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Community Factors and Outcomes of Home Health Care for High-Risk Rural Medicare Beneficiaries

KEY FINDINGS

- Outcomes of care varied by region of the country for rural Medicare beneficiaries receiving home health services for high-risk conditions, including acute myocardial infarction, heart failure, pneumonia, and chronic obstructive pulmonary disease.
- Rural beneficiaries in the East South Central and West South Central Census Divisions had lower rates of being discharged to the community and higher rates of hospital readmission and emergency department use.
- Rural beneficiaries in New England, Middle Atlantic, West North Central, and Pacific Census Divisions had higher rates of being discharged to the community and lower rates of hospital readmission and emergency department use.
- Differences in rural beneficiaries' home health outcomes appear to be related primarily to the region of the country where they live rather than other included community factors such as rurality of beneficiary residence (large, small, or isolated small rural areas), county-level economic status, and availability of local health resources.

BACKGROUND

Changes in U.S. health care payment policies, many associated with implementation of the Affordable Care Act, include incentives to prevent avoidable hospitalizations and emergency department use. At the same time, hospital stays are shorter than in the past and patients are being discharged with ongoing care needs. Post-acute care services, including inpatient rehabilitation, skilled nursing, and home health,[a] help meet these ongoing care needs. Home health care accounts for almost a third of all post-acute care expenditures.[1]

Barriers to providing home health care services that many patients require to help avoid readmission to the hospital are common in rural areas and include Medicare access and reimbursement policies (e.g., eligibility certification through face-to-face visits, homebound requirement, prospective payment system challenges for small volume agencies), requirements for equipment procurement, workforce recruitment and retention, and availability of community resources.[2] In addition, long driving distances between service sites increase the work hours and expense of delivering home health services and may even result in an inability

[a] Home health care includes services for patients following an acute care hospitalization (post-acute home health care) as well as services for patients in the community who have not experienced a prior acute care hospitalization (community-entry home health care). This brief focuses on post-acute home health care as opposed to community-entry home health care.

to admit patients, particularly in small or remote rural areas.[2,3] Since, on average, rural home health care patients compared with urban patients tend to be sicker and at higher risk for hospitalization,[4] it is especially critical to understand factors associated with unplanned care (e.g., emergency department visits, acute care hospital readmissions) in rural areas. In addition, it is unknown whether geographic variation that exists in readmission rates from acute care hospitals, skilled nursing facilities, and inpatient rehabilitation facilities[5-8] extends to home health care. Moreover, many rural communities have high poverty, low education, and low employment, and economically-disadvantaged communities may be at higher risk for readmissions.[9]

The purpose of this study was to examine associations between community factors (including rurality, geographic location, economic indicators, and available health resources) and outcomes of home health care among rural Medicare beneficiaries at high risk for hospital readmission and emergency department use.

METHODS

This study was a retrospective cohort analysis of rural, fee-for-service Medicare beneficiaries ages 65 and older who received home health care services following acute care hospitalization for one of the following high-risk diagnoses: acute myocardial infarction, heart failure, pneumonia, or chronic obstructive pulmonary disease (COPD). These high-risk diagnoses were selected based on National Quality Forum (NQF)-endorsed, publicly-reported measures of readmission for acute care hospitals (see Appendix for details). Data sources included Medicare home health claims and the Outcomes and Assessment Information Set (OASIS) from 2011 to 2013, the 2012 Area Health Resource File (AHRF), and U.S. Department of Agriculture Economic Research Service (USDA ERS) 2015 county typology files. Outcomes from the OASIS included discharge to the community[b] (yes/no) following the initial 60-day episode of home health, use of emergent care (yes/no) during the initial 60-day episode of home health, and all-cause readmission to an acute care hospital (yes/no) during the initial 60-day episode of home health. Community factors included rurality of beneficiary's residence (large rural, small rural, isolated small rural) based on the 2010 Rural Urban Commuting Area (RUCA) codes, U.S. Census division, county-level ERS economic indicators (persistent poverty, low employment, low education, and population loss), and county-level health resources (acute hospital beds, skilled nursing facility beds, home health agencies, primary care doctors, and rural health clinics) as identified from the AHRF. We used hierarchical logistic regression to estimate rates of each outcome in relation to community factors, accounting for beneficiary characteristics (demographics, dual-eligibility status, diagnosis, clinical severity, functional and cognitive status, living situation, and caregiving needs). More details about these methods are available in the Technical Appendix. This study was approved by the University of Washington Human Subjects Division.

FINDINGS

To better understand who is receiving rural home health care, Tables 1 and 2 describe the distribution of beneficiaries included in this study and the beneficiary characteristics used as control variables in the analysis by rurality and Census division, respectively. More than half of rural Medicare fee-for-service beneficiaries utilizing home health care included in this study (52.3%) lived in large rural areas, over one quarter (28.0%) in small rural areas, and almost one fifth (19.7%) in isolated small rural areas. Home health agencies in the East North Central and East South Central Census Divisions served the greatest number of rural beneficiaries with the high-risk conditions of interest for this study, while those in the Mountain, Pacific, and New England Divisions served the fewest. While descriptive analyses showed several statistically significant differences by rurality and by Census division among the characteristics of beneficiaries used as covariates, the magnitude of these differences was generally much greater by Census division than by rurality.

[b]Discharge to the community represents discharge from home health where the patient remains in the community with or without formal assistive services versus all other potential outcomes (e.g., transfer to hospital, skilled nursing facility, or other form of institutional care, continued home health services beyond initial 60-day episode, hospice care, and death).

With regard to economic indicators, among rural counties reflected in this study, 37.5% were designated by ERS as "low employment", 15.1% as "low education", 12.3% as "persistent poverty", and 16.7% as "population loss" counties. As for community-level health resources, the rural counties reflected in this study had an average of 16.5 acute care hospital beds, 50.5 skilled nursing facility beds, 2.9 primary care physicians, 0.6 rural health clinics, and 0.3 home health agencies per 1,000 Medicare beneficiaries.

Table 1. Characteristics[1] of Rural Medicare Beneficiaries Receiving Post-acute Home Health Care for High-Risk Conditions[2] by Rurality, 2011-2013

	Large Rural	Small Rural	Isolated Small Rural
Number of beneficiaries, (row %[3])	**25,507 (52.3)**	**13,683 (28.0)**	**9,612 (19.7)**
Age, column %			
65-74	29.4	30.0	29.6
75-84	40.2	40.8	40.7
85+	30.3	29.2	29.7
Male*,** column %	41.1	42.0	45.4
Non-white*,** column %	8.2	7.9	5.8
Dually eligible*,** column %	28.2	31.0	30.1
Diagnosis, column %			
Cardiac (acute myocardial infarction, heart failure)	58.7	59.2	59.4
Pulmonary (chronic obstructive pulmonary disease, pneumonia)	41.3	40.8	40.6
Clinical severity*, column %			
Low	9.0	8.4	9.6
Moderate	46.0	46.7	46.5
High	44.9	44.8	43.9
Functional status on admission*,** column%			
Low	21.4	23.7	23.7
Moderate	62.2	59.7	61.8
High	16.4	16.5	14.5
Cognitive status on admission, column %			
Intact	54.9	55.0	53.6
Mild impairment	34.3	34.6	35.5
Moderate to severe impairment	10.8	10.4	10.9
Lives alone*,** column %	30.8	32.6	30.3
Medication management,** column %			
No assist needed	21.7	22.7	21.8
Caregiver currently assisting	57.6	57.0	56.0
Assist needed but not currently sufficient	20.7	20.3	22.3
Supervision and safety,** column %			
No assist needed	38.8	39.9	40.6
Caregiver currently assisting	51.2	50.8	50.0
Assist needed but not currently sufficient	10.0	9.2	9.4

Overall chi-square: *p<.05, **p<.01, ***p<.001
1. Characteristics of beneficiaries that were used as control variables in analysis.
2. High-risk conditions included acute myocardial infarction, heart failure, chronic obstructive pulmonary disease, and pneumonia; these conditions were selected based on National Quality Forum-endorsed, publicly-reported measures of readmission for acute care hospitals.
3. Percentages do not total to 100.0 due to rounding.
Source: Beneficiary characteristics were drawn from the OASIS performed upon admission to the initial 60-day episode of home health following an acute hospitalization.

Table 2. Characteristics[1] of Rural Medicare Beneficiaries Receiving Post-acute Home Health Care for High-Risk Conditions[2] by Census Division, 2011-2013

	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
Number of total fee-for-service Medicare beneficiaries (row %)	2,235,518 (5.1)	6,153,256 (14.1)	6,776,153 (15.5)	3,056,839 (7.0)	8,889,080 (20.4)	2,672,557 (6.1)	4,471,634 (10.2)	2,926,347 (6.7)	6,487,069 (14.9)
Number of beneficiaries included in analysis (row %[3])	2,510 (5.1)	3,676 (7.5)	9,681 (19.8)	5,984 (12.3)	7,226 (14.8)	9,059 (18.6)	5,849 (12.0)	2,570 (5.3)	2,247 (4.6)
Age*,** column %									
65-74	25.9	25.0	28.5	23.7	31.2	35.8	32.6	27.1	26.9
75-84	41.8	38.0	39.6	40.2	42.3	41.0	40.9	40.0	38.4
85+	32.3	36.9	31.8	36.2	26.5	23.1	26.5	32.9	34.7
Male*,** column %	45.0	40.6	42.1	43.3	40.5	40.5	44.0	44.9	43.7
Non-white*,** column %	0.9	1.3	2.2	2.3	16.9	12.1	11.1	6.7	7.7
Dually eligible***, column %	40.1	26.5	26.9	19.1	32.7	37.9	28.5	21.4	26.4
Diagnosis, column %									
Cardiac (acute myocardial infarction, heart failure)***	54.5	60.7	61.2	63.5	59.4	55.2	57.0	57.1	60.2
Pulmonary (chronic obstructive pulmonary disease, pneumonia)***	45.5	39.3	38.8	36.5	40.6	44.7	42.9	42.9	39.8
Clinical severity*,** column %									
Low	11.4	10.1	9.2	12.4	9.1	5.6	6.2	11.6	11.6
Moderate	48.0	48.0	45.6	47.2	48.5	45.0	42.5	49.2	47.3
High	40.6	41.8	45.2	40.4	42.4	49.3	51.4	39.1	41.1
Functional status on admission*,** column %									
Low	26.0	24.6	26.5	29.5	19.7	15.0	18.9	29.6	20.7
Moderate	66.0	63.9	60.4	60.2	61.9	62.4	60.1	57.6	61.9
High	8.0	11.5	13.1	10.2	18.5	22.6	21.0	12.8	17.4
Cognitive status on admission*,** column %									
Intact	56.4	57.3	54.7	49.6	58.5	57.3	50.5	54.3	49.7
Mild impairment	34.1	34.1	34.4	37.9	31.5	33.7	39.1	32.2	33.6
Moderate to severe impairment	9.6	8.6	11.0	12.5	9.9	9.0	10.3	13.5	16.7
Lives alone*,** column %	33.7	36.0	34.4	35.6	27.2	27.2	31.0	30.5	25.5
Medication management*,** column %									
No assist needed	24.7	22.5	22.7	20.3	20.5	20.4	24.9	25.1	19.6
Caregiver currently assisting	56.5	57.4	52.3	52.4	63.8	64.0	53.4	52.2	56.9
Assist needed but not currently sufficient	18.8	20.1	25.0	27.3	15.7	15.6	21.8	22.8	23.4
Supervision and safety***, column %									
No assist needed	47.6	42.2	41.6	40.6	38.3	36.8	36.6	40.9	34.4
Caregiver currently assisting	42.7	49.0	45.9	49.3	55.0	56.9	51.2	46.8	54.8
Assist needed but not currently sufficient	9.8	8.7	12.5	10.1	6.7	6.3	12.2	12.3	10.7

Overall chi-square: *p<.05, **p<.01, ***p<.001

1. Characteristics of beneficiaries that were used as control variables in analysis.
2. High-risk conditions included acute myocardial infarction, heart failure, chronic obstructive pulmonary disease, and pneumonia; these conditions were selected based on National Quality Forum-endorsed, publicly-reported measures of readmission for acute care hospitals.
3. Percentages do not total to 100.0 due to rounding.

Sources: Beneficiary characteristics were drawn from the OASIS performed upon admission to the initial 60-day episode of home health following an acute hospitalization. Number of total fee-for-service Medicare beneficiaries by region was calculated from county-level data on fee-for-service Medicare beneficiaries ages 65 and over from the Area Health Resource File.

Table 3 presents results regarding the relationship between community factors and outcomes of the initial episode of post-acute home health care for rural Medicare beneficiaries with the selected high-risk conditions. After controlling for beneficiary characteristics from the OASIS, we found significant geographic variation across all three outcomes of home health care in this study (Table 3 and Figure 1), with higher than average rates of community discharge and lower than average rates of hospital readmission and emergency department use in New England, Middle Atlantic, West North Central, and Pacific Divisions. Rural Medicare beneficiaries receiving post-acute home health care for the selected diagnoses in East South Central and West South Central experienced lower than average rates of community discharge and higher than average rates of hospital readmission and emergency department use. It should be noted that community discharge following home health care is generally considered to be a positive outcome for beneficiaries while hospital readmission and emergency department use is considered a poorer outcome; higher or lower than average rates of outcomes are based on average rates of outcomes for the beneficiaries included in this study.

While geographic variation by Census division was significant across all outcomes ($p<.001$ for community discharge and readmissions; $p=.003$ for emergency department use; New England Census Division as reference group), rurality of beneficiary residence was not significantly associated with any outcomes. Counties with low employment versus without low employment had significantly higher probability of readmissions ($p=.004$) and emergency department visits ($p=.012$). Counties with persistent poverty versus without persistent poverty had significantly lower probability of community discharge ($p=.009$) and a higher probability of readmission ($p = .047$). The magnitudes of these differences were generally not as large as for geographic variation. All other relationships between county economic indicators and outcomes were not significant. Similarly, availability of acute hospital beds, home health agencies, primary care physicians, and rural health clinics within a county were not significantly associated with outcomes. Availability of skilled nursing facility beds was the only health resource significantly associated with outcomes; compared with counties with the highest number of skilled nursing facility beds, counties with lower numbers of beds had a significantly higher probability of community discharge ($p=.017$) and significantly lower probabilities of readmissions ($p=.016$) and emergency department visits ($p=.017$).

Table 3. Adjusted[1] Rates of Community Discharge, Hospital Readmission, and Emergency Department Use among Rural Medicare Beneficiaries Receiving Post-acute Home Health Care for High-Risk Conditions[2] by Community Factors, 2011-2013

	Community Discharge[3] (N=48,737)	Hospital Readmission[4] (N=48,737)	Emergency Department Use[5] (N=45,330)
Census Division			
1: New England (CT, ME, MA, NH, RI, VT)	76.7%	30.4%	19.8%
2: Middle Atlantic (NJ, NY, PA)	75.3%	33.2%	18.8%
3: East North Central (IL, IN, MI, OH, WI)	75.0%	32.5%	20.3%
4: West North Central (IA, KS, MN, MO, NE, ND, SD)	76.3%	30.3%	18.6%
5: South Atlantic (DE, DC, FL, GA, MD, NC, SC, VA, WV)	74.0%	33.9%	18.8%
6: East South Central (AL, KY, MS, TN)	68.1%	39.6%	20.6%
7: West South Central (AR, LA, OK, TX)	61.4%	41.7%	22.6%
8: Mountain (AZ, CO, ID, MT, NV, NM, UT, WY)	71.2%	32.6%	21.7%
9: Pacific (AK, CA, HI, OR, WA)	75.3%	28.9%	20.0%
Rurality			
Large rural	72.0%	34.9%	20.2%
Small rural	71.6%	35.0%	20.2%
Isolated small rural	72.0%	34.1%	19.7%
Economic Indicators[6]			
Persistent poverty county			
Yes	69.7%	36.5%	20.5%
No	72.2%	34.5%	20.1%
Low employment county			
Yes	71.1%	35.9%	21.0%
No	72.4%	34.0%	19.5%
Low education county			
Yes	71.7%	35.3%	19.8%
No	71.9%	34.7%	20.2%
Population loss county			
Yes	71.8%	35.7%	20.5%
No	71.9%	34.6%	20.0%
County-level Health Resources			
Acute hospital beds			
Lowest quartile	72.2%	34.3%	20.0%
Second quartile	71.8%	34.3%	20.2%
Third quartile	71.7%	35.3%	20.2%
Highest quartile	71.9%	35.1%	20.0%
Skilled nursing facility beds			
Lowest quartile	73.4%	33.3%	19.0%
Second quartile	72.3%	34.9%	19.9%
Third quartile	70.6%	36.1%	21.4%
Highest quartile	71.3%	34.6%	20.1%
Home health agencies			
Lowest quartile	71.2%	34.9%	20.2%
Second quartile	71.9%	33.9%	19.7%
Third quartile	73.0%	34.7%	19.8%
Highest quartile	71.5%	35.5%	20.7%

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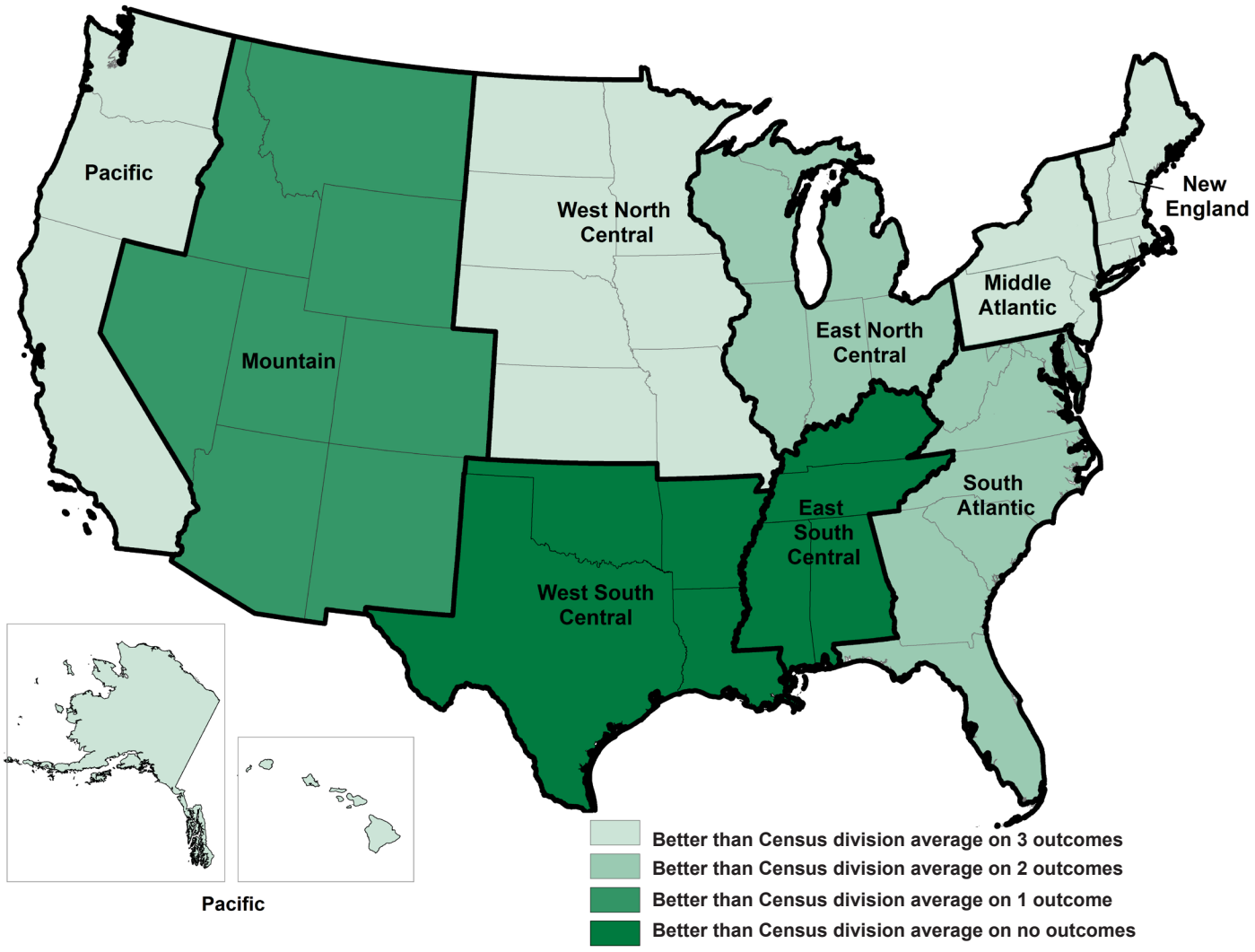
	Community Discharge[3] (N=48,737)	Hospital Readmission[4] (N=48,737)	Emergency Department Use[5] (N=45,330)
County-level Health Resources (continued)			
Primary care doctors			
Lowest quartile	72.2%	34.7%	19.2%
Second quartile	71.8%	35.0%	20.5%
Third quartile	72.4%	34.0%	20.1%
Highest quartile	71.2%	35.3%	20.6%
Rural health clinics			
Lowest quartile	72.3%	34.8%	20.6%
Second quartile	72.4%	34.1%	19.7%
Third quartile	71.3%	35.0%	20.1%
Highest quartile	71.6%	35.2%	20.0%

1. Adjusted for beneficiary characteristics including age, sex, race, dual-eligibility status, living situation, diagnosis, clinical severity, functional and cognitive status, and caregiving needs for medication management and supervision and safety.
2. High-risk conditions included acute myocardial infarction, heart failure, chronic obstructive pulmonary disease, and pneumonia; these conditions were selected based on National Quality Forum-endorsed, publicly-reported measures of readmission for acute care hospitals.
3. Discharge to the community with or without formal assistive services following initial 60-day episode of post-acute home health care versus all other outcomes (e.g., transfer to acute hospital, skilled nursing facility, or other institutional level of care, admission to hospice, death at home, continuation of home health services); higher rate represents a better outcome.
4. All-cause hospital readmission during initial 60-day episode of post-acute home health care; lower rate represents a better outcome.
5. All-cause emergency department visit during initial 60-day episode of post-acute home health care; lower rate represents a better outcome; fewer beneficiary records had complete data for emergency department use than for community discharge or hospital readmission, resulting in a smaller n.
6. Persistent poverty means 20% or more residents of a county were poor as measured by the 1980, 1990, and 2000 Census and the American Community Survey (ACS) 5-year average between 2007 and 2011; low employment means less than 65% of county residents ages 25 to 64 were employed based on the ACS 5-year average between 2008 and 2012; low education means 20% or more county residents had neither a high school diploma nor GED based on the ACS 5-year average between 2008 and 2012; and population loss means the number of county residents declined both between the 1990 and 2000 Census and between the 2000 and 2010 Census.
Sources: Outcomes and beneficiary characteristics were drawn from OASIS data from the initial 60-day home health episode following an acute hospitalization. Rurality was determined using Rural Urban Commuting Area (RUCA) codes. County-level economic indicators were drawn from the U.S. Department of Agriculture Economic Research Service files. County-level health resources were drawn from the Area Health Resource File and standardized by county-level Medicare enrollment.

Figure 1. Outcomes[1] of Post-Acute Home Health Care for High-Risk[2] Rural Medicare Beneficiaries by Census Division



1. Outcomes included community discharge, hospital readmission, and emergency department use based on OASIS data from the first 60-day episode of home health care following an acute hospitalization and were adjusted for beneficiary characteristics including age, sex, race, dual-eligibility status, living situation, diagnosis, clinical severity, functional and cognitive status, and caregiving needs for medication management and supervision and safety, and other community factors including rurality, county-level health resources (acute hospital beds, skilled nursing facility beds, primary care physicians, rural health clinics, and home health agencies), and county-level economic indicators (low employment, persistent poverty, low education, and population loss). Better outcomes refers to higher than average rate of community discharge, lower than average rate of hospital readmission, and lower than average rate of emergency department use.
2. High-risk conditions included acute myocardial infarction, heart failure, chronic obstructive pulmonary disease, and pneumonia; these conditions were selected based on National Quality Forum-endorsed, publicly-reported measures of readmission for acute care hospitals.
Sources: Outcomes and beneficiary characteristics were drawn from OASIS data from the initial 60-day home health episode following an acute hospitalization. Rurality was determined using Rural Urban Commuting Area (RUCA) codes. County-level economic indicators were drawn from the U.S. Department of Agriculture Economic Research Service files. County-level health resources were drawn from the Area Health Resource File and standardized by county-level Medicare enrollment.

CONCLUSIONS

Rural Medicare beneficiaries with high-risk conditions receiving home health care in the East South Central and West South Central Divisions were more likely to have lower rates of community discharge and higher rates of readmissions and emergency department visits than other Census divisions, even after accounting for rurality, county-level economic indicators, available health resources, and beneficiary characteristics. Fewer skilled nursing facility beds in a county were associated with higher rates of community discharge, which is consistent with previous research on variation in post-acute care use based on availability of services[10]; however, the size of this effect is not as large as for Census division. Thus results suggest that differences in home health care outcomes for rural beneficiaries receiving care for heart failure, myocardial infarction, COPD, and pneumonia are attributable primarily to geographic variation (as measured by Census division) rather than the other community factors included in these analyses. This geographic variation in readmissions is consistent with evidence from other post-acute care settings.[5-8] To help illuminate why this geographic variation exists, the characteristics of agencies providing care and care processes, such as service provision within home health episodes as well as larger contextual influences on entire regions, should be examined.

LIMITATIONS

This study was limited to rural beneficiaries receiving home health care, and was unable to account for patient admission into other post-acute care settings such as skilled nursing facilities. In some rural settings, lack of available home health care may increase admissions to skilled nursing, and vice versa, potentially causing some bias in our results, though the inclusion of available health resources at the county-level helped mitigate this potential bias. Also, without data on urban beneficiaries, it was not possible to consider urban-rural differences in home health outcomes for the population of interest. In addition, while results of this study cannot be generalized to Medicare Advantage beneficiaries as they were not available in analysis data, less than a quarter (21.2%) of rural Medicare beneficiaries were enrolled in Medicare Advantage plans in 2015.[11] Finally, although OASIS-based outcome measures provide critical initial information on home health care outcomes for high-risk rural beneficiaries, results of this study should be replicated using NQF-endorsed, claims-based outcome measures for readmissions and emergency department use. Further research addressing these limitations is warranted to appreciate fully both geographic and intra-rural variation in home health outcomes.

IMPLICATIONS FOR POLICY AND PRACTICE

This study supports the need for examination of policies and practices that could improve home health outcomes for rural beneficiaries residing in the East South Central and West South Central Census Divisions. One starting place is to explore if there are lessons to be learned from higher performing areas of the U.S. Further study could examine whether greater access to Medicaid resources or other wraparound community services, if present in higher performing areas, provides more opportunities and better support for beneficiaries to remain safely in the community after acute hospital discharge. As the movement towards paying for value over volume of services continues for Medicare beneficiaries in general and for home health care recipients in particular (a value-based purchasing demonstration was implemented in January 2016), further assessment of differences between high performing and underperforming rural home health agencies is urgently needed. This study provides an initial examination of which of a variety of community factors, ranging from Census division to county-level economic indicators to county-level health resources measures, affect rural home health care outcomes. Subsequent studies by the WWAMI Rural Health Research Center are investigating possible reasons for the finding of this study of geographic variation in outcomes of care. One new study will provide an examination of service provision within home health episodes. These studies intend to help inform future changes to Medicare policy to incentivize and support high quality care across all rural communities in the U.S.

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AUTHORS

Tracy M. Mroz, PhD, OTR/L, Department of Rehabilitation Medicine, University of Washington
C. Holly A. Andrilla, MS, WWAMI Rural Health Research Center, University of Washington
Susan M. Skillman, MS, WWAMI Rural Health Research Center, University of Washington
Lisa A. Garberson, PhD, WWAMI Rural Health Research Center, University of Washington
Davis G. Patterson, PhD, WWAMI Rural Health Research Center, University of Washington

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TECHNICAL APPENDIX

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

Design and data sources:

This study was a retrospective cohort analysis of rural Medicare beneficiaries who utilized home health care between 2011 and 2013. Data included Medicare administrative data from 2011 to 2013, specifically home health claims and the Outcomes and Assessment Information Set (OASIS), linked with data from the Area Health Resource File (AHRF) for 2012 and the 2015 Edition of County Typology Codes from the U.S. Department of Agriculture Economic Research Service (USDA ERS). Home health claims provide beneficiary-level detail on home health episodes. The OASIS is a comprehensive assessment specific to home health that was designed to collect necessary information for care planning by home health agencies and measure outcomes for quality improvement. The OASIS is completed upon admission, discharge, changes in status including transfer to a hospital, and renewal of services for each 60-day episode of care. Items from the OASIS also contribute to case-mix adjustment for Medicare reimbursement. The AHRF provides information on health resources at the county level including hospital beds, skilled nursing facility beds, home health agencies, rural health clinics, and primary care providers. The 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 following inclusion criteria: 1) Medicare fee-for-service beneficiary, 2) age 65 or over at the time of home health admission, 3) rural-residing based on beneficiary's ZIP code classified into any rural category of the ZIP code approximation of the Rural Urban Commuting Area (RUCA) codes, version 3.10 [12]; https://ruralhealth.und.edu/ruca; additional classification details below), 4) discharged from an acute care hospital within 14 days prior to home health admission, 5) began home health episode

on or after January 1, 2011 and ended on or before December 31, 2013, and 6) had a primary diagnosis considered "high-risk" for hospital readmission and emergent care use. We excluded beneficiaries who 1) transferred care between home health agencies during the initial home health episode or 2) had an unknown status at the end of the initial home health episode. For beneficiaries who were admitted to home health multiple times during the study period, we used the first initial home health episode during the study period that satisfied inclusion and exclusion criteria.

High-risk conditions were determined based on the National Quality Forum-endorsed, publicly-reported measures of readmission for acute care hospitals (see Table A1). Diagnoses included acute myocardial infarction, heart failure, pneumonia, and COPD based on the International Classification of Diseases, Ninth Revision (ICD-9) code for primary diagnosis on the claim for the initial home health episode.

Table A1. ICD-9 Codes for High Risk Conditions

Condition	Associated ICD-9 Codes[1]
Acute myocardial infarction	410.00, 410.01, 410.10, 410.11, 410.20, 410.21, 410.30, 410.31, 410.40, 410.41, 410.50, 410.51, 410.60, 410.61, 410.70, 410.71, 410.80, 410.81, 410.90, and 410.91
Chronic obstructive pulmonary disease	491.21, 491.22, 491.8, 491.9, 492.8, 493.20, 493.21, 493.22, 496; or a principal diagnosis of respiratory failure (518.81, 518.82, 518.84, 799.1) when combined with a secondary diagnosis of acute exacerbation of COPD (491.21, 491.22, 493.21, 493.22)
Heart failure	402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, and 428.9
Pneumonia	480.0, 480.1, 480.2, 480.3, 480.8, 480.9, 481, 482.0, 482.1, 482.2, 482.30, 482.31, 482.32, 482.39, 482.40, 482.41, 482.42, 482.49, 482.81, 482.82, 482.83, 482.84, 482.89, 482.9, 483.0, 483.1, 483.8, 485, 486, 487.0, and 488.11

1. From condition-specific readmission measures endorsed by the National Quality Forum and publicly reported by the Centers for Medicare and Medicaid Services for acute care hospitals. http://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier4&cid=1219069855841

Dependent variables/outcomes:

Outcomes for this study were determined based on OASIS data and included community discharge following the initial 60-day episode of home health, use of emergent care during the initial 60-day episode of home health, and readmission to an acute care hospital during the initial 60-day episode of home health. Community discharge following the initial episode of home health, based on the discharge OASIS (item M2420) and/or transfer OASIS (item M2410), included discharge to the community with or without formal assistive services versus all other outcomes (transferred to an acute care hospital, inpatient rehabilitation facility, or nursing facility without return to home health during the initial episode; admitted to hospice; died at home; and continued to receive home health services). For the outcomes of hospital readmission and emergency department use during the initial home health episode, we examined all events in the OASIS data from the initial 60-day episode of home health, including transfer, resumption of care, and discharge assessments, for indication of hospitalization and emergency department (ED) visits (items M2410 and M2300). All-cause readmissions and emergency department visits were included as binary variables indicating hospital admission (Y/N) or emergency department visit (Y/N) during the initial home health episode due to potential limitations with the potential quality of the OASIS item (M2430) on reason for hospitalization (e.g., accuracy, ability to endorse multiple response options, ability to endorse "unknown" and "other" as response options), expected low planned readmissions for the selected high-risk diagnoses, and inability to confirm diagnosis for readmission using hospital claims data. Exploratory data analysis of OASIS item M2430 confirmed our decision to use all-cause readmission as the outcome for this study.

Independent variables/community factors:

The independent variables of interest for this study were community factors, including rurality of beneficiary residence, geographic location, economic indicators, and available health resources. Rurality of beneficiary residence was determined based on the 2010 RUCA codes, version 3.10 for the beneficiary's ZIP code. We used the ZIP code approximation of the RUCA Census tract-based classification scheme, which characterizes the urban/rural status of areas based on U.S. Census Bureau definitions and work commuting information. Rurality was classified as large rural (codes 4.0, 5.0, 6.0), small rural (7.0, 7.2, 8.0, 8.2, 9.0), or isolated small rural (10.0, 10.2, 10.3).

Geographic location was categorized into one of the nine divisions defined by the U.S. Census Bureau. Available health resources from the AHRF included number of acute care hospital beds, skilled nursing facility beds, home health agencies, rural health clinics, and primary care physicians within each county in 2012, standardized by county-level Medicare enrollment ages 65 and over and grouped by quartile. County-level economic indicators from the ERS data included dichotomous variables indicating persistent poverty, low employment, low education, and population loss.[13] Persistent poverty means 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 means less than 65% of county residents ages 25 to 64 were employed based on the ACS 5-year average between 2008 and 2012. Low education means 20% or more county residents had neither a high school diploma nor GED based on the ACS 5-year average between 2008 and 2012. Population loss means the number of county residents declined both between the 1990 and 2000 Census and between the 2000 and 2010 Census.

Independent variables/beneficiary factors:

Control variables included the following beneficiary characteristics: demographics, dual-eligibility status for Medicare and Medicaid, diagnosis, clinical severity, functional and cognitive status upon admission, living situation, and caregiving needs. Demographics included age (65-74, 75-84, and 85+), gender, and race (white vs. non-white). Dual-eligibility status (Y/N) was determined based on enrollment in Medicaid at any point during the calendar year in which home health services were received from the enrollment file. Diagnosis indicated which type of high risk condition was the primary diagnosis for the initial home health episode: cardiac (heart failure or acute myocardial infarction) or pulmonary (COPD or pneumonia). Clinical severity and functional status upon admission were determined based on the OASIS-derived case-mix measures for prospective payment. Clinical severity, categorized as low, moderate, or high in the case-mix measure, depends on clinical factors such as need for intravenous or parenteral therapy, vision limitations, wounds, pressure ulcers, bowel incontinence, and shortness of breath. Functional impairment, categorized as low, moderate, or high in the case-mix measure, is based on physical assistance required with dressing, bathing, toileting, transfers, and ambulation. Cognitive status was based on an OASIS item on global cognitive status categorized into intact, mild impairment, and moderate to severe impairment. Living situation was dichotomized into lives alone versus lives with others. Caregiving needs were derived from the OASIS and included medication management (none needed, caregiver currently providing assistance, or assistance needed but not currently sufficient) and supervision and safety (no assistance needed, caregiver currently providing assistance, or assistance needed but not currently sufficient).

Analyses:

Descriptive analysis regarding beneficiary characteristics by rurality and geographic region used measures of proportion with chi-square tests. To assess the relationship between community factors and home health care outcomes, we used hierarchical multiple logistic regression models. We used general estimating equation methods in the regression analyses to account for clustering of beneficiaries within counties.[14] From these logistic regression models we calculated adjusted rates for each of our study outcomes. Analyses were completed using SAS software, Version 9.4 of the SAS System for Windows and SUDAAN software, Version 11.1. Complete case analysis was used for final models as less than 1% of beneficiaries who otherwise met inclusion

and exclusion criteria had missing covariate data. Of note, fewer beneficiaries had data available for the emergency department use outcome. A total of 48,802 beneficiaries met overall inclusion and exclusion criteria, 48,737 had complete data for the community discharge and readmissions analysis, and 45,330 had complete data for the emergency department use analysis.

University of Washington • School of Medicine
Box 354982 • Seattle WA 98195-4982
phone: (206) 685-0402 • fax: (206) 616-4768
http://depts.washington.edu/uwrhrc