

Variation in Use of Home Health Care among Fee-for-Service Medicare Beneficiaries by Rural-Urban Status and Geographic Region: Assessing the Potential for Unmet Need

KEY FINDINGS

- An increasingly smaller percent of Medicare beneficiaries used home health care as rurality increased, with 5.5% of beneficiaries in the most remote rural communities using home health care compared with 8.7% of beneficiaries in urban counties.
- Significant regional variation in percent of all Medicare beneficiaries using home health care also exists, from a low of 5.0% of beneficiaries using home health care in the West North Central, Mountain, and Pacific Census Divisions to a high of 13.0% of beneficiaries using home health care in the West South Central Census Division.
- Similar patterns of variation by rural-urban status and geographic region also occur in terms of the number of home health episodes and visits received by Medicare beneficiaries.
- Geographic region is a larger driver of variation in use of home health care than rural-urban status after taking into account county-level beneficiary characteristics (age, sex, race/ethnicity, clinical severity), economic indicators (persistent poverty, low employment, low education, and population loss), and use of other healthcare services (inpatient and skilled nursing facility care).
- The potential for unmet need for home health care is highest in the most remote rural counties and rural counties within the West North Central, East North Central, Mountain, and Pacific Census Divisions.

BACKGROUND

While the vast majority of Medicare beneficiaries live in areas served by at least one home health agency,¹ recent studies suggest there are differences in access to home health care between urban and rural areas.^{2,3} When providing care in large, rural service areas with low concentrations of patients, home health agencies face different challenges than their urban counterparts, such as greater travel and time costs.^{4,5} As a result, some rural beneficiaries have difficulty receiving any home health care, receiving specialty services, and/or receiving the appropriate amount of required services.^{2,3,6-8} Further, evidence suggests wide regional variation in use of home health care and quality outcomes among rural Medicare beneficiaries.^{9,10} Concerns about access to home health care for rural beneficiaries exist despite both historical and current incentive payments for home health agencies to encourage provision of care to rural beneficiaries.^{4,11}

Since home health care has the lowest per-case cost of all post-acute care providers and results in improvements in self-care outcomes that are comparable to more expensive inpatient providers such as skilled nursing facilities,¹² there is a need to

examine the potential for unmet need among rural Medicare beneficiaries. This need is especially urgent due to upcoming reimbursement changes for post-acute care that aim to shift payments toward value and realign incentives for home health agencies. Understanding the baseline for potential unmet need for home health care among rural Medicare beneficiaries will enable better monitoring of the impact of future reimbursement changes on rural communities. Therefore, the purpose of this study was to explore differences in rates of home health care use among fee-for-service Medicare beneficiaries in rural versus urban counties across the U.S., while accounting for beneficiary characteristics (e.g., sociodemographics, utilization of other health care services) and community characteristics (e.g., persistent poverty, population loss).

METHODS

This study was a retrospective cohort analysis of fee-for-service Medicare beneficiaries who received home health care services in 2013. We combined 2013 Medicare administrative data on rural, fee-for-service Medicare beneficiaries with publicly available data from the 2013 Centers for Medicare and Medicaid Services Geographic Variation Public Use File (GV-PUF), the Area Health Resource File (AHRF), and the U.S. Department of Agriculture Economic Research Service (USDA ERS) 2015 county typology file. Medicare administrative data included enrollment and claims for home health, inpatient hospital, and skilled nursing facility care.

Analysis was performed at the county-level. The dependent variables were three measures of home health care use: 1) percent of beneficiaries using home health services, 2) number of home health episodes per 1,000 beneficiaries, and 3) number of home health visits per 1,000 beneficiaries. These variables were taken directly from the GV-PUF for counties where the information was not suppressed due to small cell sizes. We used home health care claims for rural beneficiaries to calculate home health care use for counties where data were suppressed. The independent variables of interest were geographic region and rural-urban status. Geographic region indicated in which of the nine U.S. Census Divisions the county was located. Rural-urban status used the five-category specification of the 2013 Urban Influence Codes (UICs) county classification: (1) metropolitan, (2) micropolitan or non-core adjacent to a large or small metropolitan area, (3) micropolitan not adjacent to a metropolitan area, (4) non-core adjacent to micropolitan area, and (5) non-core not adjacent to a metropolitan or micropolitan area. Control variables included county-level beneficiary characteristics (number of beneficiaries; average age; percent female; percent non-Hispanic White; and average Hierarchical Condition Category score, a measure of clinical severity based on prior healthcare utilization), economic indicators (persistent poverty; low employment; low education; population loss), and utilization of skilled nursing facility and inpatient hospital care.

We calculated unadjusted averages of home health care use by rural-urban status and geographic region. We then used two-level hierarchical linear regression models to examine association between home health care use by rural-urban status and geographic region adjusting for control variables. Additional details about study methodology, including expanded variable definitions, are available in the Technical Appendix. The study was approved by the University of Washington Human Subjects Division.

FINDINGS

A total of 3,115 counties were included in the analysis. Of these counties, 37.3% were metropolitan counties, 32.7% micropolitan or non-core adjacent to a large or small metro area, 8.6% micropolitan not adjacent to a metro area, 11.9% non-core adjacent to a micro area, and 9.5% non-core not adjacent to a metro or micro area. Table 1 shows county-level characteristics of Medicare fee-for-service beneficiaries in 2013 by rural-urban status. Compared to metropolitan counties, rural counties had beneficiaries that were older, less often female, less diverse in terms of race and ethnicity, and had lower Hierarchical Condition Category scores (indicating lower risk of high health care costs). These differences generally increased as rurality increased. There were also significant differences in home health care utilization by rural-urban status. As rurality increased, an increasingly smaller percent of beneficiaries utilized home health services and increasingly fewer visits per 1,000 beneficiaries were received.

Table 1. County-level Characteristics of Medicare Fee-for-Service Beneficiaries in 2013 by Rural-Urban Status

	All counties (n=3,115)	Rural-urban status				
		Metropolitan (n=1,161)	Micropolitan or non-core adjacent to a large or small metro area (n=1,017)	Micropolitan not adjacent to a metro area (n=269)	Non-core adjacent to a micro area (n=372)	Non-core not adjacent to a metro or micro area (n=296)
Number of Fee-for-Service Beneficiaries, mean (SD)	10,943.7 (25,750.9)	22,978.7 (39,098.3)	4,674.4 (3,734.9)	5,180.8 (3,717.1)	1,978.3 (1,508.7)	1,784.1 (1,968.6)
Demographics, mean (SD)						
Age***	71.1 (2.0)	70.7 (1.6)	70.9 (1.8)	70.9 (2.0)	71.9 (2.5)	72.4 (2.6)
Percent Female***	53.7 (2.4)	54.3 (2.1)	53.6 (2.2)	53.7 (2.4)	53.4 (2.8)	52.6 (3.2)
Percent Non-Hispanic White***	78.4 (19.7)	75.6 (18.5)	79.0 (20.4)	78.9 (20.3)	83.1 (18.4)	81.1 (21.7)
Hierarchical Condition Category Score***	0.9 (0.1)	1.0 (0.1)	1.0 (0.1)	0.9 (0.1)	0.9 (0.1)	0.9 (0.1)
Health Care Utilization, mean (SD)						
Home Health						
Percent of beneficiaries using home health care***	8.0 (3.9)	8.7 (2.9)	8.2 (3.9)	7.4 (3.4)	7.4 (4.9)	5.5 (4.6)
Number of home health care episodes per 1,000 Medicare beneficiaries***	166.6 (144.0)	167.6 (105.1)	178.5 (154.7)	159.7 (130.6)	177.2 (200.3)	114.5 (153.5)
Number of home health care visits per 1,000 Medicare beneficiaries***	2,677.6 (2,361.2)	2,754.9 (1,915.0)	2,825.4 (2,461.1)	2,573.1 (2,188.8)	2,764.7 (3,037.1)	1,852.2 (2,611.2)
Acute Hospital						
Percent of beneficiaries using hospital inpatient services with at least one covered stay*	17.6 (2.5)	17.5 (2.0)	17.8 (2.4)	17.3 (3.0)	17.8 (2.8)	17.6 (3.5)
Hospital inpatient covered admissions per 1,000 Medicare beneficiaries**	275.5 (55.9)	277.3 (44.0)	278.0 (52.7)	269.8 (77.6)	274.4 (62.5)	266.5 (72.9)
Hospital inpatient covered days per 1,000 Medicare beneficiaries***	1,400.0 (344.6)	1,461.4 (317.4)	1,404.5 (338.3)	1,354.3 (378.5)	1,330.9 (356.2)	1,271.9 (366.5)
Skilled Nursing Facility						
Percent of beneficiaries using SNF with at least one covered stay***	5.1 (1.5)	4.8 (1.1)	5.1 (1.3)	4.8 (1.5)	5.6 (2.1)	5.5 (2.3)
SNF covered admissions per 1,000 Medicare beneficiaries***	69.1 (24.0)	65.9 (16.6)	69.5 (20.2)	65.6 (24.8)	77.0 (36.8)	73.4 (33.9)
SNF covered days per 1,000 Medicare beneficiaries***	1,744.9 (594.4)	1,780.3 (498.8)	1,796.0 (587.2)	1,678.2 (612.0)	1,730.0 (739.7)	1,509.0 (678.8)

Overall Welch's ANOVA: *p<.05, **p<.10, ***p<.001

Source: CMS Geographic Variation Public Use File (GV-PUF), Medicare Provider Analysis and Review (MedPAR) File, home health claims, and Area Health Resource File (AHRF).

Table 2. County-level Characteristics of Medicare Fee-for-Service Beneficiaries in 2013 by Census Division

	All counties (n=3,115)	Census Division								
		New England (n=67)	Middle Atlantic (n=150)	East North Central (n=437)	West North Central (n=615)	South Atlantic (n=585)	East South Central (n=364)	West South Central (n=468)	Mountain (n=276)	Pacific (n=153)
Number of Fee-for-Service Beneficiaries, mean (SD)	10,943.7 (25,750.9)	28,988.9 (33,596.0)	28,712.7 (36,443.0)	12,746.2 (33,622.1)	4,017.9 (8,544.5)	12,602.1 (20,464.8)	6,896.5 (9,974.8)	8,006.4 (19,215.0)	7,533.6 (22,006.1)	26,736.2 (58,234.7)
Demographics, mean (SD)										
Age***	71.1 (2.0)	70.9 (1.6)	71.0 (1.6)	71.1 (1.4)	72.8 (2.1)	70.4 (1.7)	69.0 (1.6)	71.1 (1.6)	71.6 (1.7)	71.0 (1.2)
Percent Female***	53.7 (2.4)	55.0 (2.0)	55.0 (2.0)	54.0 (2.0)	54.0 (2.0)	54.0 (2.0)	54.0 (2.0)	54.0 (2.0)	51.0 (3.0)	52.0 (2.0)
Percent Non-Hispanic White***	78.4 (19.7)	89.0 (10.0)	84.0 (17.0)	90.0 (9.0)	90.0 (12.0)	70.0 (19.0)	78.0 (21.0)	65.0 (19.0)	77.0 (20.0)	66.0 (22.0)
Hierarchical Condition Category Score***	0.9 (0.1)	0.9 (0.1)	1.0 (0.1)	1.0 (0.1)	0.9 (0.1)	1.0 (0.1)	1.0 (0.1)	1.0 (0.1)	0.8 (0.1)	0.9 (0.1)
Health Care Utilization, mean (SD)										
Home Health										
Percent of beneficiaries using home health care***	8.0 (3.9)	10.0 (2.0)	8.0 (2.0)	7.0 (2.0)	5.0 (2.0)	9.0 (2.0)	10.0 (3.0)	13.0 (4.0)	5.0 (3.0)	5.0 (2.0)
Number of home health care episodes per 1,000 Medicare beneficiaries***	166.6 (144.0)	156.3 (39.8)	133.1 (42.0)	117.5 (48.8)	70.9 (44.1)	150.6 (61.5)	249.0 (119.0)	378.8 (208.3)	91.1 (56.6)	81.0 (39.3)
Number of home health care visits per 1,000 Medicare beneficiaries***	2,677.6 (2,361.2)	2,585.1 (861.5)	2,078.0 (804.0)	1,888.9 (874.9)	1,121.3 (751.1)	2,445.2 (1,436.3)	3,879.1 (1,824.9)	6,139.9 (3,250.0)	1,661.5 (1,316.3)	1,087.6 (622.0)
Acute Hospital										
Percent of beneficiaries using hospital inpatient services with at least one covered stay*	17.6 (2.5)	16.0 (2.0)	18.0 (1.0)	18.0 (2.0)	18.0 (3.0)	18.0 (2.0)	19.0 (2.0)	19.0 (3.0)	15.0 (2.0)	14.0 (2.0)
Hospital inpatient covered admissions per 1,000 Medicare beneficiaries***	275.5 (55.9)	249.6 (41.0)	290.0 (32.7)	281.0 (41.6)	271.1 (62.4)	282.5 (41.3)	310.4 (44.2)	296.4 (56.1)	213.9 (42.7)	212.8 (38.7)
Hospital inpatient covered days per 1,000 Medicare beneficiaries***	1,400.0 (344.6)	1,344.8 (289.6)	1,660.1 (268.7)	1,351.1 (255.2)	1,287.3 (277.8)	1,505.3 (285.5)	1,654.3 (289.2)	1,541.7 (310.7)	998.6 (284.2)	1,044.8 (258.6)
Skilled Nursing Facility										
Percent of beneficiaries using SNF with at least one covered stay***	5.1 (1.5)	6.0 (1.0)	5.0 (1.0)	6.0 (1.0)	6.0 (2.0)	5.0 (1.0)	5.0 (1.0)	5.0 (1.0)	4.0 (1.0)	4.0 (1.0)
SNF covered admissions per 1,000 Medicare beneficiaries***	69.1 (24.0)	74.5 (16.7)	74.4 (15.9)	75.5 (16.5)	82.5 (30.1)	61.9 (16.8)	71.2 (19.4)	67.5 (21.0)	52.9 (25.9)	45.5 (15.8)
SNF covered days per 1,000 Medicare beneficiaries***	1,744.9 (594.4)	1,771.4 (455.2)	1,951.3 (446.5)	2,086.9 (526.4)	1,745.0 (571.4)	1,662.9 (466.4)	1,938.8 (587.0)	1,844.6 (609.6)	1,171.7 (428.6)	1,124.7 (448.7)

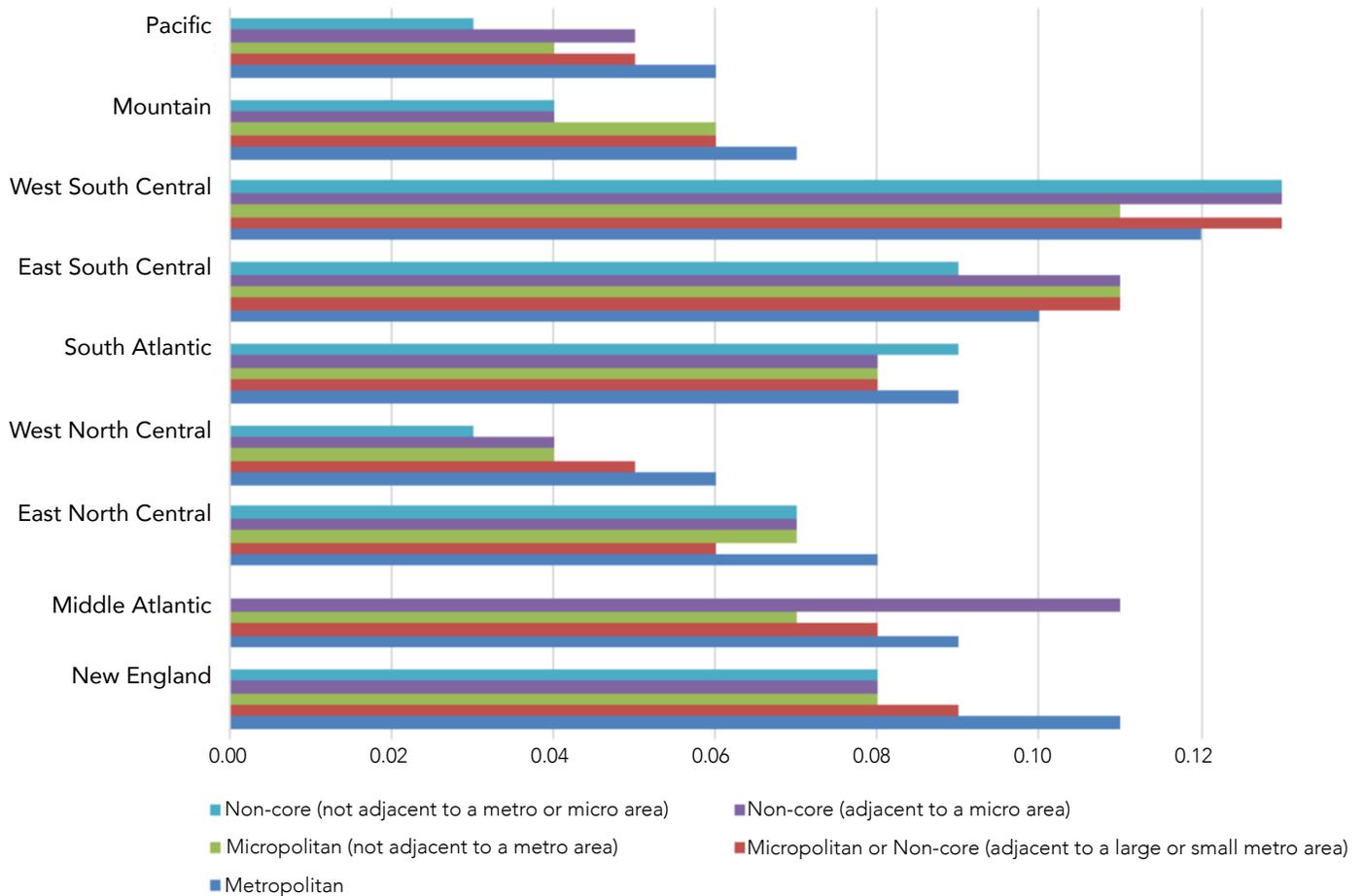
Overall Welch's ANOVA: *p<.05, **p<.10, ***p<.001

Source: CMS Geographic Variation Public Use File (GV-PUF), Medicare Provider Analysis and Review (MedPAR) File, home health claims, and Area Health Resource File (AHRF).

Table 2 shows county-level characteristics of Medicare fee-for-service beneficiaries in 2013 by Census Division. There were significant regional differences across beneficiary demographics and health care utilization. The lowest utilization of home health care was observed in the West North Central, Mountain, and Pacific Census Divisions and the highest utilization of home health care was observed in the New England, East South Central, and West South Central Census Divisions.

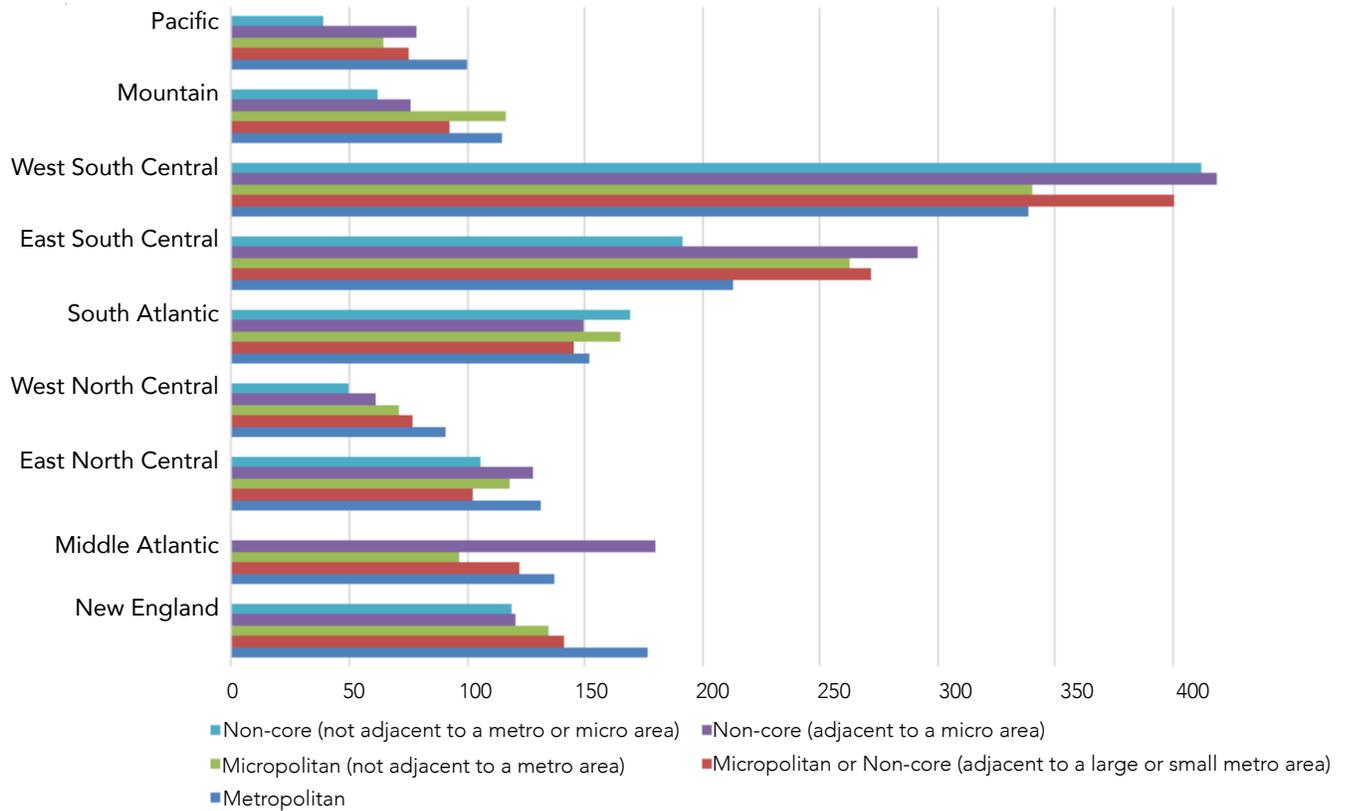
Figures 1 through 3 present unadjusted averages for each of the three measures of home health care use by geographic region and rural-urban status combined, which highlights variation across these two domains. The Pacific, Mountain, West North Central, and New England Census Divisions in particular have lower home health care use across all three measures in non-core and micropolitan counties not adjacent to metropolitan counties. Conversely, lower home health care use among rural counties is not seen consistently in the West South Central, East South Central, East North Central, South Atlantic, and Middle Atlantic Census Divisions. Home health care use is actually higher in the most remote rural counties compared to metropolitan counties in the West South Central and South Atlantic Census Divisions.

Figure 1. Percent of Medicare Fee-for-Service Beneficiaries using Home Health Care in 2013 by Geographic Region and Rural-Urban Status



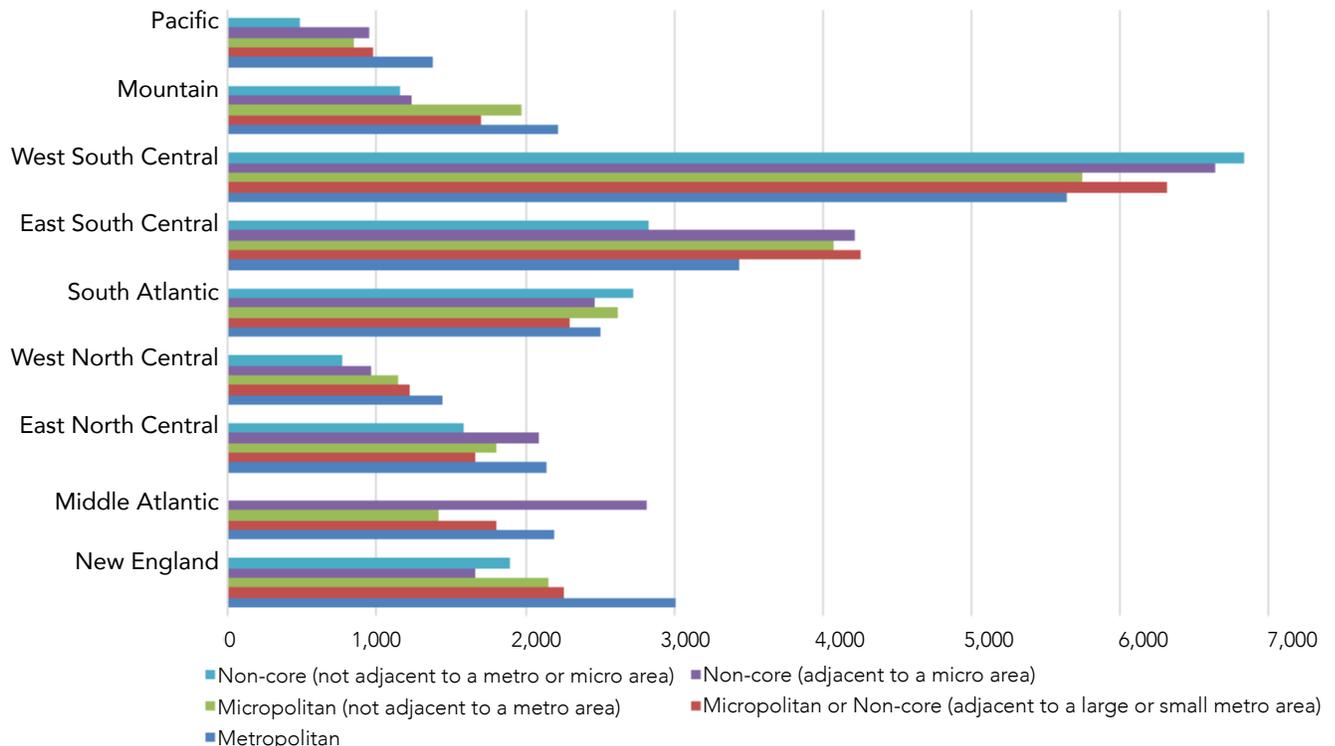
Source: CMS Geographic Variation Public Use File (GV-PUF) and home health claims.

Figure 2. Number of Home Health Care Episodes per 1,000 Medicare Fee-for-Service Medicare Beneficiaries in 2013 by Geographic Region and Rural-Urban Status



Source: CMS Geographic Variation Public Use File (GV-PUF) and home health claims.

Figure 3. Number of Home Health Care Visits per 1,000 Medicare Fee-for-Service Beneficiaries in 2013 by Geographic Region and Rural-Urban Status



Source: CMS Geographic Variation Public Use File (GV-PUF) and home health claims.

Table 3 presents the adjusted relationships between home health care use and rural-urban status and geographic region from the regression models that controlled for beneficiary and community characteristics. In the adjusted analysis, a linear relationship between increasing rurality and decreasing home health utilization was not observed. While the relationship between rural-urban status and percent of beneficiaries utilizing home health care remained significant, it was driven by lower utilization in counties classified as non-core, not adjacent to metro or micro areas (i.e., the most remote rural counties) rather than by rural counties overall. The relationships between rural-urban status and number of home health episodes and visits per 1,000 beneficiaries were no longer significant in the adjusted analyses. The relationships between home health care utilization and geographic region remained significant across all three measures. The lowest percentages of beneficiaries using home health were in the West North Central, East North Central, Mountain, and Pacific Census Divisions. The lowest numbers of episodes and visits per 1,000 beneficiaries were in the West North Central, Middle Atlantic, East North Central, and Pacific Census Divisions.

Table 3. Adjusted Relationships between Home Health Care Utilization and Rural-Urban Status and Geographic Region for Medicare Fee-for-Service Beneficiaries, 2013

	Percent of Medicare FFS beneficiaries using HH		Number of HH episodes per 1,000 Medicare FFS beneficiaries		Number of HH visits per 1,000 Medicare FFS beneficiaries	
	Coeff (95% CI)	p-value	Coeff (95% CI)	p-value	Coeff (95% CI)	p-value
Rural-Urban Status		.01		.08		.13
Metropolitan (Reference)	--		--		--	
Micropolitan or non-core adjacent to large or small metro area	-0.2% (-0.6%, 0.1%)	.18	4.9 (-8.5, 18.4)	.47	67.3 (-128.1, 262.6)	.50
Micropolitan not adjacent to metro area	-0.4% (-0.7%, -0.0%)	.04	4.0 (-8.9, 17.0)	.54	84.8 (-150.4, 319.9)	.48
Non-core adjacent to micro area	-0.3% (-0.8%, 0.3%)	.33	17.2 (-5.6, 40.0)	.14	259.3 (-72.9, 591.5)	.13
Non-core not adjacent to metro or micro area	-1.2% (-1.9%, -0.4%)	.002	-10.3 (-32.0, 11.5)	.35	-75.5 (-460.4, 309.3)	.70
Census Division		.008		.04		.02
New England (Reference)	--		--		--	
Middle Atlantic	-2.2% (-3.7%, -0.8%)	.003	-61.2 (-98.8, -23.5)	.001	-1,180.3 (-1,746.9, -613.8)	<.0001
East North Central	-3.0% (-4.4%, -1.6%)	<.0001	-59.2 (-91.4, -27.0)	.0003	-958.5 (-1,441.1, -475.8)	<.0001
West North Central	-4.6% (-5.8%, -3.4%)	<.0001	-88.5 (-116.9, -60.1)	<.0001	-1,352.0 (-1,775.3, -928.8)	<.0001
South Atlantic	-1.8% (-3.0%, -0.7%)	.002	-45.0 (-82.5, -7.5)	.02	-595.9 (-1,186.1, -5.7)	.05
East South Central	-0.2% (-1.7%, 1.3%)	.83	42.2 (-16.8, 101.2)	.16	681.7 (-141.2, 1,504.5)	.10
West South Central	2.1% (0.3%, 3.8%)	.02	172.9 (94.3, 251.6)	<.001	2,962.5 (1,712.0, 4,213.1)	<.0001
Mountain	-2.7% (-4.1%, -1.2%)	.0005	-39.4 (-76.1, -2.8)	.04	-238.0 (-1,027.0, 551.0)	.55
Pacific	-3.4% (-4.5%, -2.4%)	<.0001	-60.9 (-93.4, -28.4)	.0002	-1,021.5 (-1,618.1, -424.9)	.0008

Source: CMS Geographic Variation Public Use File (GV-PUF), Medicare Provider Analysis and Review (MedPAR) File, home health claims, and Area Health Resource File (AHRF).

CONCLUSIONS

Findings suggest the potential for unmet need for home health care for beneficiaries in the most remote rural counties in terms of access to home health care since a significantly lower percentage of beneficiaries use home health care in the most remote rural counties relative to urban counties. However, the population-adjusted number of episodes and visits do not vary significantly by rural-urban status.

Findings indicate geographic region is a larger driver of variation in the use of home health care compared to rural-urban status. The regional variation observed in home health care use mirrors prior research on geographic variation in the use of acute and post-acute care services among Medicare beneficiaries in general and home health care among rural beneficiaries in particular.^{9,13-15} Taken together, the findings for rural-urban status and geographic region suggest the potential for unmet need may be greatest in rural communities in the West North Central, East North Central, Pacific, and Mountain Census Divisions.

LIMITATIONS

Although population-level analyses are useful for describing variations in care, they cannot account for beneficiary-level differences in home health care use. County-level analysis also precludes study of intra-county variation which is an area for additional research, especially for rural counties covering large areas. Also, the publicly available data in the GV-PUF do not distinguish between post-acute and community-entry home health use, so we could not study variation based on admission source for home health, which prior research suggests varies for rural Medicare beneficiaries by rural-urban status and state.⁹ In addition, data sources used in this study only included fee-for-service Medicare beneficiaries; thus results do not generalize to the one-quarter of rural Medicare beneficiaries enrolled in Medicare Advantage plans.¹⁶ Finally, the optimal amount of home health care use is unknown, so it is possible that low use represents an appropriate level of care rather than unmet need.

IMPLICATIONS FOR POLICY AND PRACTICE

Efforts to increase home health care use among rural beneficiaries may be most effective if targeted to the most remote rural communities and within rural communities with historically low utilization rather than broadly directed at rural populations overall. As such, findings from this study support the intent of revisions to the rural add-on payments that were mandated by the Bipartisan Budget Act of 2018.¹⁷ The rural add-on payment revisions were designed to temporarily increase incentive payments for serving beneficiaries in rural counties that have low population density and low current utilization of home health care (4.0% add-on in 2019 versus 3.0% in 2018) and decrease incentive payments in high utilization rural counties (1.5% add-on in 2019 versus 3.0% in 2018). However, it is unknown whether this temporary 1 percentage point increase is adequate to incentivize home health agencies to serve beneficiaries in the most rural, underserved counties. In addition, rural add-on payments are scheduled to be phased out over the next four years for low density, low utilization counties. So, if increases in care for beneficiaries in the most rural counties are observed with the initially higher add-on payment, changes may not be sustained over time. CMS estimates that rural add-on payment revisions will have a negative impact on reimbursements to rural home health agencies on an aggregate basis, with decreases of 0.6% and 0.7% in payments projected on average across all rural home health agencies in 2019 and 2020, respectively.^{11,18} This overall decrease will be driven by reduced add-on payments in the 510 high utilization rural counties, which are concentrated in the East South Central and West South Central Census Divisions, compared with 334 counties classified as low density, low utilization, which are concentrated in the West North Central, Mountain, and Pacific Census Divisions.

In addition to the rural add-on payment revisions, findings must be considered in the context of the upcoming prospective payment system reform. The Patient-Driven Groupings Model (PDGM) is scheduled to be implemented in 2020 and is designed

in part to decrease regional variation in home health utilization and increase payments for providing nursing care relative to therapy services.^{11,19} CMS impact analysis of the PDGM suggests rural home health agencies will see an average 3.7% increase in payments compared to a 0.5% decrease among urban agencies under PDGM compared with the current prospective payment system.¹⁸ The estimated impact varies greatly based on geographic region, however, ranging from a decrease of 0.9% on average for rural home health agencies in the East North Central Census Division to an increase of 11.7% for rural home health agencies in the Pacific Census Division.¹⁸ In addition, design of the PDGM suggests that changes will not be uniform across all clinical populations. Payments for beneficiaries who are older, have mild to moderate cognitive impairment, orthopedic or neurological diagnoses, or are admitted to home health care from the community will be reduced under PDGM.¹¹

How home health agencies will actually respond to the rural add-on payment revisions and the implementation of PDGM and the resultant impact on access to care for rural Medicare beneficiaries remains to be seen. Therefore, in keeping with CMS's rural health strategy of applying a rural lens to policy,²⁰ it will be important to monitor the effects of these overlapping policies on access to home health for all rural Medicare beneficiaries as well as unintended consequences for especially vulnerable patient populations living in rural communities.

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ACKNOWLEDGMENTS

The authors gratefully acknowledge Beverly Marshall for her assistance with manuscript production.

FUNDING

This study was supported by the Federal Office of Rural Health Policy (FORHP), Health Resources and Services Administration (HRSA), U.S. Department of Health and Human Services (HHS) under cooperative agreement #U1CRH03712. The information, conclusions, and opinions expressed in this policy brief are those of the authors and no endorsement by FORHP, HRSA, or HHS is intended or should be inferred.

SUGGESTED CITATION

Mroz TM, Garberson LA, Wong JL, Andrilla CHA, Skillman SM, Patterson DG, Larson EH. *Variation in Use of Home Health Care among Fee-for-Service Medicare Beneficiaries by Rural-Urban Status and Geographic Region: Assessing the Potential for Unmet Need*. Policy Brief #169. Seattle, WA: WWAMI Rural Health Research Center, University of Washington, Feb 2020.

TECHNICAL APPENDIX

This appendix contains detailed technical notes regarding the methods used in this study.

Design and data sources:

This secondary analysis of Medicare administrative data was conducted to determine whether there are differences in the rates of home health care utilization in rural as compared with urban counties among fee-for-service Medicare beneficiaries. The analytic dataset was created by combining publicly available data from the 2013 CMS Geographic Variation Public Use File (GV-PUF) with research-identifiable data for rural beneficiaries in 2013 from home health claims and inpatient and SNF claims from the MedPAR file. The GV-PUF is a set of publicly available data files that includes data on the number of fee-for-service beneficiaries and health service use at state and county levels. Data in the GV-PUF are suppressed for counties with counts of less than 11 by beneficiary or service use. Research-identifiable claims data for rural beneficiaries enable calculation of health services use for the counties for which publicly available data are suppressed. We linked the CMS data with the 2013 Area Health Resource File (AHRF) and the 2015 Edition of County Typology Codes from the U.S. Department of Agriculture Economic Research Service (USDA ERS) to obtain additional county-level control variables. The AHRF provides county-level information about sociodemographic characteristics. The USDA ERS data classifies all U.S. counties in terms of economic dependence indicators, including low employment, persistent poverty, low education, and population loss, that are derived from U.S. Census data and the American Community Survey (ACS).

Sample:

We used the following inclusion criteria for this study: 1) data available on home health, inpatient hospital, and skilled nursing facility use in the GV-PUF file, OR 2) data available from home health claims and MedPAR files for rural counties when data are suppressed in the GV-PUF file. We excluded 21 counties that had all points of data suppressed for home health care use in the GV-PUF and had no data available in the home health claims file. Included and excluded counties only differed significantly in terms of average percent female Medicare fee-for-service beneficiaries. See Table 1A for comparison of included versus excluded counties.

Dependent variables – use of home health:

We used three county-level measures to describe use of home health care: 1) percent of Medicare beneficiaries using home health; 2) number of home health episodes per 1,000 Medicare beneficiaries; and 3) number of home health visits per 1,000 Medicare beneficiaries. These measures were taken directly from the GV-PUF when available and calculated using home health claims for counties for which data in the GV-PUF were suppressed due to small cell size per CMS policy. Using variables standardized by the population of Medicare beneficiaries allows for comparison of home health care use between counties without comparable numbers of Medicare beneficiaries. These measures of home health care use included home health following an inpatient stay (post-acute home health) and home health without a preceding inpatient stay (community-entry home health). The available measures in the GV-PUF do not distinguish between the two types of home health care, thus we also did not distinguish between the two types of home health care in the research-identifiable home health claims when computing these measure from home health claims for counties with suppressed data in the GV-PUF.

Independent variables of interest – rural-urban status and geographic region:

Rural-urban status and geographic region were the independent variables of interest in this study. Rural-urban status was determined using the five-category specification of the 2013 UIC county classification: metropolitan (codes 1 and 2); micropolitan or non-core adjacent to a large or small metropolitan area (codes 3, 4, 5, 6, and 7); micropolitan not adjacent to a metropolitan area (code 8); non-core adjacent to micropolitan area (codes 9 and 10); or non-core not adjacent to a metropolitan or micropolitan area (codes 11 and 12). Geographic region indicated in which of the nine U.S. Census Divisions the county was located: 1) New England which includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; 2) Middle Atlantic which includes New Jersey, New York, and Pennsylvania; 3) East North Central which includes Illinois, Indiana, Michigan, Ohio, and Wisconsin; 4) West North Central which includes Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota; 5) South Atlantic which includes Delaware, the District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia; 6) East South Central which includes Alabama, Kentucky, Mississippi, and Tennessee; 7) West South Central which includes Arkansas, Louisiana, Oklahoma, and Texas; 8) Mountain which includes Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming; or 9) Pacific which includes Alaska, California, Hawaii, Oregon, and Washington.

Control variables:

Control variables for the analysis included the following county-level measures: Medicare fee-for-service enrollment, inpatient use, skilled nursing facility use, average clinical severity of Medicare fee-for-service beneficiaries, average age of Medicare fee-for-service beneficiaries, percent of female Medicare fee-for service beneficiaries, ethnicity/race, and economic indicators. The measures for inpatient use and skilled nursing facility use were analogous to the three measures of home health care use: 1) percent of beneficiaries using care; 2) number of stays; and 3) number of days. The control variables for inpatient use and skilled nursing facility use that corresponded to the outcome variable were included in the fully-adjusted models. Clinical severity was represented using the average Hierarchical Condition Category score which is calculated using prior claims data to estimate expected cost of future care; recent research has suggested rural beneficiaries have lower Hierarchical Condition Category scores compared to urban beneficiaries, though it is unclear whether differences are due to health status, coding practices, or some combination.²¹ Ethnicity/race was the percentage of Medicare fee-for-service beneficiaries who were non-Hispanic White taken from the AHRF. County-level economic indicators from the USDA ERS County Typology codes included dichotomous variables indicating persistent poverty, low employment, low education, and population loss. Persistent poverty indicates that 20% or more residents of a county were poor as measured by the 1980, 1990, and 2000 Census and the ACS 5-year average between 2007 and 2011. Low employment indicates that less than 65% of county residents ages 25-64 were employed based on the ACS 5-year average between 2008 and 2012. Low education indicates that 20% or more of county residents had neither a high school diploma nor GED based on the ACS 5-year average between 2008 and 2012. Counties designated with population loss had the number of county residents decline both between the 1990 and the 2000 Census and between the 2000 and 2010 Census.

Analyses:

We calculated averages of each of the three measures of home health care use overall and by rural-urban status and geographic region. To assess the relationship between home health care use and rural-urban status and geographic region, we used three, two-level hierarchical multiple regressions, one model for each of the three measures of home health care use, and adjusted for all control variables. We used generalized estimating equation methods in the regression analyses to account for clustering of counties within states. Complete case analysis was used for final models as less than 1% of counties were excluded due to missing home health data. Table 1B provides regression coefficients for control variables as a supplement to Table 3 which provides regression coefficients for the independent variables of interest. Analyses were completed using SAS software, Version 9.4 of the SAS system for Windows.

Table 1A. County-level Characteristics of Medicare Fee-for-Service Beneficiaries in Included versus Excluded Counties

	Included Counties (n=3,115)	Excluded Counties (n=21)
Number of Fee-for-Service Beneficiaries, mean (SD)	10,943.7 (25,750.9)	578.0 (451.7)
Demographics, mean (SD)		
Age	71.1 (2.0)	71.6 (1.5)
Percent Female	53.7 (2.4)	50.6 (3.9)
Percent Non-Hispanic White	78.4 (19.7)	69.9 (27.2)
Hierarchical Condition Category Score	0.9 (0.1)	0.9 (0.2)
Health Care Utilization, mean (SD)		
Home Health		
Percent of beneficiaries using home health care	8.0 (3.9)	--
Number of home health care episodes per 1,000 Medicare beneficiaries	166.6 (144.0)	--
Number of home health care visits per 1,000 Medicare beneficiaries	2,677.6 (2,361.2)	--
Acute Hospital		
Percent of beneficiaries using hospital inpatient services with at least one covered stay	17.6 (2.5)	15.7 (5.0)
Hospital inpatient covered admissions per 1,000 Medicare beneficiaries	275.5 (55.9)	239.1 (105.7)
Hospital inpatient covered days per 1,000 Medicare beneficiaries	1,400.0 (344.6)	1,166.0 (550.4)
Skilled Nursing Facility		
Percent of beneficiaries using SNF with at least one covered stay	5.1 (1.5)	5.0 (1.7)
SNF covered admissions per 1,000 Medicare beneficiaries	69.1 (24.0)	66.1 (20.7)
SNF covered days per 1,000 Medicare beneficiaries	1,744.9 (594.4)	1,502.9 (661.8)

Source: CMS Geographic Variation Public Use File (GV-PUF), Medicare Provider Analysis and Review (MedPAR) File, home health claims, and Area Health Resource File (AHRF).

Table 1B. Regression Coefficients for Control Variables from Fully Adjusted Models

	Percent of Medicare FFS beneficiaries using HH		Number of HH episodes per 1,000 Medicare FFS beneficiaries		Number of HH visits per 1,000 Medicare FFS beneficiaries	
	Coeff (95% CI)	p-value	Coeff (95% CI)	p-value	Coeff (95% CI)	p-value
Control Variables						
Number of Fee-for-Service Beneficiaries	0.0% (0.0%, 0.0%)	.01	0.0 (0.0, 0.0)	.32	0.0 (-0.0, 0.0)	.12
Age	0.1% (-0.2%, 0.3%)	.60	4.4 (-3.8, 12.6)	.29	89.4 (-44.9, 223.7)	.19
Percent Female	0.4% (-15.3%, 16.0%)	.96	-124.8 (-690.2, 440.5)	.67	-1,426.8 (-10,820.2, 7,966.6)	.77
Percent Non-Hispanic White	-0.2% (-2.4%, 2.1%)	.89	-30.5 (-1,12.1, 51.2)	.46	-36.6 (-1,313.5, 1,240.3)	.96
Hierarchical Condition Category Score	0.1% (0.0%, 0.2%)	.002	309.1 (42.1, 576.2)	.02	5,477.0 (1,597.4, 9,356.7)	.01
Percent of beneficiaries using inpatient services with at least one covered stay	12.4% (-1.1%, 25.9%)	.07	-	-	-	-
Number of inpatient stays per 1,000 Medicare FFS beneficiaries	-	-	0.2 (0.0, 0.4)	.02	-	-
Number of inpatient days per 1,000 Medicare FFS beneficiaries	-	-	-	-	0.5 (-0.1, 1.1)	.11
Percent of beneficiaries using SNF with at least one covered stay	13.5% (-11.4%, 38.3%)	.29	-	-	-	-
Number of SNF stays per 1,000 Medicare FFS beneficiaries	-	-	0.2 (-0.1, 0.5)	.17	-	-
Number of SNF days per 1,000 Medicare FFS beneficiaries	-	-	-	-	0.2 (-0.0, 0.5)	.10
Percent with Low Education	0.1% (-0.4%, 0.6%)	.65	6.3 (-13.8, 26.4)	.54	30.6 (-350.2, 411.4)	.87
Percent in Persistent Poverty	0.8% (-0.0%, 1.6%)	.06	40.6 (4.8, 76.4)	.03	571.3 (45.4, 1,097.1)	.03
Percent with Low Employment	0.5% (-0.0%, 1.0%)	.06	13.2 (-3.9, 30.4)	.13	123.9 (-155.9, 403.8)	.39
Percent with Population Loss	-0.6% (-1.1%, -0.1%)	.02	-14.4 (-33.3, 4.6)	.14	-242.8 (-5,73.7, 88.1)	.15

Source: CMS Geographic Variation Public Use File (GV-PUF), Medicare Provider Analysis and Review (MedPAR) File, home health claims, and Area Health Resource File (AHRF).

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