Furthermore, Black patients who were discharged from the hospital to self-care were significantly more likely to receive home health care within two weeks of discharge from the index hospitalization, suggesting inadequate discharge planning and care coordination. To our knowledge, no other studies have examined home care utilization among American Indian/Alaska Native (AIAN) patients, however disparities in health services utilization have been reported including forgoing medical care [32], lack of primary providers [33], and higher rates of hospital readmissions [34], generally attributed to geographic and socioeconomic barriers [35]. Our findings for AAPI and Hispanic patients are, consistent with prior studies of Medicare beneficiaries with Hawaiian [36], or national samples [28, 37]. Barriers to timely referral and utilization of post-acute home health care may be a contributing factor to the increased risk of severe diabetes-related complications observed in racial and ethnic minorities [38]. Home health care may reduce risk of adverse outcomes if encouraged, prescribed, and provided in a timely and equitable manner. Further examination of informal care, cultural values, and patient preferences may also help to inform transition practices.

In addition, our findings suggest potential system-level barriers to post-acute home health care exist in this population related to insurance plan coverage details. Patients with Medicare Advantage were more likely to receive home health referrals at hospital

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discharge compared to fee-for-service beneficiaries, but then were half as likely to receive home health services. Previous research found that Medicare Advantage beneficiaries use fewer home health care services [39-41] and plans have lower expenditures for patients with diabetes than traditional Medicare [42]. These differences may in part be due to cost-containment strategies including requiring prior authorizations, restricting networks, cost-sharing, and utilization reviews [41, 43]. We acknowledge that there is heterogeneity among Medicare Advantage plans [39] as well as the role healthcare provider's play in decision making for post-acute services [43]. These findings are relevant as enrollment in Medicare Advantage increases, today 36% of Medicare beneficiaries are in a Medicare Advantage plan, from 24% a decade ago [44].

Our study had several limitations. Unmeasured health system characteristics may contribute to the differences we observed in home health care referral and utilization [9]. For example, hospitals in urban areas serving a high volume of patients are more likely to provide formal care coordination, while hospitals serving communities with high poverty and uninsurance rates were significantly less likely to do so [45]. Inclusion of hospital and agency characteristics could further our understanding of these relationships. Additionally, patients' functional status, living situation, and caregiver availability are important considerations for discharge planning decisions, which we did not include, as this information is only available for the patients who received home health care. We also did not seek to determine if patients met federal and state requirements for home health care services under Medicare or Medicaid [46, 47], and were unable to determine if patients refused to accept home health care services. Lastly, while the index hospital admissions occurred in 2015 the data remain relevant today because policy changes (i.e., PDGM, CARES Act) are unlikely to have impacted the racial/ethnic differences we observed in home health care referral.

5. Conclusions

Among older adults with a diabetes-associated hospitalization, persistent racial and ethnic disparities were observed in home health care referral and utilization. Disparities in use of home health care services were compounded for patients enrolled in Medicare Advantage plans. Further work to understand and eliminate systemic barriers contributing to racial/ethnic disparities in home health care referral and use of services is needed. Special emphasis should be placed on improving health care system capacity to provide culturally and linguistically appropriate services, awareness of the role of home health care as part of community-based long-term supports and services provided under Medicaid and Medicare special needs plans, and continued elimination of barriers to home health care usage in Medicare Advantage plans. Lastly, while we do not fully know how the COVID-19 pandemic will change the landscape of the post-acute care in the long term. In the short term, home health agencies face increased expenses and decreased patient volume [48, 49]. These challenges could exacerbate the disparities uncovered in this study and therefore important to factor into policy and practice decisions made in response to the COVID-19 pandemic.

Supplementary Materials: The following are available online at www.mdpi.com/xxx/s1, Table S1: Sample Characteristics Overall, by Discharge Destination, and Use of Home Health Care (HHC) within 14 Days of Index Hospitalization, Table S2: Sample Characteristics Stratified by Neighborhood Profile based on Rural-Urban Designation and the Area Deprivation Index 2.0, Table S3: Sample Characteristics Stratified by Insurance Type.

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References

1. Centers for Disease Control. National Diabetes Statistics Report, 2020. Available online: https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf (accessed on 20 December 2020).
2. Collins, J.; Abbass, I.M.; Harvey, R.; Suehs, B.; Uribe, C.; Bouchard, J.; Prewitt, R.; DeLuzio, T.; Allen, E. Predictors of all-cause 30 day readmission among Medicare patients with type 2 diabetes. *Curr Med Res Opin.* **2017**, *33*, 1517-1523. doi:10.1080/03007995.2017.1330258
3. O'Neill, K.N.; McHugh, S.M.; Tracey, M.L.; Fitzgerald, A.P.; Kearney, P.M. Health service utilization and related costs attributable to diabetes. *Diabet Med.* **2018**, *35*, 1727-1734. doi:10.1111/dme.13806
4. Enomoto, L.M.; Shrestha, D.P.; Rosenthal, M.B.; Hollenbeak, C.S.; Gabbay, R.A. Risk factors associated with 30-day readmission and length of stay in patients with type 2 diabetes. *J Diabetes Complications.* **2017**, *31*, 122-127. doi:10.1016/j.jdiacomp.2016.10.021
5. Ostling, S.; Wyckoff, J.; Ciarkowski, S.L.; Pai, C.; Choe, H.M.; Bahl, V.; Gianchandani, R. The relationship between diabetes mellitus and 30-day readmission rates. *Clin Diabetes Endocrinol.* **2017**, *3*, 3. doi:10.1186/s40842-016-0040-x
6. LaManna, J.B.; Bushy, A.; Norris, A.E.; Chase, S.K. Early and intermediate hospital-to-home transition outcomes of older adults diagnosed with diabetes. *Diabetes Educ.* **2016**, *42*, 72-86. doi:10.1177/0145721715620020
7. Lysy, Z.; Fung, K.; Giannakeas, V.; Fischer, H.D.; Bell, C.M.; Lipscombe, L.L. The association between insulin initiation and adverse outcomes after hospital discharge in older adults: A population-based cohort study. *J Gen Intern Med.* **2019**, *34*, 575-582. doi:10.1007/s11606-019-04849-3
8. Topaz, M.; Trifilio, M.; Maloney, D.; Bar-Bachar, O.; Bowles, K. H. Improving patient prioritization during hospital-homecare transition: A pilot study of a clinical decision support tool. *Res Nurs Health.* **2018**, *41*, 440-447. doi:10.1002/nur.21907
9. Murtaugh, C.M.; Deb, P.; Zhu, C.; Peng, T.R.; Barrón, Y.; Shah, S.; Moore, S.M.; Bowles, K.H.; Kalman, J.; Feldman, P.H.; Siu, A.L. Reducing readmissions among heart failure patients discharged to home health care: Effectiveness of early and intensive nursing services and early physician follow-up. *Health Serv Res.* **2017**, *52*, 1445-1472. doi:10.1111/1475-6773.12537
10. Wang, J.; Liebel, D.V.; Yu, F.; Caprio, T.V.; Shang, J. Inverse dose-response relationship between home health care services and rehospitalization in older adults. *J Am Med Dir Assoc.* **2019**, *20*, 736-742.
11. Hildebrand, J.A.; Billimek, J.; Lee, J.A.; Sorkin, D.H.; Olshansky, E.F.; Clancy, S.L.; Evangelista, L.S. Effect of diabetes self-management education on glycemic control in Latino adults with type 2 diabetes: A systematic review and meta-analysis. *Patient Educ Couns.* **2020**, *103*, 266-275. doi:10.1016/j.pec.2019.09.009
12. Cunningham, A.T.; Crittendon, D.R.; White, N.; Mills, G.D.; Diaz, V.; LaNoue, M.D. The effect of diabetes self-management education on HbA1c and quality of life in African-Americans: a systematic review and meta-analysis. *BMC Health Serv Res.* **2018**, *18*, 367. doi:10.1186/s12913-018-3186-7
13. Beck, J; Greenwood, D.A.; Blanton, L.; Bollinger, S.T.; Butcher, M.K.; Condon, J.E.; Cypress, M.; Faulkner, P.; Fischl, A.H.; Francis, T.; Kolb, L.E.; Lavin-Tompkins, J.M.; MacLeod, J.; Maryniuk, M.; Mensing, C.; Orzeck, E.A.; Pope, D.D.; Pulizzi, J.L.; Reed, A.A.; Rhinehart, A.S.; Siminerio, L.; Wang, J. 2017 national standards for diabetes self-management education and support. *Diabetes Spectr.* **2017**, *30*, 301-314. doi:10.2337/ds17-0067
14. Sefcik, J.S.; Nock, R.H.; Flores, E.J.; Chase, J.D.; Bradway, C.; Potashnik, S.; Bowles, K.H. Patient preferences for information on post-acute care services. *Res Gerontol Nurs.* **2016**, *9*, 175-82. doi:10.3928/19404921-20160120-01

15. Sefcik, J.S.; Ritter, A.Z.; Flores, E.J.; Nock, R.H.; Chase, J.D.; Bradway, C.; Potashnik, S.; Bowles, K.H. Why older adults may decline offers of post-acute care services: A qualitative descriptive study. *Geriatr Nurs.* **2017**, *38*, 238-243. doi:10.1016/j.gerinurse.2016.11.003
16. Bowles, K.H.; Ratcliffe, S.J.; Holmes, J.H.; Keim, S.; Potashnik, S.; Flores, E.; Humbrecht, D.; Whitehouse, C.R.; Naylor, M.D. Using a decision support algorithm for referrals to post-acute care. *J Am Med Dir Assoc.* **2019**, *20*, 408-413. doi:10.1016/j.jamda.2018.08.016
17. Gaskin, D.J.; Roberts, E.T.; Chan, K.S.; McCleary, R.; Buttorff, C.; Delarmente, B.A. No man is an island: The impact of neighborhood disadvantage on mortality. *Int J Environ Res Public Health.* **2019**, *16*, 7. doi:10.3390/ijerph16071265
18. Tsui, J.; Hirsch, J.A.; Bayer, F.J.; Quinn, J.W.; Cahill, J.; Siscovick, D.; Lovasi, G.S. Patterns in geographic access to health care facilities across neighborhoods in the United States based on data from the national establishment time-series between 2000 and 2014. *JAMA Netw Open.* **2020**, *3*, e205105. doi:10.1001/jamanetworkopen.2020.5105
19. Kind, A.J.H.; Golden, R.N. Social determinants of health: Fundamental drivers of health inequity. *WMJ.* **201**8, 117, 231-232.
20. Kind, A.J.H.; Jencks, S.; Brock, J.; Yu, M.; Bartels, C.; Ehlenbach, W.; Greenberg, C.; Smith, M. Neighborhood socioeconomic disadvantage and 30-day rehospitalization: a retrospective cohort study. *Ann Intern Med.* **2014**, *161*, 765-74. doi:10.7326/M13-2946
21. Joynt Maddox, K.E.; Chen, L.M.; Zuckerman, R.; Epstein, A.M. Association between race, neighborhood, and Medicaid enrollment and outcomes in Medicare home health care. *J Am Geriatr Soc.* **2018**, *66*, 239-246. doi:10.1111/jgs.15082
22. Durfey, S.N.M.; Kind, A.J.H.; Buckingham, W.R.; DuGoff, E.H.; Trivedi, A.N. Neighborhood disadvantage and chronic disease management. *Health Serv Res.* **2019**, *54*, 206-216. doi:10.1111/1475-6773.13092
23. Medicare Payment Advisory Commission. Report to the Congress: Medicare Payment Policy. Washington DC: MedPAC; 2020. Chapter 13 The Medicare Advantage program: Status report. 365-401. Available online: http://medpac.gov/docs/default-source/reports/mar20_entirereport_sec.pdf (accessed 21 December 2020).
24. Andersen, R.; Newman, J.F. Societal and individual determinants of medical care utilization in the United States. *Milbank Mem Fund Q Health Soc.* **1973**, *51*, 95-124.
25. Jiang, H.J.; Andrews, R.; Stryer, D.; Friedman, B. Racial/ethnic disparities in potentially preventable readmissions: the case of diabetes. *Am J Public Health.* **2005**, *95*, 1561-7. doi:10.2105/AJPH.2004.044222
26. Moore, B.J.; White, S.; Washington, R.; Coenen, N.; Elixhauser, A. Identifying increased risk of readmission and in-hospital mortality using hospital administrative data: The AHRQ Elixhauser comorbidity index. *Med Care.* **2017**, *55*, 698-705. doi:10.1097/MLR.0000000000000735
27. Jarrín, O.F.; Nyandege, A.N.; Grafova, I.B.; Dong, X.; Lin, H. Validity of race and ethnicity codes in Medicare administrative data compared with gold-standard self-reported race collected during routine home health care visits. *Med Care.* **2020**, *58*, e1-e8. doi:10.1097/MLR.0000000000001216
28. Jones, C.D.; Wald, H.L.; Boxer, R.S.; Masoudi, F.A.; Burke, R.E.; Capp, R.; Coleman, E.A.; Ginde, A.A. Characteristics associated with home health care referrals at hospital discharge: Results from the 2012 National Inpatient Sample. *Health Serv Res.* **2017**, *52*, 879-894. doi:10.1111/1475-6773.12504
29. University of Wisconsin School of Medicine and Public Health. Neighborhood Atlas. 2020. Available online: https://www.neighborhoodatlas.medicine.wisc.edu/ (accessed 22 December 2020).
30. U.S. Department of Agriculture. Rural-Urban Continuum Codes Documentation. 2013. Available online: https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/documentation/ (accessed 22 December 2020).
31. Hosmer, D.W.; Lemeshow, S.; Sturdivant, R.X. *Applied Logistic Regression*, 3rd ed.; Wiley Series in Probability and Statistics. John Wiley & Sons, Inc; 2013.
32. Towne, S.D.; Bolin, J.; Ferdinand, A.; Nicklett, E.J.; Smith, M.L.; Ory, M.G. Assessing diabetes and factors associated with foregoing medical care among persons with diabetes: Disparities facing American Indian/Alaska Native, Black, Hispanic, low income, and Southern adults in the U.S. (2011-2015). *Int J Environ Res Public Health.* **2017**, *14*, 5. doi:10.3390/ijerph14050464
33. Adakai, M.; Sandoval-Rosario, M.; Xu, F.; Aseret-Manygoats, T.; Allison, M.; Greenlund, K.J.; Barbour, K.E. Health disparities among American Indians/Alaska Natives - Arizona, 2017. *MMWR Morb Mortal Wkly Rep.* **2018**, *67*, 1314-1318. doi:10.15585/mmwr.mm6747a4
34. King, C.; Atwood, S.; Lozada, M.; Nelson, A.K.; Brown, C.; Sabo, S.; Curley, C.; Muskett, O.; Orav, E.J.; Shin, S. Identifying risk factors for 30-day readmission events among American Indian patients with diabetes in the Four Corners region of the southwest from 2009 to 2016. *PLoS One.* **2018**, *13*, e0195476. doi:10.1371/journal.pone.0195476
35. Franz, C.; Atwood, S.; Orav, E.J.; Curley, C.; Brown, C.; Trevisi, L.; Nelson, A.K.; Begay, M.; Shin, S. Community-based outreach associated with increased health utilization among Navajo individuals living with diabetes: a matched cohort study. *BMC Health Serv Res.* **2020**, *20*, 460. doi:10.1186/s12913-020-05231-4
36. Gandhi, K.; Lim, E.; Davis, J.; Chen, J.J. Racial disparities in health service utilization among Medicare fee-for-service beneficiaries adjusting for multiple chronic conditions. *J Aging and Health.* **2018**, *30*, 1224-1243. doi:10.1177/0898264317714143
37. Li, J.; Qi, M.; Werner, R.M. Assessment of receipt of the first home health care visit after hospital discharge among older adults. *JAMA Netw Open.* **2020**, *3*, e2015470. doi:10.1001/jamanetworkopen.2020.15470
38. Hazel-Fernandez, L.; Li, Y.; Nero, D.; Moretz, C.; Slabaugh, L.; Meah, Y.; Baltz, J.; Costantino, M.; Patel, N.C.; Bouchard, J. Racial/ethnic and gender differences in severity of diabetes-related complications, health care resource use, and costs in a Medicare population. *Popul Health Manag.* **2015**, *18*, 115-22. doi:10.1089/pop.2014.0038

39. Li, Q.; Rahman, M.; Gozalo, P.; Keohane, L.M.; Gold, M.R.; Trivedi, A.N. Regional variations: The use of hospitals, home health, and skilled nursing in traditional Medicare and Medicare Advantage. *Health Aff.* **2018**, *37*, 1274-1281. doi:10.1377/hlthaff.2018.0147
40. Skopec, L.; Huckfeldt, P.J.; Wissoker, D.; Aarons, J.; Dey, J.; Oliveira, I.; Zuckerman, S. Home health and postacute care use in Medicare Advantage and traditional Medicare. *Health Aff.* **2020**, *39*, 837-842. doi:10.1377/hlthaff.2019.00844
41. Skopec, L.; Zuckerman, S.; Aarons, J.; Wissoker, D.; Huckfeldt, P.J.; Feder, J.; Berenson, R.A.; Dey, J.; Oliveira, I. Home health use in Medicare Advantage compared to use in traditional Medicare. *Health Aff.* **2020**, *39*, 1072-1079. doi:10.1377/hlthaff.2019.01091
42. Mahmoudi, E.; Tarraf, W.; Maroukis, B.L.; Levy, H.G. Does Medicare Managed Care reduce racial/ethnic disparities in diabetes preventive care and healthcare expenditures? *Am J Manag Care.* **2016**, *22*, e360-e367.
43. Li, Q.; Keohane, L.M.; Thomas, K.; Lee, Y.; Trivedi, A.N. Association of cost sharing with use of home health services among Medicare Advantage enrollees. *JAMA Intern Med.* **2017**, *177*, 1012-1018. doi:10.1001/jamainternmed.2017.1058
44. Freed, M.; Damico, A.; Neuman, T. A dozen facts about Medicare Advantage in 2020. Kaiser Family Foundation. 2020. Available online: https://www.kff.org/medicare/issue-brief/a-dozen-facts-about-medicare-advantage-in-2020/ (accessed 21 December 2020).
45. Chen, J.; DuGoff, E.H.; Novak, P.; Wang, M.Q. Variation of hospital-based adoption of care coordination services by community-level social determinants of health. *Health Care Manage Rev.* **2020**, *45*, 332-341. doi:10.1097/HMR.0000000000000232
46. Kaiser State Health Facts. Medicaid & CHIP. 2020. Available online: https://www.kff.org/state-category/medicaid-chip/ (accessed 18 December 2020).
47. Center for Medicare and Medicaid Services. Important Message About the Jimmo Settlement. 2019. Available online: https://www.cms.gov/Center/Special-Topic/Jimmo-Center (accessed 20 December 2020).
48. Jones C, Bowles K. Emerging challenges and opportunities for home health care in the time of COVID-19. *J Am Med Dir Assoc.* **2020**, *21*, 1517-1518. doi:10.1016/j.jamda.2020.09.018
49. Shang, J.; Chastain, A.M.; Perera, U.G.E.; Quigley, D.D.; Fu, C.J.; Dick, A.W., Pogorzelska-Maziarz, M.; Stone, P.W. COVID-19 Preparedness in US Home Health Care Agencies. *J Am Med Dir Assoc.* **2020**, *21*, 924-927. doi:10.1016/j.jamda.2020.06.002