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Racial, ethnic, and income inequities in functional improvement within and between home health agencies

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Abstract

Objective: To quantify racial, ethnic, and income-based disparities in home health (HH) patients' functional improvement within and between HH agencies (HHAs).

Data Sources: 2016-2017 Outcome and Assessment Information Set, Medicare Beneficiary Summary File, and Census data.

Data Collection/Extraction Methods: Not Applicable.

Study Design: We use a multinomial-logit analyses with and without HHA fixed effects. The outcome is a mutually exclusive five-category outcome; (1) discharged with functional improvement; (2) discharged without functional improvement; (3) death while still a patient; (4) transfer to inpatient setting; and (5) still using HH as of December 31, 2017. The adjusted outcome rates are calculated by race, ethnicity, and income level using predictive margins.

Principal Findings: Of the 3+ million Medicare beneficiaries with a HH start-of-care assessment in 2016, 69% experienced functional improvement at discharge, 7% were discharged without functional improvement, 0.4% died, 20% were transferred to an inpatient setting, and 4% continued using HH. Adjusting for selected individual-level characteristics, Black and low-income HH patients had a lower adjusted rate of functional improvement at discharge (-1.1pp (95% CI: -1.4, -0.7) & -4.4pp; (95% CI: -4.6, -4.1), respectively), as compared to their White and higher income counterparts. Additionally, Black, Hispanic/Latine, and low-income HH patients were all more likely to be discharged without functional improvement (1.2pp (95% CI: 0.9, 1.4), 1.2pp (95% CI: 0.7, 1.7), 0.5pp (95% CI: 0.4, 0.6), respectively) compared to their White and higher income counterparts. After including HHA fixed effects, the differences for Black and Hispanic/Latine HH patients are generally mitigated. However, outcome disparities for all low-income HH patients persists within HHAs.

Conclusions: A large part of the overall disparity in functional outcomes among Black, Hispanic/Latine, and low-income home health patients is attributable to agencies'

characteristics; therefore, improving access to higher quality HH services for our most vulnerable HH patients is imperative to improve outcomes.

Keywords: Medicare home health; functional improvement; health disparities; home health agency; disability, post-acute care

Callout Box

What is known on this topic:

- For Medicare home health patients, within home health agency inequities exist in hospital readmissions and emergency department use, where patients are treated differently by race, ethnicity, and income.
- Racial, ethnic, and income-based inequities in functional improvement also exist for Medicare home health patients, but we don't know if that is driven by within-agency or between-agency differences.
- Most of what we know about functional improvement disparities in the home health setting comes from one region of the country.

What this study adds:

- Disparities in functional improvement exist across the U.S.
- Low-income patients have less functional improvement than their higher income counterparts within the same home health agencies.
- Functional improvement inequities for Black, Hispanic/Latine, and low-income patients are mostly attributable to agency characteristics which highlights the need to improve access to higher quality agencies.

Introduction

One of the primary responsibilities of home health (HH) is to improve the functional status of HH patients. Home health care is the provision of skilled care services in the home. Skilled services include nursing, physical and occupational therapy, speech language therapy, and medical social services. These services are ordered by a healthcare provider and HH staff develop a plan of care that is implemented to facilitate the patients' physical, mental and social well-being. The goal of intermittent HH services is to enable the patient to regain or maintain independence at home through the improvement of functional ability.

Medicare HH patients, on average, are older, poorer, and sicker than other Medicare beneficiaries.¹ Between 2002 and 2018, the number of HH fee-for-service patients increased by about 37%.¹ Approximately 20% of Medicare HH patients are from minoritized groups, 2/3 live below 200% of the Federal Poverty Line, over 50% have 5+ chronic conditions, and almost 1/3 need assistance with everyday activities of daily living.^{1,2} In fact, HH patients on average have greater assistance needs for activities of daily living (e.g., bathing, eating, transferring, etc.) than do nursing home residents.² As the demand for HH continues to grow, it is increasingly important to ensure high-quality care and functional improvement for all HH patients.³

There have been only a few studies that focus on racial disparities in functional improvements among home health agency (HHA) patients and the findings have been mixed.⁴⁻⁷ Among the first studies in this area, Peng et al. found no differences in functional status by race and ethnicity in one non-profit HHA in the Northeast.⁴ Conversely, using a small sample of HH patients nationwide, Brega et al. found evidence of functional improvement differences between racial and ethnic groups, especially between Black and non-Hispanic/Latine White HH patients.⁵ Similarly, Chase et al. found that Black, Hispanic/Latine, and Medicare/Medicaid dually eligible HH patients in New York experienced significantly less functional improvement than non-Hispanic/Latine White HH patients, even after adjusting for various covariates.⁶ Most recently, Wang et al. also found that being Black was associated with less functional improvement at

discharge as compared to White HH patients in New York.⁷ While providing valuable insights into disparities that exist within HH, this prior work is limited in that it mostly focuses on services delivered in only one geographic region (i.e., Northeast), does not examine differences in death or transfers, and only examines disparities in care delivered within agencies – as opposed to also considering disparities between agencies.

Prior research suggests that there are racial, ethnic, and income disparities in receiving care from high-quality HHAs.⁸ In addition, various HHA characteristics have been shown to be associated with quality differences. For example, agencies with low quality at baseline, non-profit or hospital-based agencies, and agencies with longer Medicare tenure show greater improvement for some quality measures than their counterparts after the introduction of HH public reporting.⁹ Given this research, it is important to understand how disparities in outcomes may be a function of differences in agencies from whom older patients receive their care. Knowing what contributes to disparities can help to shape interventions and policies to achieve health equity.^{10,11}

Two prior studies have examined the question of within- and between-HHA disparities.^{12,13} A study examining disparities in the patient-reported experiences of care found that 14 of 19 statistically significant quality outcomes were associated with within HHA racial disparities where racially minoritized patients had a different experience of care than their White counterparts.¹³ Another study identified within-HHA racial disparities in 30-day and 60-day hospital readmissions and emergency department use.¹² However, compared to functional improvement, disparities in hospital readmissions and emergency department use may be considered more distal from the quality of care received by the HHA, prompting our focus on functional improvement.

The overall objective of this study is to examine racial, ethnic, and income-based disparities in functional improvement within and between HHAs to determine what part of those disparities are attributable the treatment received within an HHA versus measured and

unmeasured HHA characteristics. Addressing this objective is vital because solutions and interventions to promote health equity in HH will be different depending on the source of the disparity (i.e., differences in treatment of individual patients or differences in access to high-quality care). We hypothesize that: (1) there will be both between- (overall) and within-HHA racial, ethnic, and income-based disparities in functional improvement; and (2) HHA-measured and unmeasured characteristics will contribute to a large portion to the observed disparities given that there are disparities in access to high-quality HHAs.⁸

Methods:

Study Design

This study estimates racial, ethnic, and income-based differences in functional improvement rates among patients successfully discharged from HH using a retrospective cohort design.

Data

Data come from the 2016 and 2017 Medicare Beneficiary Summary File (MBSF), the 2016 and 2017 Outcome and Assessment Information Set (OASIS), the 2015 ZIP Code Tabulation Area (ZCTA) Social Deprivation Index (SDI),¹⁴ the 2015 American Community Survey (ACS) 5-year estimates, and the 2013 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for Counties.

The MBSF contains patients' demographic characteristics, enrollment information, and current address ZIP codes. Medicare-certified HHAs are required to submit OASIS assessments for all Medicare beneficiaries receiving skilled HH services. We used the OASIS to identify individual HH patients, the HHA serving them, as well as other patient-level information (e.g., health status, living arrangements, social support). These data are linked to the MBSF using the patient/beneficiary ID number.

Last, we used the publicly-available Social Deprivation Index, which uses ACS 5-year estimates to collate information on place-based economic disadvantage.¹⁴ Neighborhood racial composition is collated from the ACS 5-year estimates available through data.census.gov, and county rurality is derived from the NCHS Urban-Rural Classification Scheme for Counties.¹⁵ The neighborhood details are described further, below. These data are linked to the beneficiary-level data using the ZCTAs and Social Security Administration standard county code.

Study Sample

Our sample consists of White, Black, and Hispanic/Latine Medicare enrolled HH patients aged 65 years and older who had a start of care assessment in 2016. Because we were interested in functional improvement, we excluded HH patients without any functional limitations reported on their start of care assessment (n=24,818). We also exclude HH patients residing in congregate housing at the start of care (e.g., Assisted Living n=410,500) due to their limited choice in HHA and to maintain our focus on community-dwelling and noninstitutionalized older adults. Our analytic sample consists of 3,173,454 patients who were followed until their first discharge, death, transfer assessment, or December 31, 2017, if they had none of the identified follow-up assessments.

Variables

While functional improvement is our primary outcome of interest, we must account for potential differences in the likelihood of being discharged between racial/ethnic and income groups. Therefore, we created a mutually exclusive five-category outcome variable operationalized as: (1) discharged from the HHA with any functional improvement; (2) discharged from the HHA without functional improvement; (3) death while still a patient of the HHA; (4) transfer from the HHA to an inpatient facility; and (5) still using HH at the end of the study period (December 31, 2017). Functional improvement is calculated using the overall

improvement in the composite Activities of Daily Living (ADL) score.^{5,6,16} We calculate the composite ADL score using 8 ADLs: grooming, dressing lower body, dressing upper body, bathing, toileting, transferring, ambulation, and eating. To calculate our ADL measure, we use a corrected Likert approach where each individual ADL is divided by the highest possible value for that ADL, allowing all of the individual ADLs to be on the same scale (0-1).¹⁶ We then sum all of the individual ADLs and create a score ranging from 0 to 8, where 0 would indicate that the HH patient required no assistance with any of the ADLs and 8 indicates some level of assistance for all ADLs.

To quantify the overall change in ADL functional improvement, we calculate the difference between the ADL composite score on the start of care and discharge assessments. Positive scores indicate improvement, negative scores indicate a decline, and scores of 0 indicate no change in function. HH patients with scores of 0 or less are grouped into the “no improvement” category and everyone with scores above 0 are categorized as “any improvement.”

The independent variables of interest are measured at the patient level and describe the patients' race, ethnicity, and socioeconomic status. To identify the race and ethnicity of HH patients, we use the Research Triangle International race indicator in the MBSF, which has been shown to improve the accuracy of race data in the Medicare enrollment record via an imputation algorithm.¹⁷ All racial/ethnic groups are mutually exclusive. A patients' low-income status is determined by dual enrollment in Medicare and Medicaid and participation in Medicare Part-D low-income cost-sharing subsidy (LIS) at the time of HH initiation. We use the Part-D LIS to capture more potentially low-income patients, as the LIS has a more generous eligibility than Medicaid, does not vary by state, and therefore allows for more uniform and potentially sensitive measure of low-income status.

A number of covariates are also included in the study based on the disablement conceptual model (see Table 1).¹⁸ These variables include risk factors (e.g., age, sex, SDI), intra-individual

factors (i.e., behavioral risk factors), extra-individual factors (e.g., Medicare Advantage status, living alone, caregiver assistance), pathology (i.e., prognosis), impairment (e.g., vision impairment, surgical wound, incontinence), functional limitations (e.g., pain, shortness of breath, cognitive impairment), and disability/prior function.⁶ We also control for referral source as a proxy for patient risk and need at their start of care.^{6,19} The values for all patient-level control variables come from the start of care assessment.

Analytic Approach

Summary statistics are calculated for patient characteristics by race, ethnicity and income level. We conduct two separate analyses. First, we estimate the relationship between patient characteristics and the outcome using a multinomial logit model adjusting for all aforementioned covariates. Second, to determine within HHA disparities we estimate another multinomial logit model adjusting for all covariates and using HHA fixed effects. We used a Mundlak hybrid model to account for HHA differences by inserting HHA-level means of all model covariates and clustered standard errors on the HHA to approximate fixed effects.^{20,21} The approximated fixed effects account for both observed and unobserved HHA characteristics.

To determine the disparities attributable to individual characteristics, net of the HHA effects, we compare the models with and without HHA fixed effects. Comparing the estimates across the two models (with and without fixed effects) allows us to quantify the explanatory power of HHAs on the observed disparities in functional improvements. We only complete this calculation for discharged HH patients and those who die, as the other outcome values are not conceptualized as categorically “good” or “bad” outcomes.

The Brown University Institutional Review Board reviewed and approved this study. All data cleaning and analyses were completed using STATA 16.²²

Results

Of the 3,173,454 Medicare patients who started HH in 2016, 80% were White, 12% were Black, approximately 8% were of Hispanic/Latine descent, and 27% were low-income (**Table 2**). Overall, 69% of patients had functional improvement while 7% had no functional improvement upon discharge. The percent of patients with functional improvement was highest among White and higher income patients (70% and 72% vs 64% of Black and Hispanic/Latine, and 63% of low-income HH patients). Black, Hispanic/Latine, and low-income patients had higher rates of discharge without functional improvement (9%, 11%, and 9%, respectively vs 6.1% for both White and higher income patients). The percent of patients who died or were transferred to inpatient settings was highest among Black and low-income HH patients. Black, Hispanic/Latine, and low-income HH patients were more likely to be still using HH at the end of the study period than were White and higher income patients. Among HH patients who were discharged, there was an average 2-point improvement in the overall function score. This was slightly lower for Black, Hispanic/Latine, and low-income HH patients, 1.8(1.3), 1.7(1.3), and 1.7(1.3) points, respectively relative to white discharged patients. Other individual-level covariates are displayed by race and socioeconomic position in **Table 2**.

Black and low-income HH patients were still significantly less likely to be discharged with functional improvement, as compared to their White and higher income counterparts (**Table 3**), after controlling for various patient-level characteristics and examining overall differences in being discharged with functional improvement. However, after including HHA fixed effects in the adjusted model, race differences were no longer statistically significant; only income disparities remained. When examining the overall difference, Black HH patients had a 1.1 percentage point (pp; 95% CI: -1.4, -0.7) lower adjusted rate of functional improvement as compared to their White counterparts, and low-income HH patients had a 4.4pp (95% CI: -4.6, -4.1) lower adjusted rate of functional improvement as compared to their higher income counterparts. Within HHAs, Black HH patients had a 0.1pp (95% CI: -0.3, 0.1) lower adjusted rate of functional improvement

and low-income HH patients had a 4.2pp (95% CI: -4.4, -4.0) lower adjusted rate of functional improvement.

After controlling for various patient-level characteristics and examining overall differences in being *discharged without functional improvement*, Black, Hispanic/Latine, and low-income HH patients were all significantly more likely to not experience functional improvement (**Table 3**). However, after including HHA fixed effects in the adjusted model, within-HHA results were only statistically significant for Black and low-income HH patients. Black and Hispanic/Latine HH patients both had a 1.2pp higher adjusted rate of no functional improvement as compared to their White counterparts (95% CI for Black patients: 0.9, 1.4; 95% CI for Hispanic/Latine patients: 0.7, 1.7), and low-income HH patients had a 0.5pp (95% CI: 0.4, 0.6) higher adjusted rate of no functional improvement as compared to their higher income counterparts. Within HHAs, Black HH patients had a 0.3pp (95%CI: 0.2, 0.4) higher adjusted rate of not having functional improvement as compared to their White counterparts, Hispanic/Latine HH patients had a 0.1pp (95% CI: -0.1, 0.2) increased rate, and low-income HH patients had a 0.4 (95%CI: 0.3, 0.5) higher adjusted rate of no functional improvement as compared to their non-low-income counterparts. Other outcome results are also shown in **Table 3**.

Adjustment for HHA characteristics with HHA fixed effects conveyed that varying rates of the overall disparities were related to HHA factors. Hispanic/Latine patients did not experience a disparity in having any improvement but 91% of the Black-White disparity in having any functional improvement was related to HHA characteristics while only 5% of the income-based disparity could be tied to HHA characteristics. As it relates to not experiencing functional improvement, 74% of the Black-White disparity, 92% of the Hispanic/Latine-White disparity, and 20% of the income-based disparity are related to HHA factors (**Table 3**). Main regression results can be found in Table 4 and full regression results can be found in Supplemental Tables 1 and 2.

Discussion

Our study contributes to the limited literature around HH inequities and suggests that the overall HH racial, ethnic, and income disparities in functional improvement are attributable to the HHAs used. We find that there are Black, Hispanic/Latine, and income-based disparities in functional improvement between HHAs, as well as within-HHA Black-White and income-based disparities. It is important to note that race is socially constructed, and therefore, none of the observed disparities here result from a biological process. On the contrary, the fundamental cause may be racism. The between-HHA aggregate disparities may reflect structural inequities in access to higher quality HHAs for Hispanic/Latine and Black HH patients, whereas the within-HHA disparities could reflect differences in how patients are treated by the HHA or interpersonal/personally-mediated racism and discrimination within HHAs.²³

Our study provides insight into why the literature may be mixed concerning racial disparities in functional improvement. The earliest study in this area found no racial/ethnic differences, but only examined disparities within one HHA in a Northeast urban area.⁴ Another study only found differences affecting Black HH patients,⁵ but this study was limited to a small sample of HHAs. Our work best aligns with the findings from the two most recent studies by Chase et al. and Wang et al.,^{6,7} who find racial and ethnic disparities in functional improvement. Our study further contributes to the literature by including all HH patients in our model - as opposed to solely focusing on patients with a discharge assessment - thus allowing for the observed differential rate of mortality, hospitalization and censoring among Black, Hispanic/Latine and low-income patients, relative to White patients.

When accounting for all possible outcomes, Hispanic/Latine patients have greater functional improvement than their White counterparts. This finding is consistent with findings of other studies,^{5,7} but also inconsistent with some literature.^{4,6} For example, Brega et al. found that Hispanic/Latine patients were significantly more likely than White patients to improve in the

“transferring” ADL measure but less likely than White patients to improve on other individual ADL measures.⁵ In addition, Wang et al. recently reported that Hispanic/Latine patients without dementia had greater functional improvement than all other racial groups.⁷ We also found that Hispanic/Latine patients have higher rates of not having functional improvement which aligns with recent research findings by Chase et al. (2018) showing a lower functional improvement for Hispanic/Latine and Black HH post-acute patients.⁶ Our findings indicate that the observed ethnic differences in functional improvement are strongly influenced by HHA characteristics and therefore differences in the HHAs that are used by Hispanic/Latine patients. The contradictory findings within the Hispanic/Latine population may be related to health status characteristics that we do not have in this study and are an issue for further study.

Similarly, we find that a majority of the Black-White disparities in functional improvement are also attributable to HHA characteristics. When we controlled for which HHA served patients, the differences in functional improvement between White and Black HH patients was no longer statistically significant. This finding is consistent with other research indicating that Black HH patients are accessing HHAs whose patients experience poorer outcomes. For low-income HH patients, we do not find that a large share of the disparity in functional improvement is attributed to the quality and types of HHAs that they are using. Conversely, it seems that much of disparity between income levels is related to differences in treatment between low-income and non-low-income HH patients; however, because we are unable to adequately adjust for other clinical factors, our results may be influenced by lower income HH patients being unable to functionally improve due to fewer resources or other challenges.

Mitigating disparities related to HHA use. Our findings suggest that the HHA from which patients receive care explains much of the between group differences observed in prior literature.⁵⁻⁷ Both Black and Hispanic/Latine HH patients experienced disparities in functional improvement that were largely related to measured and unmeasured HHA characteristics. When racial and ethnic disparities are examined within HHAs, these differences were greatly

reduced. These findings are supported by prior work that illustrates inequities in access to high-quality HHAs for Black and Hispanic/Latine HH patients when compared to White HH patients.^{8,12} However, our findings also contradict those of Maddox et al. (2018) who found that disparities in 30-day and 60-day readmissions and emergency department use were related to within HHA differences, rather than characteristics of the agencies from which patients received care,¹² which is why we chose to study an outcome that is more proximate to HHA services. To have the greatest impact on health equity in functional improvement, interventions and policies should focus on addressing structural/institutional racism and improving access to higher quality HHAs⁸ or targeting HHAs with large proportions of minoritized patients for quality improvement initiatives.

There are three potential approaches to mitigating overall functional improvement disparities. First, CMS could incentivize higher quality HHAs to better serve racially/ethnically minoritized and low-income HH patients as the agency is working to do through the “Better Care for Dually Eligible People” initiative.^{24,25} However, increasing financial payments does not directly correspond with improving expertise on supporting more vulnerable patients and/or mitigating disparities.²⁶ Future work should explore what characteristics of HHAs are associated with the greatest functional improvement and lowest disparities. Alternatively, CMS could target the HHAs that are already serving more vulnerable populations for quality improvement initiatives focused on functional improvement. Last, CMS could also target minoritized and low-income patients to increase their awareness and use of the CMS quality information and 5-star ratings,^{27–30} which may in turn increase their use of higher quality HHAs.

Mitigating within-HHA Disparities. Our findings also indicate that even within the same HHA there are income-based and Black-White disparities in functional improvement. This implies that within a given HHA, low-income and Black HH patients are being treated differently than their non-low-income and White counterparts. This reflects the presence of interpersonal or personally-mediated racism within HHAs.²³ We propose three potential approaches that may

help to mitigate disparities within HHAs. First, CMS could report inequities as a measure of HHA quality.^{31,32} This will help to reward HHAs for mitigating disparities. Second, HHAs should consider developing targeted and socially conscious caregiver training programs to better engage and encourage caregivers to support ADL improvement.^{33–36} Education and training programs and resources should be culturally appropriate and socially conscious programs that take into account the possible limitations in the built and social environment.^{37–39} Last, HHAs may be able to augment pain management, wound care, PT, & OT for minoritized and low-income populations. Research shows that proper management of pain and wound care, and increased PT and OT could promote ADL improvement and if the HHA were to put increased focus on providing these services to dually-eligible HH patients then this could help to mitigate disparities.⁶

This study is not without limitations. We only examine functional improvement among those who are discharged from the HHA. We operationalize functional improvement as a dichotomous indicator within our discharge group, which means that we can't see incremental change differences by groups as is done in other studies.⁶ However, our choice to examine any improvement versus no improvement was done to minimize floor/ceiling effects, but additional work incorporating a clinically meaningful degree of change would be beneficial.⁴⁰ In addition, we use a composite ADL measure; future work could disaggregate this measure to examine individual measures of ADL as prior research has suggested that improvement in specific ADLs has varied between racial groups.⁵ Furthermore, our racial and ethnic groups are mutually exclusive, meaning that we may not be appropriately assigning people to their preferred race or ethnicity, for example people who consider themselves as Black and Hispanic/Latine are referred to as Hispanic/Latine only. In addition, we excluded Asian Americans, Pacific Islanders, and Native Americans, who make up less than 3 percent of home health patients in our data—future work is needed to understand home health use among these populations. Of note, we do not take an intersectional approach;⁴¹ however, there are important joint effects of race and

other factors that may be important to consider, and literature has indicated an interactive effect between race and dementia.⁷ As such, future research should consider other intersections of identity and health status. Last, our data predates the advent of the 2020 HH Patient-Driven Groupings Model (PDGM),⁴² which values therapy services differently and may likely cause a decrease in physical therapy services, and having fewer therapy services may exacerbate disparities in functional improvement. In addition, PDGM lowers reimbursement for non-post-acute episodes. This lower reimbursement may differentially impact on Black, Hispanic/Latine, and lower income HH patients who tend to be community referrals as opposed to post-acute referrals,⁴³ and this differential impact may in turn exacerbate disparities.

Conclusion

Mitigating the observed disparities described within this study requires that we acknowledge the structural inequities that hinder access to higher quality services and implement targeted approaches, as discussed in this paper. Rarely are inequities eliminated with a broad approach to quality improvement, and in fact, there is even greater risk for the unintended consequence of exacerbating disparities.^{26,32,44} There are between-HHA aggregate disparities that reflect structural inequities in access to higher quality HHAs for Hispanic/Latine and Black HH patients, as well as within-HHA disparities that exist and reflect differences in how patients are treated especially for Black and low-income HH patients, and both of these types of inequities need targeted solutions.

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Table 1. Conceptual and Operational Definition of Covariates as Informed by Prior Studies and the Disablement Model.

Covariates	Type	Description (Data Source)
Risk Factors		
Sex	Dichotomous	Male/Female (MBSF)
Age	Continuous	(MBSF)
Proportion of Black Residents in Neighborhood Centile Score	Ordinal	Ranging from 1-100, neighborhoods in the 100 th centile represent those with the greatest percentage of Black residents (ACS).
Proportion of Hispanic/Latine Residents in Neighborhood Centile Score	Ordinal	Ranging from 1-100, neighborhoods in the 100 th centile represent those with the greatest percentage of Latine residents (ACS).
Social Deprivation Index (SDI) Score ¹⁴	Ordinal	The SDI score is a centile that divides the ordered set of sociodemographic measures into 100 parts, making the SDI score easily interpretable by way of an underlying scale. The SDI score is calculated from a composite of the percent of the population: (1) living below 100% FPL; (2) 25 years of age or more with less than 12 years of education; (3) non-employed; (4) unemployed; (5) living in renter occupied housing; (6) living in crowded housing units; (7) without a car; (8) single-parent households with dependents < 18 years. The higher the SDI score, the more socioeconomically disadvantaged the neighborhood. An SDI score of 100 means that the ZCTA is the most deprived while a score of 1 makes it the least deprived. (ACS & Robert Graham Center)
Intra-Individual Factors		
Behavioral risk factors	Categorical	Total number of behavioral risk factors (i.e., smoking, obesity, alcohol dependency, and drug dependency). 0=no behavioral risks; 1=1 behavioral risk; 2=2+ behavioral risks. (OASIS Items: M1036 1-4)
Pathology		
Prognosis	Categorical	Patients' overall status, stability, and risk for serious complications and death. 0= No heightened risks, patient is stable; 1= Temporarily facing heightened health risks but will likely return to "0"; 2=Heightened health risks with low likelihood have becoming stable and possible increased risk for death. (OASIS Item: M1034; original OASIS codes 2 & 3 are collapsed into category 2(high risk))
Impairment		
Vision Impairment	Dichotomous	Yes/No (OASIS Item: M1200)
Hearing Impairment	Dichotomous	Yes/No (OASIS Item: M1210)

Has a Surgical Wound	Dichotomous	Yes/No (OASIS Item: M1340)
Urinary Incontinence	Dichotomous	Yes/No (OASIS Item: M1610)
Bowel Incontinence	Dichotomous	Yes/No (OASIS Item: M1620)
Functional limitations		
Interfering Pain	Dichotomous	Yes/No for patient having pain that interferes with activity or movement at any frequency. (OASIS Item: M1242; original OASIS codes 0 & 1 =No and code 2-4=Yes)
Shortness of Breath	Categorical	Indicates when patients experience shortness of breath. 0=Never; 1=With minimal to moderate exertion; 2=With heavy exertion. (OASIS Item: M1400; original OASIS codes 2-4=With minimal to moderate exertion and code 1=With heavy exertion)
Cognitive impairment	Dichotomous	Yes/No for any cognitive impairment if the patient requires prompting, assistance, or are totally dependent on care providers due to disturbances (codes 1-4) (OASIS Item: M1700)
Confusion	Dichotomous	Yes/No for confusion at any time (codes 1-4) (OASIS Item: M1710)
Cognitive, Behavioral, or Psychiatric Symptoms	Categorical	Total cognitive, behavioral and psychiatric symptoms (i.e., verbal disruption, memory deficit, impaired decision making, physical aggression, delusional/hallucinatory/paranoid) present at least once/week categorized as 0=No Symptoms; 1=1 Symptom; 2=2+ Symptoms. (OASIS Item: M1740)
Disability		
Prior Function	Ordinal	Patients' total dependence with self-care, ambulation, transfer, and household tasks prior to current illness, exacerbation, or injury leading to home care episode summed. Ranges from 0-8 where 0 indicates full independence and 8 indicates full dependence in all areas. (OASIS Item: M1900)
Extra-Individual Factors		
Medicare Advantage Status ⁴⁵	Dichotomous	Yes/No if ever on Medicare Advantage during the course of the episode. (MBSF)
Caregiver ADL Assistance	Dichotomous	Yes/No for having a caregiver that provides assistance with Activities of Daily Living (ADLs) (OASIS Item: M2100 code 1)
Frequency of Caregiver ADL Assistance	Categorical	Categories for how often the patient receives ADL or IADL assistance from any caregiver: 0=No assistance received; 1=Daily Assistance; 2=Weekly Assistance; 3=Less than Weekly Assistance. (OASIS Item: M2110)
Living Alone ⁴⁶	Dichotomous	Yes/No if living alone (OASIS Item: M1100; Codes 1-5=Living Alone)
Other Factors		

Referral Source ⁵	Categorical	Categorizes where HH patients are referred or discharged from in the past 14 days as: 0=No discharge/referral code; 1=Acute hospitalization; 2=Post-Acute Inpatient Stay; 3=Other. (OASIS Item: M1000)
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Table 2. Home Health Patient Characteristics by Race, Ethnicity, and Income Level

	Overall 3,173,454	White 2,550,720	Black 384,443	Hispanic/ Latine 238,291	Higher Income 2,330,890	Low- Income 842,564
Outcome, %						
Discharged with functional improvement	69.1	70.3	64.2	64.2	71.5	62.5
Discharged Without functional improvement	6.7	6.1	8.5	10.9	6.1	8.5
Death – no discharge	0.4	0.4	0.5	0.4	0.4	0.4
Transfer – no discharge	19.7	19.6	21.6	18.4	18.3	23.7
Continued use – no discharge	4.0	3.7	5.2	6.2	3.7	4.9
Amount of functional improvement, mean (SD)	2.0 (1.3)	2.0 (1.3)	1.8 (1.3)	1.7 (1.3)	2.0 (1.3)	1.7 (1.3)
Race, %						
White	80.4	-	-	-	88.4	58.1
Black	12.1	-	-	-	8.1	23.2
Hispanic/Latine	7.5	-	-	-	3.5	18.7
Low-income-Eligible, %	26.6	19.2	50.8	66.2	-	-
Medicare Advantage, %	30.7	28.6	39	40.4	28.5	36.8
Female, %	61.3	60.5	65.6	62.3	57.9	70.6
Average Age, mean (SD)	79.3 (8.4)	79.6 (8.3)	77.6 (8.4)	78.5 (8.2)	79.8 (8.3)	78.0 (8.4)
Behavioral Risks, %						
No behavioral risks	63.3	63	60.7	70.8	65.2	58
1 Behavioral risk	30.8	30.9	33	25.7	29.4	34.6
2+ Behavioral risks	5.9	6.1	6.3	3.5	5.4	7.4
Prognosis, %						
No heightened risk	7.1	7.1	7.1	7.8	7.3	6.7
Temporary risk	56.5	55.9	56.5	62.3	56.7	55.8
High risk	36.4	37	36.4	29.9	36	37.5
Vision impairment, %	26.9	24.5	33.4	42.4	23.8	35.5
Hearing impairment, %	39.9	41.1	31.8	40.1	39.5	40.9
Presence of a surgical wound, %	28.4	30.1	21	21.7	32.4	17.4
Urinary incontinence, %	56.4	55.8	59.3	58.3	53.7	64
Bowel incontinence, %	14.1	13.5	17.3	15.9	12.9	17.5
Interfering pain, %	76.9	76.9	75.5	78.5	76.1	78.8
Shortness of breath, %						
None	24.2	24.2	23.5	25.9	25.9	19.5
with Minimal- moderate exertion	50.4	50.2	51.6	50.8	47.8	57.7
with Heavy exertion	25.4	25.6	24.9	23.3	26.3	22.8
Cognitive Impairment, %	46.2	44.9	50.2	53.7	43.4	53.9
Confusion, %	53.8	52.7	57.5	59.4	51.2	61.2
Cognitive, Behavioral, & Psychiatric Symptoms, %						
No symptoms	73.5	74.2	70.8	70.7	75	69.2
1 Symptom	17	16.5	18.9	19.4	15.8	20.1

2+ Symptoms	9.5	9.4	10.3	9.9	9.1	10.7
Prior Function, mean (SD)	2.6 (2.3)	2.5 (2.3)	3.2 (2.3)	3.3 (2.3)	2.4 (2.3)	3.2 (2.3)
Has ADL Assistance, %	52.6	51.9	54.2	57.5	52.8	52
ADL Assistance Frequency, %						
Daily	84.2	84	82.6	88.9	85.4	80.7
Weekly	12.5	12.7	13.6	8.5	11.6	14.8
Less than weekly	1.7	1.7	1.9	1.1	1.5	2.2
None	1.7	1.7	1.9	1.5	1.5	2.3
Living Alone, %	28.5	29.3	27.7	20.1	26.4	34.1
Proportion Black neighborhood centile, mean (SD)	50.5 (28.9)	45.6 (27.0)	84.6 (17.3)	46.8 (27.4)	48.6 (28.2)	55.6 (30.4)
Proportion Hispanic/Latine neighborhood centile, mean (SD)	50.5 (28.9)	47.2 (27.3)	49.7 (29.3)	86.7 (17.8)	48.6 (27.6)	55.7 (31.5)
SDI Score, mean (SD)	49.5 (28.2)	44.0 (26.0)	72.6 (24.7)	71.4 (25.6)	44.6 (27.0)	62.9 (26.9)
Referral Source, %						
Acute hospitalization	42	43.1	38.4	35.8	44.5	35
PAC inpatient stay	25.5	26.8	21.8	17.5	26.6	22.5
Other	0.3	0.3	0.3	0.4	0.3	0.3
Missing source	32.2	29.8	39.5	46.3	28.6	42.2

Source. Authors' analysis of data from the 2016 and 2017 Medicare Beneficiary Summary File (MBSF), the 2016 and 2017 Outcome and Assessment Information Set (OASIS), the 2015 ZIP Code Tabulation Area (ZCTA) Social Deprivation Index, and the 2015 American Community Survey (ACS) 5-year estimates. **Notes.** Data are derived from the start-of-care assessments. SD, standard deviation. ADL, Activities of Daily Living. PAC, Post-Acute Care. SDI, Social Deprivation Index. Low-Income identified a beneficiary as having dual enrollment in Medicare and Medicaid and/or participation in Medicare Part-D low-income cost-sharing subsidy. Neighborhood is defined by the ZIP Code Tabulation Area. See table 1 for other variable descriptions.

Table 3. Difference in Functional Improvement for Individual Home Health Patients by Race, Ethnicity, and Socioeconomic Position, Comparing the Inclusion of Home Health Agency Characteristics.

Unadjusted Percent of <u>Discharged Patients with Functional Improvement</u>			Adjusted	Adjusted with HHA FEs	Relative Percentage of Disparity Due to HHA Characteristics
White	Black	Unadjusted pp Diff.	Adjusted Difference pp (CI)	Within-HHA Difference pp (CI)	Black-White Disparity
70.3	64.2	-6.1	-1.1 (-1.4, -0.7)	-0.1 (-0.3, 0.1)	91%
White	Hispanic/Latine				Latine-White Disparity
70.3	64.2	-6.1	0.7 (0.1, 1.3)	1.9 (1.6, 2.2)	N/A
Higher Income	Low-Income				Socioeconomic Disparity
71.5	62.5	-9.0	-4.4 (-4.6, -4.1)	-4.2 (-4.4, -4.0)	5%
Unadjusted Percent of <u>Discharged Patients without Functional Improvement</u>			Adjusted	Adjusted with HHA FEs	Relative Percentage of Disparity Due to HHA Characteristics
White	Black	Unadjusted pp Diff.	Adjusted Difference pp (CI)	Within-HHA Difference pp (CI)	Black-White Disparity
6.1	8.5	2.4	1.2 (0.9, 1.4)	0.3 (0.2, 0.4)	75%
White	Hispanic/Latine				Latine-White Disparity
6.1	10.9	4.8	1.2 (0.7, 1.7)	0.1 (-0.1, 0.2)	92%
Higher Income	Low-Income				Socioeconomic Disparity
6.1	8.5	2.4	0.5 (0.4, 0.6)	0.4 (0.3, 0.5)	20%
Unadjusted Percent of <u>Death during HH Episode</u>			Adjusted	Adjusted with HHA FEs	Relative Percentage of Disparity Due to HHA Characteristics
White	Black	Unadjusted pp Diff.	Adjusted Difference pp (CI)	Within-HHA Difference pp (CI)	Black-White Disparity
0.4	0.5	0.1	0.04 (0.01, 0.07)	0.02 (-0.01, 0.05)	50%
White	Hispanic/Latine				Latine-White Disparity

0.4	0.4	0.0	-0.10 (-0.13, -0.07)	-0.09 (-0.1, -0.06)	10%
Higher Income	Low-Income				Socioeconomic Disparity
0.4	0.4	0.0	-0.06 (-0.08, -0.04)	-0.06 (-0.1, -0.04)	0%
Unadjusted Percent of <u>Transfer from HH</u>			Adjusted	Adjusted with HHA FEs	
White	Black	Unadjusted pp Diff.	Adjusted Difference pp (CI)	Within-HHA Difference pp (CI)	
19.6	21.6	2	-0.73 (-1.0, -0.5)	-0.30 (-0.4, -0.1)	
White	Hispanic/Latine				
19.6	18.4	-1.2	-2.35 (-2.7, -2.0)	-2.06 (-2.2, -1.8)	
Higher Income	Low-Income				
18.3	23.7	5.4	3.69 (3.5, 3.87)	3.85 (3.7, 4.0)	
Unadjusted Percent of <u>HH Patients Continuing Care</u>			Adjusted	Adjusted with HHA FEs	
White	Black	Unadjusted pp Diff.	Adjusted Difference pp (CI)	Within-HHA Difference pp (CI)	
3.7	5.2	1.5	0.61 (0.4, 0.8)	-0.02 (-0.1, 0.1)	
White	Hispanic/Latine				
3.7	6.2	2.5	0.56 (0.2, 0.9)	0.12 (0.01, 0.2)	
Higher Income	Low-Income				
3.7	4.9	1.2	0.25 (0.1, 0.4)	-0.01 (-0.1, 0.1)	

Source. Authors' analysis of data from the 2016 and 2017 Medicare Beneficiary Summary File (MBSF), the 2016 and 2017 Outcome and Assessment Information Set (OASIS), the 2015 ZIP Code Tabulation Area (ZCTA) Social Deprivation Index, and the 2015 American Community Survey (ACS) 5-year estimates.

Notes. PP, Percentage Point. CI, Confidence Interval. HH, Home Health. HHA, Home Health Agency. FEs, Fixed Effects. Diff., Differences. Low-Income identified a beneficiary as having dual enrollment in Medicare and Medicaid and/or participation in Medicare Part-D low-income cost-sharing subsidy. Analysis uses a multinomial logit model with and without HHA fixed effects and adjusts for all covariates listed in table 2.

Table 4. Multinomial Regression Results of Main Effects for Models with and without Home Health Agency Fixed Effects.

Variable	Model without HHA Fixed Effects					Model with HHA Fixed Effects				
	RRR	SE	95% CI LL	95% CI UL	p	RRR	SE	95% CI LL	95% CI UL	p
Any Functional Improvement (base outcome)										
No Functional Improvement										
Black	1.21	0.02	1.17	1.25	<.001	1.05	0.01	1.03	1.07	<.001
Hispanic/Latino	1.18	0.04	1.09	1.26	<.001	0.98	0.01	0.96	1.01	.17
Low-Income	1.16	0.01	1.14	1.19	<.001	1.15	0.01	1.13	1.17	<.001
Death during Home Health										
Black	1.12	0.04	1.05	1.19	<.001	1.05	0.04	0.99	1.13	.109
Hispanic/Latino	0.76	0.04	0.69	0.83	<.001	0.77	0.04	0.70	0.84	<.001
Low-Income	0.95	0.02	0.90	0.99	<.05	0.94	0.02	0.90	0.98	<.05
Transfer from Home Health										
Black	0.98	0.01	0.96	1.00	<.05	0.99	0.01	0.98	1.00	.074
Hispanic/Latino	0.87	0.01	0.85	0.89	<.001	0.87	0.01	0.85	0.88	<.001
Low-Income	1.29	0.01	1.28	1.31	<.001	1.30	0.01	1.29	1.31	<.001
Continued Use of Home Health										
Black	1.18	0.02	1.13	1.23	<.001	1.00	0.01	0.98	1.02	.731
Hispanic/Latino	1.14	0.05	1.05	1.23	<.01	1.00	0.01	0.97	1.03	.987
Low-Income	1.14	0.02	1.11	1.17	<.001	1.07	0.01	1.05	1.09	<.001

Source. Authors' analysis of data from the 2016 and 2017 Medicare Beneficiary Summary File (MBSF), the 2016 and 2017 Outcome and Assessment Information Set (OASIS), the 2015 ZIP Code Tabulation Area (ZCTA) Social Deprivation Index, and the 2015 American Community Survey (ACS) 5-year estimates. **Notes.** RRR, Relative Risk Ratio. SE, Standard Error. CI, Confidence Interval. LL, Lower Limit. UL, Upper Limit. P, p-value. HHA, Home Health Agency. Low-Income identified a beneficiary as having dual enrollment in Medicare and Medicaid and/or participation in Medicare Part-D low-income cost-sharing subsidy. Analysis uses a multinomial logit model with and without HHA fixed effects and adjusts for all covariates listed in table 2.