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Association Between Race, Neighborhood, and Medicaid Enrollment and Outcomes in Medicare Home Health Care

Brief Title: Social Risk in Medicare Home Health

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ABSTRACT

BACKGROUND/OBJECTIVES: More than 3 million Medicare beneficiaries use home health care annually, yet little is known about how vulnerable beneficiaries fare in the home health setting. This is particularly important given the recent launch of Medicare's Home Health Value-Based Purchasing model. The objective of this study was to determine odds of adverse clinical outcomes associated with dual enrollment in Medicaid and Medicare as a marker of individual poverty, residence in a low-income ZIP code tabulation area (ZCTA), and black race.

DESIGN: Retrospective observational study using individuals-level logistic regression.

SETTING: Home health care.

PARTICIPANTS: Fee-for-service Medicare beneficiaries from 2012 to 2014.

MEASUREMENTS: Thirty- and 60-day clinical outcomes, including readmissions, admissions, and emergency department (ED) use.

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RESULTS: Home health agencies serving a high proportion of dually enrolled, low-income ZCTA, or black beneficiaries were less often high-quality dually enrolled, low-income ZCTA and black beneficiaries receiving home health care after hospitalization had higher risk-adjusted odds of 30-day readmission (odds ratio (OR)=1.08, OR=1.03, and OR=1.02 respectively, all $p<.001$) and 30-day ED use (OR=1.20, OR=1.07, and OR=1.15, respectively, all $p<.001$); those receiving home health care without a preceding hospitalization had higher odds of 60-day admission (OR=1.06, OR=1.01, and OR=1.05, respectively, $p<.01$ for each), and 60-day ED use (OR=1.16, OR=1.03, and OR=1.19, respectively, all $p<.001$) than their counterparts. Differences were primarily within agencies rather than between the agencies where these beneficiaries sought care.

CONCLUSION: Medicare beneficiaries receiving home health services who are dually enrolled, live in a low-income neighborhood, or are black have higher rates of adverse clinical outcomes. These populations may be an important target for quality improvement under Home Health Value-Based Purchasing.

Key words: home health, readmission, disparities, value-based purchasing

INTRODUCTION

More than 3 million Medicare beneficiaries use home health care annually, and Medicare spending on home health care totaled nearly \$18 billion in 2014.¹ A home health agency (HHA) provides home health care, which includes services such as part-time or intermittent skilled nursing, physical therapy, and occupational therapy and home health aide services such as personal care and assistance with preparing meals, in a beneficiary's home on a visiting basis. With the proportion of the population aged 65 and older projected to near 22% by 2040,² the need for such services will grow.

Lower-cost settings such as home health care may be a critical component of ongoing efforts to improve quality and reduce costs of care as pressure to do so mounts across the healthcare system. The Centers for Medicare and Medicaid Services (CMS) recently announced the launch of a mandatory national Home Health Value-Based Purchasing model (HHVBP) in nine states.³ HHAs will receive bonuses or penalties based on performance on a range of quality measures, including unplanned hospitalizations and ED use. The HHVBP model, which will affect payments in 2018, puts a significant amount of HHAs' payment at risk—up to 8% by 2022—and has the potential to be implemented nationally if it improves quality and reduces costs or is cost-

neutral to Medicare. As value-based payment programs become increasingly prevalent across care settings, there is rising concern about how such programs will affect providers who serve individuals with social risk factors and, consequently, access to care for such individuals.⁴⁻⁶ Little is known about how vulnerable beneficiaries, such as those living in poverty and racial minorities, fare in the home health setting. Some research suggests that black individuals have worse functional outcomes⁷ and worse experiences⁸ with home health care and that individuals from neighborhoods with high proportions of black residents have higher readmission rates from home health.⁹ Although a recent Department of Health and Human Services report examined some of these issues,¹⁰ there are no peer-reviewed data to our knowledge examining the relationship between black race and other home health outcomes such as preventable admissions and ED use or the relationship between poverty and outcomes in the home health setting. We therefore set out to answer three research questions. First, do beneficiaries who are poor, identified as those dually enrolled in Medicaid and Medicare or living in low-income neighborhoods, or black receive care from lower-quality home health agencies than other beneficiaries? Second, do these beneficiaries have higher rates of unplanned hospitalization, rehospitalization, or ED use while receiving home health care? Third, if so, are worse outcomes due primarily due to individual factors or to the agencies from which these beneficiaries receive care?

METHODS

Data

We used the Medicare enrollment database and home health, inpatient, outpatient, and skilled nursing facility claims data from 2012 to 2014 to examine all four National Quality Forum–endorsed claims-based outcome measures used in the current Home Health Quality Reporting Program from CMS. This includes two pairs of measures; one pair examines outcomes in the 30 days after hospitalization (roughly one-third of home health stays follow a hospitalization), and one pair examines outcomes in the first 60 days of a home health stay, regardless of whether a hospitalization preceded the stay.

Posthospitalization Outcomes

The two measures of posthospitalization outcomes were readmission during the first 30 days of HHA care and ED use without readmission during the first 30 days of HHA care. These measures apply only to home health stays preceded by a hospitalization and use 3 years of data

for performance measurement. Detailed methodology can be found on the CMS website;¹¹ stays are included in the measure if they begin within 5 days of a hospitalization, unless the hospitalization was for treatment of cancer, primary psychiatric disease, or rehabilitation or the beneficiary was discharged against medical advice. Of the 10,022,072 Medicare home health stays from 2012 to 2014, 6,813,418 were excluded because a hospitalization did not precede them. Additional exclusions are shown in Supplementary Table S1. Readmissions are considered outcomes unless they have diagnosis or procedure codes that indicate a readmission was planned; ED visits are considered outcomes unless there was also an inpatient admission during the same 30-day window. Thus, for these paired measures, beneficiaries can have one of three outcomes: readmission, ED use without readmission, or no acute care event.

Outcomes Regardless of Prior Hospitalization

The second paired set of measures included in the study examines hospitalization and ED use without hospitalization in the first 60 days of home health enrollment, regardless of whether a hospitalization preceded the stay. The denominator for this sample was thus much larger, and the measures were calculated on 1 instead of 3 years of data. Fiscal year 2014 was used for this analysis. Similar to the 30-day measures described above, the 60-day measures excluded admissions for planned procedures or cancer therapy; 39,537 of the 3,306,496 stays in 2014 were excluded for this reason. Other exclusions are shown in Supplementary Table S2.

Our primary predictors for all four outcomes were beneficiary-level dual enrollment in Medicare and Medicaid, residence in a low-income neighborhood, and black race. Medicaid enrollment was obtained from Medicare enrollment data. Beneficiaries' home ZIP codes were cross-walked to ZIP code tabulation areas (ZCTAs) using the Uniform Data Set mapper.¹² To define low-income neighborhoods, all ZCTAs were ranked based on 5-year estimates of median household income from the American Community Survey. A cut-off for the lowest quintile of ZCTA-level income was determined using these rankings, weighted by the number of households in each ZCTA. Individuals with a most recent ZIP code of residence before the HHA admission date that were in a ZCTA with median household income below the cut-off were low income; the 1,491 stays (0.06%) with ZIP codes that did not map to ZCTAs and the 4,467 stays (0.12%) stays in ZCTAs with missing median household income were considered non-low income. To identify black beneficiaries, we used the race variable that Research Triangle International created (which is available in the enrollment database) rather than the raw race data, because this has previously

been shown to improve the accuracy of race data in Medicare.¹³ To create a group of high-dual HHAs, we followed methods that have been used in the hospital safety-net literature,^{14,15} ranking all HHAs according to the proportion of dually enrolled beneficiaries served and creating a cutpoint that included 20% of all beneficiaries in the high-dual group. Because high-dual agencies tended to be small, this included more than 20% of agencies. A similar algorithm was followed to identify low-income ZCTA and high-black HHAs.

HHA location and size were obtained from Medicare home health files. Information on HHA quality was obtained from the publicly available Home Health Compare website, which provides ratings from one (worst) to five (best) stars for agencies participating in Medicare.¹⁶ CMS calculated the star ratings based on agency performance in 2014 and 2015 on a number of process and outcome measures.

Analysis

Summary statistics were calculated for beneficiary characteristics and agency characteristics for the denominator populations of the 30- and 60-day measures.

Outcomes were calculated using multinomial logistic regression models, as specified in measure documentation. First, models were built with only the primary predictor to examine the overall risk of each clinical outcome for the population of interest. Generalized estimating equations were used for these models, which allowed us to examine outcomes across HHAs while still accounting for within-provider correlation. Next, random-effects models using HHA-specific random intercepts were used to examine outcomes within HHAs, which allowed us to determine the degree to which differences between dual and nondual or black and nonblack beneficiaries were related to different outcomes within the same HHAs versus use of different HHAs. For the random-effects models, an additional term for the proportion of each agency composed of the population of interest (dual, low-income neighborhood, black) was added to the models to control for potential residual confounding according to agency. Next, the full random-effects models with risk adjustment were run for each outcome. Variables included in the risk-adjustment model for the 30-day measures, following published measure specifications,¹¹ included age, sex, disability, functional status, and comorbidities. A full list is provided in Supplementary Table S3. Risk adjustment for the 60-day models included similar factors and is provided in Supplementary Table S4. Finally, an additional model with full risk adjustment plus

all of the primary predictors (dual status, neighborhood, race) was estimated to help determine the independent effect of each predictor.

Because of the de-identified nature of the data, this was not considered human subjects research.

Analyses were performed using SAS (SAS Institute, Inc., Cary, NC); two-sided $p < .05$ was considered statistically significant.

RESULTS

Participant Characteristics

Of the 2,464,387 home health stays in the sample for the 30-day readmission and ED use measures, 570,964 (23.2%) were for dually enrolled beneficiaries, 518,090 (21.0%) for individuals in low-income neighborhoods, and 258,086 (10.5%) for black beneficiaries (Table 1). Dually enrolled, low-income neighborhood, and black beneficiaries were younger and had higher clinical risk scores, representing a higher burden of comorbidities, than their counterparts. Patterns were similar when considering stays included in the 60-day admission and ED use measures (Supplementary Table S5).

Agency Characteristics and Quality

There were 11,774 home health agencies in the sample, of which 5,113 (43.4%) were in the high-dual group, 4,085 (34.7%) in the low-income ZCTA group, and 3,637 (30.9%) in the high-black group; these agencies provided 12.6%, 16.3%, and 18.1% of home health stays, respectively, during the study period (Table 2). High-dual, low-income ZCTA, and high-black agencies had fewer stays per provider and were more often for profit in ownership. High-dual agencies (18.1%), low-income ZCTA agencies (16.8%), and high-black agencies (15.1%) were less likely to receive 4- or 5-star ratings based on 2014–15 performance than their peers and more likely to have no star rating, generally because of small sample size. Findings were similar for the sample of agencies included in the 60-day admission and ED use measures (Supplementary Table S6).

Raw Rates of 30- and 60-Day Adverse Clinical Outcomes

In unadjusted analyses, dually enrolled beneficiaries had significantly higher rates of all four clinical outcomes examined: 30-day readmissions (16.0% vs 12.3%, $p < .001$), 30-day ED use without readmission (11.7% vs 8.1%, $p < .001$), 60-day admissions (15.9% vs 15.4%, $p < .001$), and 60-day ED use without admission (13.7% vs 11.3%, $p < .001$, Figure 1A). Beneficiaries in low-income neighborhoods had higher rates of 30-day readmission, 30-day ED use and 60-day

ED use (Figure 1B). Black beneficiaries had higher rates of all four adverse clinical outcomes (Figure 1C).

Relationship Between Poverty, Neighborhood, Race, and Clinical Outcomes

Dually enrolled beneficiaries (odds ratio (OR)=1.44, $p<.001$), beneficiaries living in a low-income neighborhood (OR=1.16, $p<.001$), and black beneficiaries (OR=1.31, $p<.001$) all had higher odds of 30-day readmission (Table 3). In all cases, when a random effect for home health agency was added to the model, the odds fell slightly or increased, suggesting that the majority of the greater risk was within agency—associated with the individual's characteristics rather than the agency from which care was received (Table 3).

When risk-adjustment variables, such as age and medical comorbidities, were added to the random-effects models, the odds of each clinical outcome associated with the social risk factors of interest dropped considerably but remained significant in all cases (Table 3). For example, with risk adjustment, the odds of 30-day readmission for a dually enrolled beneficiary dropped to 1.08. After risk adjustment, the largest ORs were seen for 30- and 60-day ED use without hospital admission, with 15% to 20% higher odds of this outcome for dually enrolled and black beneficiaries than for their counterparts even after controlling for comorbidities and even using models to isolate the within-agency effect of each factor.

Finally, when all risk factors were entered into a single model for each outcome, dual enrollment remained significantly associated with higher odds of each adverse clinical outcome (Table 3), whereas the effect of low-income neighborhood residence was nearly eliminated. The association between black race and higher odds of adverse clinical outcomes remained significant for all outcomes except 30-day readmission, although relationships were attenuated somewhat.

DISCUSSION

Dually enrolled beneficiaries, those living in low-income neighborhoods, and black beneficiaries receiving home health care were more likely to receive care from lower-rated agencies and agencies that did not receive a star rating than their counterparts. They also had higher rates of 30-day readmission and ED use and 60-day admission and ED use; these differences were diminished by controlling for differences in comorbidities, but where they persisted, they reflected different outcomes within HHAs, rather than an effect related to the agencies from which these beneficiaries sought care.

Our first finding was that dually enrolled, low-income, and black beneficiaries were more likely to receive care from HHAs with lower star ratings or agencies that did not receive any rating because of inadequate data, although the fact that the time frame for our claims-based measures and the publicly reported star ratings do not overlap perfectly somewhat limit these findings. The star ratings are based on a broader range of factors than the clinical outcomes we examined, including process measures such as influenza immunization and outcome measures such as improvement in functional status and pain.¹⁷ The reasons these beneficiaries disproportionately receive care from low-star (and no-star) agencies are unclear. They may have fewer choices of HHAs based on the availability of high-quality agencies in their service area or may be less likely to comparison shop for high-quality agencies. Alternatively, there may be a structural feature, such as profit status, that is associated with the type of individuals it serves and the star rating; for example, for-profit home health agencies have somewhat lower performance on quality measures.¹⁸ If they also serve a higher proportion of poor or minority individuals, this could in part mediate these relationships. Further study to understand the factors that influence home health agency choice of vulnerable populations may be an important component in efforts toward improving equity in home health care.

We also found significant differences in admission and readmission rates according to dual status and race that were of similar magnitude to disparities that have been previously reported outside the home health setting,^{19–21} but the highest odds associated with dual enrollment or black race were those for 30- and 60-day ED use without admission, even after adjusting for clinical risk and even when compared with other beneficiaries within the same HHAs; this suggests that the reasons underlying these patterns are likely to be related to individual rather than agency factors. Lack of a usual source of care,²² lower-quality primary care,²³ barriers to seeking non-ED care (e.g., hours, transportation),²⁴ language barriers, mistrust, culturally insensitive care,²⁵ and less experience navigating the healthcare system,²⁴ all of which have previously been demonstrated that individuals in poverty and racial minorities more commonly experience, may contribute to these findings.

Our findings may have implications as HHAs prepare for a move to value-based purchasing models, which will reward providers for high quality and good clinical outcomes. Understanding the underlying reasons why there are disparities for dually enrolled and black beneficiaries in home health care—for example, whether preventable ED visits²⁶ are primarily related to access

to care as discussed above or whether they are due to other critical but less easily measured factors such as higher levels of frailty or lower levels of social support^{27,28}—is an important next step in designing interventions to reduce them. Such knowledge may be critical as clinical leaders and policymakers seek to harness value-based payment in the home health setting to improve care and clinical outcomes while not inappropriately penalizing providers for factors beyond their control.

Our study adds to a growing body of literature documenting disparities in clinical outcomes for poor and minority individuals and extends it to the home healthcare setting. For example, prior work has shown that, of all discharged individuals (not just those discharged to home health), dually enrolled beneficiaries had 15% higher odds of readmission after a hospitalization and that black beneficiaries had 13% to 19% higher odds of readmission.^{19,29} We found slightly smaller effects, which may in part be related to the differences in the factors included in risk adjustment for the HHA readmission measure and the hospital readmission measure, because of the composite nature of this measure, or because of true differences in the underlying relationships. Similarly, prior work has documented higher rates of preventable admission and ED use among dually eligible and black beneficiaries outside the home health setting, although direct comparison of effect size is difficult given differences in methodology.^{30–32}

There are limitations to our study. We examined outcomes only of Medicare fee-for-service beneficiaries, and whether patterns would hold in other populations is unclear. Clinical risk adjustment relies on coded comorbidities, which may underestimate actual comorbidities. The time frame for the claims-based measures and star ratings do not overlap perfectly. Although we anticipate that the racial and economic makeup of the agencies is relatively stable over time, any major shifts in demographic characteristics that occurred could have led us to misclassify agencies. Finally, whether disparities in clinical outcomes will change under the financial incentives in the HHVBP program or other postacute value-based payment models remains to be seen but should be monitored closely.

In conclusion, Medicare beneficiaries receiving home health services who are poor or black tend to receive care from lower-quality home health agencies and have higher rates of adverse clinical outcomes such as admission, readmission, and ED use. Reducing disparities in access to and delivery of high-quality home health care may be important in avoiding any potential unintended consequences of value-based payment programs in the home health setting.

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REFERENCES

1. March 2016 Report to the Congress: Medicare Payment Policy. Washington, DC: Medicare Payment Advisory Commission, 2016.
2. Department of Health and Human Services, Administration for Community Living, Administration on Aging. Aging Statistics 2016 [on-line]. Available at https://aoa.acl.gov/Aging_Statistics/Index.aspx Accessed March 22, 2017.
3. Centers for Medicare and Medicaid Services. Home Health Value-Based Purchasing Model 2016 [on-line]. Available at <https://innovation.cms.gov/initiatives/home-health-value-based-purchasing-model> Accessed October 23, 2016.
4. Joynt KE, Jha AK. Characteristics of hospitals receiving penalties under the Hospital Readmissions Reduction Program. *JAMA* 2013;309:342–343.
5. Gilman M, Adams EK, Hockenberry JM, Milstein AS, Wilson IB, Becker ER. Safety-net hospitals more likely than other hospitals to fare poorly under Medicare's value-based purchasing. *Health Aff (Millwood)* 2015;34:398–405.
6. Ryan AM. Will value-based purchasing increase disparities in care? *N Engl J Med* 2013;369:2472–2474.
7. Brega AG, Goodrich GK, Powell MC, Grigsby J. Racial and ethnic disparities in the outcomes of elderly home care recipients. *Home Health Care Serv Q* 2005;24:1–21.
8. Smith LM, Anderson WL, Kenyon A et al. Racial and ethnic disparities in patients' experience with skilled home health care services. *Med Care Res Rev* 2015;72:756–774.

9. Chen HF, Homan S, Carlson E, Popoola T, Radhakrishnan K. The impact of race and neighborhood racial composition on preventable readmissions for diabetic Medicare home health beneficiaries. *J Racial Ethn Health Disparities* 2017;4:648–658
10. Office of the Assistant Secretary for Planning and Evaluation. Report to Congress: Social Risk Factors and Performance Under Medicare's Value-Based Purchasing Programs. Washington, DC: U.S. Department of Health & Human Services, 2016.
11. Centers for Medicare and Medicaid Services. Home Health Quality Initiative: Quality Measures 2016 [on-line]. Available at <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HomeHealthQualityInits/HHQIQualityMeasures.html> Accessed November 21, 2016.
12. American Academy of Family Physicians. UDS Mapper 2017 [on-line]. Available at <https://www.udsmapper.org> Accessed July 20, 2017.
13. Eicheldinger C, Bonito A. More accurate racial and ethnic codes for Medicare administrative data. *Health Care Financ Rev* 2008;29:27–42.
14. Chatterjee P, Joynt KE, Orav EJ, Jha AK. Patient experience in safety-net hospitals: Implications for improving care and value-based purchasing. *Arch Intern Med* 2012;172:1204–1210.
15. Gilman M, Hockenberry JM, Adams EK, Milstein AS, Wilson IB, Becker ER. The financial effect of value-based purchasing and the hospital readmissions reduction program on safety-net hospitals in 2014: A cohort study. *Ann Intern Med* 2015;163:427–436.
16. U.S. Department of Health & Human Services. Home Health Compare [on-line]. Available at <https://www.medicare.gov/homehealthcompare/search.html> Accessed January 14, 2016.
17. Centers for Medicare and Medicaid Services. Home Health Star Ratings 2016 [on-line]. Available at <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-instruments/HomeHealthQualityInits/HHQIHomeHealthStarRatings.html> Accessed October 23, 2016.
18. Cabin W, Himmelstein DU, Siman ML, Woolhandler S. For-profit medicare home health agencies' costs appear higher and quality appears lower compared to nonprofit agencies. *Health Aff (Millwood)* 2014;33:1460–1465.

19. Tsai TC, Orav EJ, Joynt KE. Disparities in surgical 30-day readmission rates for Medicare beneficiaries by race and site of care. *Ann Surg* 2014;259:1086–1090.
20. Jiang HJ, Wier LM. All-Cause Hospital Readmissions among Non-Elderly Medicaid Patients, 2007. Healthcare Cost and Utilization Project 2010; HCUP Statistical Brief #89 [on-line]. Available at <http://www.hcup-us.ahrq.gov/reports/statbriefs/sb89.pdf> .
21. Joynt KE, Orav E, Jha AK. Thirty-day readmission rates for Medicare beneficiaries by race and site of care. *JAMA* 2011;305:675–681.
22. National Center for Health Statistics. Access to Health Care 2016 [on-line]. Available at <http://www.cdc.gov/nchs/fastats/access-to-health-care.htm> Accessed November 21, 2016.
23. Bach PB, Pham HH, Schrag D, Tate RC, Hargraves JL. Primary care physicians who treat blacks and whites. *N Engl J Med* 2004;351:575–584.
24. Kangovi S, Barg FK, Carter T, Long JA, Shannon R, Grande D. Understanding why patients of low socioeconomic status prefer hospitals over ambulatory care. *Health Aff (Millwood)* 2013;32:1196–1203.
25. Arnett MJ, Thorpe RJ Jr., Gaskin DJ, Bowie JV, LaVeist TA. Race, medical mistrust, and segregation in primary care as usual source of care: Findings from the Exploring Health Disparities in Integrated Communities Study. *J Urban Health* 2016;93:456–467.
26. Ballard DW, Price M, Fung V et al. Validation of an algorithm for categorizing the severity of hospital emergency department visits. *Med Care* 2010;48:58–63.
27. Kahlon S, Pederson J, Majumdar SR et al. Association between frailty and 30-day outcomes after discharge from hospital. *Can Med Assoc J* 2015;187:799–804.
28. Arbaje AI, Wolff JL, Yu Q, Powe NR, Anderson GF, Boult C. Postdischarge environmental and socioeconomic factors and the likelihood of early hospital readmission among community-dwelling Medicare beneficiaries. *Gerontologist* 2008;48:495–504.
29. Joynt KE, Orav EJ, Jha AK. Thirty-day readmission rates for Medicare beneficiaries by race and site of care. *JAMA* 2011;305:675–681.
30. Mukamel DB, Ladd H, Li Y, Temkin-Greener H, Ngo-Metzger Q. Have racial disparities in ambulatory care sensitive admissions abated over time? *Med Care* 2015;53:931–939.
31. Dresden SM, Feinglass JM, Kang R, Adams JG. Ambulatory care sensitive hospitalizations through the emergency department by payer: Comparing 2003 and 2009. *J Emerg Med* 2016;50:135–142.

32. Wright B, Potter AJ, Trivedi A. Federally qualified health center use among dual eligibles: Rates of hospitalizations and emergency department visits. *Health Aff (Millwood)* 2015;34:1147–1155.

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Table 1: Participant Characteristics

Characteristic	Dually Enrolled	Not Dually Enrolled	Low-Income Neighborhood	Non-Low-Income Neighborhood	Black	Not Black
Stays, n ^a	570,964	1,893,423	518,090	1,946,297	258,086	2,206,301
Percentage of population	23.2	76.8	21.0	79.0	10.5	89.5
Age, median	70	77	74	76	71	76
Female, %	66.4	56.3	59.9	58.3	63.4	58.1
Dually eligible, %	100.0	0.0	37.5	19.4	48.2	20.2
Low-Income ZCTA, %	34.0	17.1	100.0	0.0	46.9	18.0
Race, %						
White	56.9	88.2	65.7	85.0	0.0	90.4
Black	21.8	7.1	23.3	7.0	100.0	0.0
Hispanic	14.5	2.8	8.5	4.7	0.0	6.1
Asian or Pacific Islander	4.7	0.8	1.0	1.9	0.0	1.9
Other	0.8	0.5	0.4	0.6	0.0	0.6
Risk score, mean	1.72	1.22	1.40	1.31	1.68	1.29
Number of comorbidities, %						
0–2	5.9	10.1	8.0	9.4	6.7	9.4
3–5	19.7	24.4	22.1	23.6	20.6	23.6
≥6	74.4	65.5	69.9	67.0	72.7	67.0
Comorbidities, %						
Ischemic heart disease	32.8	33.9	34.3	33.5	30.5	34.0

Renal failure	35.6	29.3	33.6	30.0	45.5	29.0
Heart failure	32.0	28.1	30.9	28.5	35.4	28.3
Chronic obstructive pulmonary disease	29.7	21.5	26.4	22.6	20.7	23.7
Depression	19.4	13.7	15.0	15.0	11.0	15.5
Drug or alcohol	22.1	9.7	16.8	11.4	17.3	12.0
Other psychiatric	15.2	10.7	12.2	11.7	8.1	12.2
HHA, %						
High-dual	27.2	8.2	21.5	10.3	21.5	11.6
Low-income ZIP code tabulation area	22.2	14.5	46.2	8.4	24.7	15.4
High-black	22.4	16.8	28.4	15.3	52.1	14.1
Urban	93.7	95.1	88.2	96.5	95.7	94.6
For-profit	51.1	47.4	55.5	46.3	53.2	47.7
Star rating, %						
1.0–1.5	0.4	0.2	0.4	0.2	0.3	0.3
2.0–2.5	14.4	11.2	15.5	11.0	15.2	11.6
3.0–3.5	54.2	55.8	54.0	55.8	55.4	55.4
4.0–5.0	27.8	30.6	27.3	30.7	26.2	30.4
Not available ^b	3.2	2.2	2.8	2.3	2.8	2.4

Participant characteristics shown here are based on the 30-day measures. See Supplementary Table S5 for similar table for 60-day measures.

Comorbidities are based on the hierarchical condition categories used in the risk adjustment models for home health outcome measures. Categories are not mutually exclusive.

^aA home health stay for purposes of the measure was a 60-day home health episode separated from other episodes by at least 60 days that met measure inclusion criteria.

^bA missing star rating can be because the home health agency (HHA) was not open long enough or the agency was too small to receive a rating. Provider categories are not mutually exclusive.

Table 2: Home Health Agency (HHA) Characteristics

Agency Characteristic	High Dual, n=5,113 (43.4%)	Not High Dual, n=6,661 (56.6%)	Low-Income ZCTA, n=4,085 (34.7%)	Not Low-Income ZCTA, n=7,689 (65.3%)	High Black, n=3,637 (30.9%)	Not High Black, n=8,137 (69.1%)
Stays, n (%) ^a	311,183 (12.6%)	2,153,204 (87.4%)	402,294 (16.3%)	2,062,093 (83.7%)	445,784 (18.1%)	2,018,603 (81.9%)
Stays/agency						
Median	10	106	13	67	11	66
Mean	61	323	98	268	123	248
For profit, %	86.6%	64.5%	80.0%	70.9%	86.3%	68.6%
Urban (Core Based Statistical Area)	90.7%	85.2%	84.9%	89.0%	92.4%	85.4%
Star ratings						
1.0–1.5	2.5%	0.9%	2.5%	1.1%	2.2%	1.3%
2.0–2.5	22.7%	18.1%	23.3%	18.4%	23.3%	18.7%
3.0–3.5	25.2%	44.1%	27.4%	40.4%	28.0%	39.4%
4.0–5.0	18.1%	22.4%	16.8%	22.5%	15.0%	22.9%
NA ^b	31.6%	14.5%	30.0%	17.6%	31.5%	17.6%

Agency characteristics shown here are based on the 30-day measures. See Supplementary Table S6 for similar table for 60-day measures.

Provider categories are not mutually exclusive.

^aA home health stay for purposes of the measure is a 60-day home health episode separated from other episodes by at least 60 days that meets measure inclusion criteria.

^bA missing star rating can be because the HHA was not open long enough or the agency was too small to receive a rating.

Table 3: Beneficiary-Level Social Risk Factors and Clinical Outcomes

Social Risk Factor	Total ^a	Within	Risk Adjusted	Risk Adjusted Within
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		Agency (Random- Effects Model)	Within Agency (Random-Effects Model with Risk Adjustment)	Agency (Random- Effects Model with Risk Adjustment Plus All Social Risk Factors)
	Odds Ratio, P-Value			
30-day readmission				
Dually enrolled	1.44, <.001	1.41, <.001	1.08, <.001	1.08, <.001
Low-income ZCTA	1.16, <.001	1.14, <.001	1.03, <.001	1.02, <.001
Black	1.31, <.001	1.28, <.001	1.02, .002	1.00, .61
30-day ED use				
Dually enrolled	1.58, <.001	1.59, <.001	1.20, <.001	1.18, <.001
Low-income ZCTA	1.20, <.001	1.17, <.001	1.07, <.001	1.03, <.001
Black	1.36, <.001	1.39, <.001	1.15, <.001	1.11, <.001
60-day admission				
Dually enrolled	1.08, <.001	1.22, <.001	1.06, <.001	1.06, <.001
Low-income ZCTA	1.01, .10	1.07, <.001	1.01, .002	1.00, .667
Black	1.11, <.001	1.15, <.001	1.05, <.001	1.04, <.001
60-day ED use				
Dually enrolled	1.27, <.001	1.39, <.001	1.16, <.001	1.15, <.001
Low-income ZCTA	1.08, <.001	1.09, <.001	1.03, <.001	1.00, .39
Black	1.22, <.001	1.27, <.001	1.19, <.001	1.17, <.001

^aCalculated from generalized estimating equations models with an independent correlation matrix, which gives the total (within and between home health agencies (HHAs)) effect of the social risk factor in each row.

Random effects models include a random effect for agency and an additional term for HHA social risk makeup (high vs low proportion of the social risk factor) to isolate the within-facility effect of the social risk factor in question.

ZCTA= ZIP code tabulation area; ED=emergency department.

Figure 1: 30- and 60-day clinical outcomes. Rates of adverse clinical outcomes for (A) dually enrolled vs non-dually enrolled, (B) low-income neighborhood vs non-low-income

neighborhood, and (C) black vs. non-black beneficiaries. ED=emergency department. $P<.001$ for all comparisons except for low-income ZIP code tabulation area (ZCTA) beneficiaries' 60-day admission comparison ($p=.80$).

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Supplementary Table S1: Exclusions from 30-Day Measures

LUPA=Low-utilization payment adjustment

Supplementary Table S2: Exclusions from 60-Day Measures

LUPA=Low-utilization payment adjustment

Supplementary Table S3: Risk Adjustment Variables, 30-Day measures

ESRD=end-stage renal disease; IP=inpatient; OP=outpatient; SNF=skilled nursing facility

Supplementary Table S4: Risk Adjustment Variables, 60-Day measures

ESRD=end-stage renal disease; IP=inpatient

Supplementary Table S5: Patient Characteristics, 60-Day Measures

* A home health stay for purposes of the measure is a 60-day home health episode, separated from other episodes by at least 60 days, that meets measure inclusion criteria.

†A missing star rating can be due to: 1) the HHA not being open long enough; or 2) the agency being too small to receive a rating.

Provider categories are not mutually exclusive.

COPD=chronic obstructive pulmonary disease. Comorbidities are based on the hierarchical condition categories (HCCs) used in the risk adjustment models for home health outcome measures. Categories are not mutually exclusive.

Supplementary Table S6: Home Health Agency Characteristics, 60-Day Measures

* A home health stay for purposes of the measure is a 60-day home health episode, separated from other episodes by at least 60 days, that meets measure inclusion criteria.

†A missing star rating can be due to: 1) the HHA not being open long enough; or 2) the agency being too small to receive a rating.

Provider categories are not mutually exclusive.