

Geographic Access to Health Care for Rural Medicare Beneficiaries in Five States: An Update

KEY FINDINGS

1. In 2014, rural Medicare beneficiaries in the five study states (Alaska, Idaho, North Carolina, South Carolina, Washington) received a higher proportion of their visits (50.7%) from generalist physicians, nurse practitioners and physician assistants than did urban Medicare beneficiaries (41.8%).
2. The proportion of visits for Medicare beneficiaries provided by generalist physicians, nurse practitioners, and physician assistants increased from 1998 to 2014 among both rural and urban beneficiaries.
3. Overall, the average number of annual visits (outpatient and inpatient) per beneficiary in the five study states declined between 1998 to 2014, from 10.1 to 8.6 among urban beneficiaries and from 9.6 to 8.9 among rural beneficiaries.
4. Rural beneficiaries traveled farther to receive care and spent more time traveling than urban beneficiaries to access treatment, and residents of smaller rural areas traveled farther than residents of large rural places.
5. Median one-way travel times for visits for some serious conditions (including ischemic heart disease and cancer) exceeded 30 minutes among residents of small rural and isolated rural areas, and exceeded 60 minutes in 25% of cases.
6. Overall, rural beneficiaries received 74.2% of their visits in rural areas. Beneficiaries from large rural areas were less likely to travel to urban areas for care than those from small or isolated small rural areas.

BACKGROUND

Although Medicare provides near-universal health care coverage in the United States for those 65 years of age and older, residents of rural areas may experience more difficulties accessing medical and surgical specialists than their urban counterparts.¹⁻⁶ In the context of an urban-oriented health care system that systematically disadvantages rural communities,⁷ these differences in access, and in the mix and supply of providers caring for Medicare beneficiaries, may contribute to negative consequences and poorer outcomes for rural beneficiaries compared to urban ones.^{1,7-12}

Previous WWAMI RHRC work by Chan et al.¹ using 1998 Medicare data from five states (Alaska, Idaho, North Carolina, South Carolina, and Washington) found that rural Medicare beneficiaries had about 10% fewer mean visits per year than urban ones and that residents of the most isolated rural areas had the lowest mean number of annual visits. Urban patients also had a

higher proportion of visits with medical specialists while rural patients had a higher proportion of visits with generalists. The proportion of visits with surgical specialists, however, was similar regardless of rural/urban residence.^{1,6}

In addition to these disparities in utilization of medical and surgical specialists, rural residents were, not surprisingly, likely to travel farther than their urban counterparts for health care services.¹³ Noting that health care utilization may be negatively affected by overly long travel times to health care providers and facilities,^{1,3-5} Chan et al. also examined the travel distance and travel times for care for beneficiaries with a number of selected diagnoses (e.g., depression, ischemic heart disease, malignant neoplasms, and others). Findings indicated that travel times to providers caring for those conditions were typically two to three times longer for residents of isolated small rural and small rural areas than for residents of large rural and urban areas. A detailed analysis of travel behavior of rural beneficiaries found that residents of isolated small rural and small rural areas did not use urban providers for much of their care. Residents of all three types of rural areas (large rural, small rural and isolated small rural) traveled to urban areas for less than 33% of their visits.

The purpose of this study was to describe, for the same five states reported on by Chan et al.,¹ who provided care for rural Medicare beneficiaries, the quantity of care they received, and how far those beneficiaries traveled for care in 2014 (the latest data available at the time of the analysis). In addition, we sought to compare our 2014 utilization and travel estimates with the 1998 estimates provided by Chan et al. in order to assess the degree to which rural/urban differences in geographical access to care were ameliorated or exacerbated in the intervening sixteen years.

METHODS

Medicare administrative data for calendar year 2014 were used to examine the number of visits received by rural fee-for-service Medicare beneficiaries age 65 years and older who resided in Alaska, Idaho, North Carolina, South Carolina or Washington. Our data included inpatient claims (where each claim represented a hospital stay), outpatient claims, a 20% random sample of the carrier claims and carrier line files, and the Medicare Data on Provider Practice and Specialty (MD-PPAS) file. A single visit was defined by a group of rows of data from the inpatient claims file, the outpatient claims file, or the carrier line file with the same beneficiary ID, visit date and National Provider Identifier. We obtained beneficiary information (residence ZIP code, age, race, and gender) from the carrier claims file and visit information (service facility ZIP code, provider National Provider Identifier number, diagnosis code, procedure code, and cost) from the carrier line file. We obtained provider specialty codes from the MD-PPAS file for most providers (96.6%) in the study. For providers not in the MD-PPAS file, we used the Medicare specialty code from the claims files. We considered generalist physicians to include the following specialties: general practice, family practice, internal medicine, pediatrics, and geriatrics. We classified other physicians as medical specialists (e.g., allergy/immunology, cardiology, or dermatology) or surgical specialists (e.g., general surgery, otolaryngology, or neurosurgery). The two remaining provider groups were nurse practitioners (NPs) and physician assistants (PAs), and other (e.g., psychologists, social workers, or clinical nurse specialists).

The service facility ZIP code was used to identify where a visit took place (provider location). We used the primary digit of the 2010 Rural-Urban Commuting Area (RUCA) codes¹⁴ to classify each beneficiary and provider location as urban (RUCAs 1-3), large rural (RUCAs 4-6), small rural (RUCAs 7-9), or isolated small rural (RUCA 10). Version 3.1 of the ZIP code approximation of RUCA codes was used.¹⁴

We calculated the distance and time travelled for each visit using the beneficiary and service facility ZIP code and Google Maps. Full details of the provider type classifications, dataset construction and analyses, and distance/travel time calculations are in the Technical Appendix. We used Version 9.4 of the SAS System for Windows software for analysis. The University of Washington's Human Subjects Division approved this research.

FINDINGS

Table 1 shows the demographic characteristics of Medicare beneficiaries 65 or older who had a visit in 2014 by the level of rurality of their residence. Overall, the average age of these patients was 75.2 years. Most beneficiaries who had a visit were White (84.4%), 10.9% were Black and less than 2% were Asian, Hispanic, Native American, or another unspecified race. More than half (58.6%) were women. Almost three-quarters of visits were by beneficiaries (71.0%) who lived in an urban location, while 17.4% lived in large rural, 6.9% in small rural, and 4.7% in isolated small rural places. Among the five study states, the most beneficiaries lived in North Carolina (40.1%). About a quarter lived in South Carolina (25.1%) and in Washington (26.3%).

Table 1. Characteristics of Medicare Beneficiaries from Alaska, Idaho, North Carolina, South Carolina, and Washington by Beneficiary Residence, 2014

	Urban n=1,275,899 (71.0% of all)		Rural (all) n=521,223 (29.0% of all)		Large Rural n=313,061 (17.4% of all)		Small Rural n=124,086 (6.9% of all)		Isolated Small Rural n=84,076 (4.7% of all)		All n=1,797,122 (100.0% of all)	
Average Age	75.3		75.1		75.2		75.1		74.9		75.2	
	Count	Col. %	Count	Col. %	Count	Col. %	Count	Col. %	Count	Col. %	Count	Col. %
Age												
65-69	376,261	29.5	153,282	29.4	91,555	29.3	36,499	29.4	25,228	30.0	529,543	29.5
70-74	306,247	24.0	128,997	24.8	76,964	24.6	30,700	24.7	21,333	25.4	435,244	24.2
75-79	230,732	18.1	96,407	18.5	57,602	18.4	23,127	18.6	15,678	18.7	327,139	18.2
80-84	169,928	13.3	69,475	13.3	42,074	13.4	16,485	13.3	10,916	13.0	239,403	13.3
85+	192,731	15.1	73,062	14.0	44,866	14.3	17,275	13.9	10,921	13.0	265,793	14.8
Gender												
Male	523,683	41.0	219,729	42.2	129,849	41.5	52,534	42.3	37,346	44.4	743,412	41.4
Female	752,216	59.0	301,494	57.8	183,212	58.5	71,552	57.7	46,730	55.6	1,053,710	58.6
Race/Ethnicity*												
White	1,080,186	84.7	437,268	83.9	264,626	84.5	99,767	80.4	72,875	86.7	1,517,454	84.4
Black	130,505	10.2	65,008	12.5	37,899	12.1	20,020	16.1	7,089	8.4	195,513	10.9
Asian	21,326	1.7	1,595	0.3	1,099	0.4	366	0.3	130	0.2	22,921	1.3
Hispanic	6,768	0.5	2,684	0.5	1,733	0.6	654	0.5	297	0.4	9,452	0.5
North American Native	6,174	0.5	6,866	1.3	2,605	0.8	1,711	1.4	2,550	3.0	13,040	0.7
Other Unspecified Race	17,524	1.4	4,127	0.8	2,871	0.9	780	0.6	476	0.6	21,651	1.2
State												
Alaska	19,116	1.5	16,450	3.2	8,001	2.6	4,067	3.3	4,382	5.2	35,566	2.0
Idaho	64,678	5.1	52,588	10.1	23,373	7.5	15,457	12.5	13,758	16.4	117,266	6.5
North Carolina	481,454	37.7	239,155	45.9	148,434	47.4	55,183	44.5	35,538	42.3	720,609	40.1
South Carolina	350,250	27.5	100,587	19.3	73,503	23.5	20,595	16.6	6,489	7.7	450,837	25.1
Washington	360,401	28.3	112,443	21.6	59,750	19.1	28,784	23.2	23,909	28.4	472,844	26.3

*Data on race was missing for 17,091 beneficiaries.

The average numbers of visits for urban and rural beneficiaries are shown in Table 2. Urban beneficiaries averaged 8.6 visits in 2014 compared to 8.9 among rural beneficiaries. Rural beneficiaries living in large rural places averaged 8.8 annual visits, and those from small and isolated small rural places had 9.2 and 8.7 visits, respectively. Alaskan residents had fewer visits per beneficiary in all types of areas compared to residents of the other four states in the study.

Table 2. Mean Number of Medicare Beneficiary Visits by State and Beneficiary Residence, 2014

Mean number of visits (SD)* by state	Urban	Rural (all)	Large Rural	Small Rural	Isolated Small Rural	All
Alaska	7.3 (10.4)	6.9 (9.5)	7.1 (10.2)	7.3 (9.6)	6.1 (7.9)	7.1 (10.0)
Idaho	9.3 (11.4)	9.3 (10.5)	9.5 (10.8)	9.2 (10.2)	9.0 (10.1)	9.3 (11.0)
North Carolina	8.6 (11.4)	8.7 (11.0)	8.5 (11.1)	9.1 (10.9)	8.6 (10.7)	8.6 (11.2)
South Carolina	8.3 (11.6)	8.6 (10.7)	8.5 (10.8)	8.9 (10.3)	8.6 (10.4)	8.4 (11.4)
Washington	8.9 (11.9)	9.7 (11.1)	9.8 (11.3)	9.9 (11.0)	9.1 (10.7)	9.1 (11.7)
All Study States	8.6 (11.5)	8.9 (10.9)	8.8 (11.0)	9.2 (10.7)	8.7 (10.5)	8.7 (11.4)

*SD-Standard Deviation

Table 3 describes the types of providers seen by beneficiaries from the five study states by the rural/urban category of their residence. Overall, generalist physicians and medical specialist physicians each provided slightly more than one third of all beneficiary visits (35.7% and 34.5% respectively). Surgical specialist physicians provided 13.9% of all visits. NPs and PAs combined provided 8.7% of visits, and other clinicians provided 7.2% of visits. The most frequent 'other providers' included physical therapists (31.1%), chiropractors (24.0%), podiatrists (16.6%), and optometrists (13.8%). Generalist physicians as well as NPs and PAs provided a larger share of the care for rural populations (50.7%) than for urban populations (41.8%). Medical specialist physicians provided a larger percentage of visits for urban beneficiaries than for rural beneficiaries from all types of rural places.

Table 3. Medicare Beneficiary Visits by Provider Type and Beneficiary Residence, 2014

	Generalists		Medical Specialists		Surgical Specialists		Nurse Practitioners and Physician Assistants		Other Providers		All	
	Visits	Row (%)	Visits	Row (%)	Visits	Row (%)	Visits	Row (%)	Visits	Row (%)	Visits	Row (%)
Urban	3,771,600	34.2	4,031,378	36.5	1,555,740	14.1	837,401	7.6	844,228	7.7	11,040,347	100.0
Rural (all)	1,801,549	39.3	1,362,755	29.7	617,997	13.5	522,848	11.4	276,845	6.0	4,581,994	100.0
Large Rural	1,033,613	37.8	873,914	32.0	377,846	13.8	277,768	10.2	171,084	6.3	2,734,225	100.0
Small Rural	476,568	42.2	300,942	26.6	148,336	13.1	140,136	12.4	63,831	5.7	1,129,813	100.0
Isolated Small Rural	291,368	40.6	187,899	26.2	91,815	12.8	104,944	14.6	41,930	5.8	717,956	100.0
All	5,573,149	35.7	5,394,133	34.5	2,173,737	13.9	1,360,249	8.7	1,121,073	7.2	15,622,341	100.0

The median one-way distance (in miles) and time (in minutes) that beneficiaries travelled for care for all visits, and for a select group of diagnoses, is shown in Table 4. Across the five study states, the median miles urban beneficiaries travelled for care was 11.2 miles. The median distance all rural beneficiaries travelled for care was 13.6 miles, ranging from 11.7 miles for beneficiaries from large rural places to 23.4 miles for those from isolated small rural places. Travel time estimates for rural beneficiaries were also longer. The median time patients living in small and isolated small rural places travelled for care was 22 minutes and 34 minutes respectively, compared to 20 minutes for urban beneficiaries. The median distance rural beneficiaries travelled for treatment for ischemic heart disease and malignant neoplasms was more than 50% farther than for treatment overall or for other selected diagnoses, such as congestive heart failure and fractures and dislocations. It should also be noted that the interquartile ranges (IQR) for distance traveled are much broader for visits by rural beneficiaries compared to urban beneficiaries for many of the conditions specified in Table 4. For example, residents of isolated small rural areas traveled a median distance of 34.6 miles for an ischemic heart disease visit and the IQR was 17.1 to 63.2 miles. This means that 25% of those visits involved travel distances exceeding 63.2 miles. In contrast, visits by urban beneficiaries for ischemic heart disease involved a median travel distance of 13.2 miles with an IQR of 6.8 to 21.6 miles.

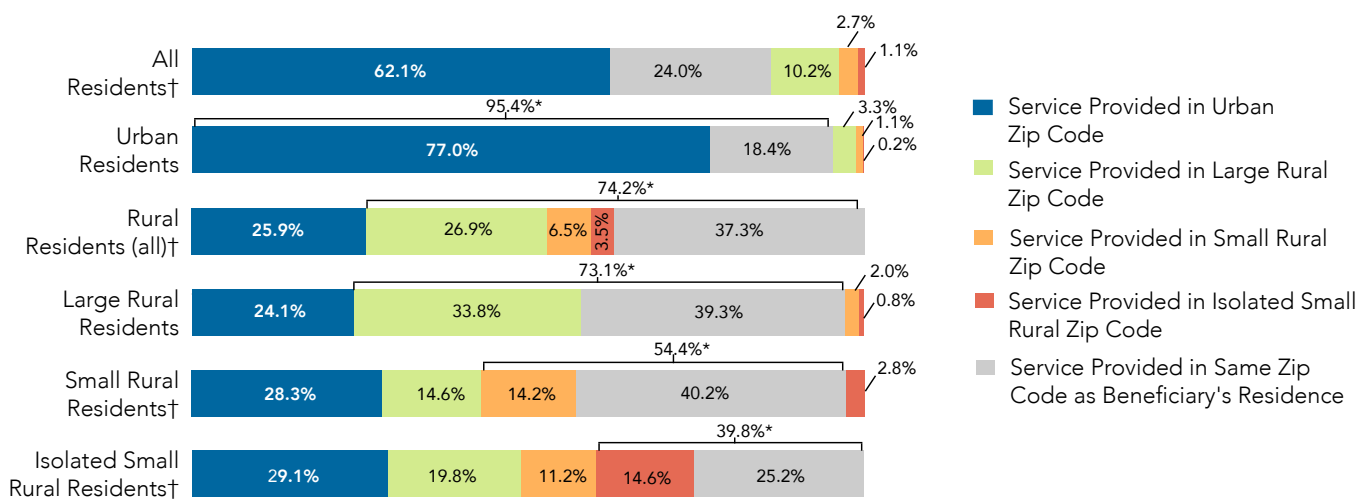
Table 4. Median Medicare Beneficiary Travel Distance and Travel Time by Selected Diagnosis and Beneficiary Residence, 2014*

Selected Diagnoses		Median Distance in Miles (IQR)**, Median Time in Minutes (IQR)**					
		Urban	Rural (all)	Large Rural	Small Rural	Isolated Small Rural	All
All Visits (15,622,341)	Median Distance in Miles (IQR)	11.2 (5.0-19.2)	13.6 (0.0-31.5)	11.7 (0.0-29.2)	15.1 (0.0-37.2)	23.4 (0.0-45.1)	11.9 (2.9-22.2)
	Median Time in Min (IQR)	20.0 (12.0-30.0)	21.0 (0.0-43.0)	19.0 (0.0-39.0)	22.0 (0.0-51.0)	34.0 (0.0-63.0)	21.0 (8.0-33.0)
Depression and Anxiety (94,430)	Median Distance in Miles (IQR)	12.3 (5.0-24.2)	17.9 (0.0-47.6)	17.7 (0.0-52.9)	15.6 (0.0-39.1)	22.7 (0.0-47.0)	13.0 (3.1-31.0)
	Median Time in Min (IQR)	21.0 (12.0-36.0)	27.0 (0.0-59.0)	26.0 (0.0-58.0)	23.0 (0.0-55.0)	34.0 (0.0-69.0)	22.0 (9.0-43.0)
Fractures and Dislocations (164,721)	Median Distance in Miles (IQR)	10.9 (4.6-18.4)	14.5 (0.0-32.2)	11.5 (0.0-26.8)	14.9 (0.0-37.8)	24.4 (10.9-47.7)	11.3 (2.2-21.2)
	Median Time in Min (IQR)	20.0 (11.0-29.0)	22.0 (0.0-44.0)	18.0 (0.0-37.0)	21.0 (0.0-53.0)	38.0 (18.0-67.0)	20.0 (7.0-32.0)
Cerebrovascular Disease (173,033)	Median Distance in Miles (IQR)	11.7 (5.3-20.3)	16.5 (0.0-36.3)	14.2 (0.0-31.8)	15.9 (0.0-38.9)	27.9 (12.1-55.6)	12.5 (3.9-24.0)
	Median Time in Min (IQR)	21.0 (12.0-31.0)	25.0 (0.0-48.0)	21.0 (0.0-43.0)	24.0 (0.0-55.0)	40.0 (19.0-73.0)	21.0 (10.0-35.0)
Congestive Heart Failure (150,614)	Median Distance in Miles (IQR)	11.5 (5.3-19.3)	12.2 (0.0-29.9)	11.0 (0.0-25.2)	11.4 (0.0-32.5)	23.2 (0.0-43.4)	11.6 (2.9-21.7)
	Median Time in Min (IQR)	20.0 (12.0-30.0)	19.0 (0.0-41.0)	16.0 (0.0-35.0)	18.0 (0.0-43.0)	33.0 (0.0-61.0)	20.0 (8.0-32.0)
Degenerative Joint Disease (244,534)	Median Distance in Miles (IQR)	11.2 (4.9-19.3)	16.3 (0.0-35.7)	13.5 (0.0-31.3)	18.5 (0.0-41.2)	27.1 (9.3-52.2)	12.1 (3.0-22.7)
	Median Time in Min (IQR)	20.0 (12.0-30.0)	25.0 (0.0-48.0)	21.0 (0.0-40.0)	27.0 (0.0-56.0)	40.0 (15.0-74.0)	21.0 (8.0-34.0)
Ischemic Heart Disease (265,935)	Median Distance in Miles (IQR)	13.2 (6.8-21.6)	22.0 (0.0-45.4)	17.3 (0.0-37.0)	28.4 (0.0-51.7)	34.6 (17.1-63.2)	14.6 (6.4-27.0)
	Median Time in Min (IQR)	22.0 (14.0-33.0)	32.0 (0.0-57.0)	26.0 (0.0-46.0)	39.0 (0.0-65.0)	48.0 (26.0-83.0)	24.0 (14.0-39.0)
Malignant Neoplasm (757,830)	Median Distance in Miles (IQR)	14.1 (7.5-23.6)	27.9 (9.0-50.3)	21.1 (0.0-43.7)	36.2 (15.4-58.0)	39.4 (22.4-67.7)	15.4 (7.7-29.5)
	Median Time in Min (IQR)	23.0 (15.0-35.0)	39.0 (16.0-65.0)	30.0 (0.0-52.0)	48.0 (22.0-77.0)	54.0 (32.0-90.0)	25.0 (15.0-42.0)

*For beneficiaries in Alaska, Idaho, North Carolina, South Carolina, and Washington
 **Interquartile Range

Figure 1 depicts the travel patterns of beneficiaries by showing the types of places residents of urban, large rural, small rural and isolated small rural places went for their care. The figure shows that 95.4% of the visits received by urban residents took place in urban areas. One in five (18.4%) of those visits took place in the home ZIP codes of the beneficiaries. Among residents of large rural areas, the majority of visits (73.1%) occurred in large rural places, and 39.3% of those visits were received in the beneficiaries' home ZIP codes. A slight majority (54.4%) of the visits received by residents of small rural areas took place in small rural areas. In contrast, a minority of visits (39.8%) received by residents of isolated small rural areas took place in the isolated small rural areas. Beneficiaries from small and isolated small rural areas received 28.3% and 29.1% (respectively) of their visits in urban places. Overall, rural beneficiaries received 74.2% of their visits in rural areas.

Figure 1. Medicare Visit Origins and Care Destinations for Alaska, Idaho, North Carolina, South Carolina, and Washington by Beneficiary Residence, 2014



*Brackets indicate the total proportion of visits that occurred in the same type of area as that of the beneficiary's residence. The gray portion under the bracket indicates the proportion that occurred in the beneficiary's home ZIP code; the colored portion under the bracket indicates the proportion that occurred in the same type of area (urban, large rural, small rural, isolated small rural), but not in the home ZIP code.
 †Percentages do not add to 100.0% due to rounding.

DISCUSSION

Summary. Study results indicate differences in both the types of healthcare providers treating rural and urban Medicare beneficiaries and the travel time and distance required to receive care. The observed differences follow an expected pattern. Rural beneficiaries receive more care from generalist physicians, NPs and PAs, and less care from specialists and other providers. This study updates a 2006 study of the same five states using data from 1998.¹ The 2014 beneficiaries in this study had fewer annual visits on average than 1998 beneficiaries in the earlier study, however, the rural-urban differences in mean visits observed in the earlier study (about 10% fewer among rural residents) were not found in the analysis of the 2014 data.

Generalist physicians provided a substantially larger share of the care of both urban and rural beneficiaries in 2014 than in 1998. Overall, in 1998, generalist physicians provided about one fifth of visits (20.5%), while in 2014 they provided more than a third of all visits (35.7%). The share of care provided by specialist physicians, both medical and surgical, declined in the new study. In 1998, 50.7% of visits were provided by medical specialists compared to 34.5% in 2014. Surgical specialist visits declined from 20.0% of visits to 13.9% in 2014. The 1998 study did not consider visits provided by NPs and PAs as a separate

group, so a direct comparison is not possible. However, in 1998, providers other than physicians delivered 8.8% of care. In 2014, NPs and PAs (together) delivered 8.7% of visits, and other non-physician providers delivered 7.2% of visits.

Limitations. The analysis presented above has some limitations. An important limitation of this study is that the claims data used only includes traditional fee-for-service beneficiaries. Medicare Advantage beneficiaries, about 30% of all enrollees,¹⁵ were not included in the study. In 2014 Medicare Advantage covered 33% of beneficiaries in Idaho, 28% in North Carolina, 22% in South Carolina, and 29% in Washington.¹⁶ There were no Medicare Advantage plans available to Alaska residents in 2014.¹⁶ Since then, participation in Medicare Advantage (2020) has remained at 33% in Idaho and grown to 36% in North Carolina, 28% in South Carolina and 33% in Washington.¹⁷ There are still no plans available to Alaska residents.¹⁷

This study attempted to replicate a study published in 2006. Due to ambiguity in the names of the Medicare administrative data files used in the 2006 study, we could not determine if the data source(s) in the two studies were identical. We were also unable to determine the practice specialties of NPs and PAs caring for the beneficiaries in the study. In addition, it was not possible to adjust for differences in access associated with non-geographical factors such as beneficiary socio-economic status. The constellation of particular states in the study (two southern states and three Pacific Northwest states) also dictates caution in generalization of the results to the U.S. as a whole; a national study of geographic access to care for Medicare beneficiaries is forthcoming from the WWAMI RHRC¹⁸ and will support generalization and includes analyses across region and beneficiary race/ethnicity.

The calculation of time and distance traveled by rural beneficiaries posed some challenges. Since many rural ZIP codes are larger than urban ZIP codes, rural beneficiaries were more likely than urban beneficiaries to see a provider in the same ZIP code as their residence ZIP code. For those visits, it was not possible to calculate the distance and time travelled. In those cases, we chose to impute zeros to allow for a comparison to results from the 2006 study,¹ almost certainly underestimating travel time and distance. Since a larger proportion of visits in rural places occurred in the beneficiaries' ZIP code, distances and travel times are more likely to be underestimated for rural than for urban visits. We also conducted the distance and time calculations without imputing zeros and, as expected, saw larger rural/urban differences.

Conclusions. The findings of this study are a reminder of the importance of monitoring changes in Medicare utilization in rural areas of the United States, especially in small rural and isolated small rural areas. Two findings in particular illustrate this point. First, for several serious conditions, most notably ischemic heart disease and cancer, one-way median travel times to providers for residents of small rural areas and isolated small rural areas remain well over the 30-minute benchmark identified by Chan et al.¹ as marking "appropriate access to care" (p. 144). Less geographic access to certain types of specialty care for some serious conditions continues to challenge residents and providers in small and isolated small rural areas. Second, rural Medicare beneficiaries from all types of rural areas continue to depend on generalist physicians, PAs, and NPs to a higher degree than urban areas, and their importance appears to be growing. Sustaining a robust workforce able to provide access to high quality health care for rural Medicare beneficiaries will require continued support for programs that identify, nurture, and train health care students and professionals with interest in rural careers.

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TECHNICAL APPENDIX

Data Set and Analytic Approach As noted in the text, this study used 2014 Medicare administrative data on fee-for-service Medicare beneficiaries age 65 years and older from Alaska, Idaho, North Carolina, South Carolina and Washington. The data set included inpatient claims, outpatient claims, a 20% random sample of the carrier claims and carrier line files, and the Medicare Data on Provider Practice and Specialty (MD-PPAS) file.

The inpatient claims file contained claims submitted by inpatient hospital providers (not skilled nursing facilities) for reimbursement of facility costs. Each inpatient claim represented a covered inpatient stay. The outpatient claims file contained claims submitted by institutional outpatient providers. Examples included hospital outpatient departments, Rural Health Clinics, renal dialysis facilities, Federally Qualified Health Centers, and outpatient rehabilitation facilities. Each outpatient claim represented an outpatient visit (e.g., colonoscopy, cataract surgery).

The carrier claims file contained claims submitted by professional providers such as physicians, PAs, NPs, and clinical social workers. In addition, the carrier file contained claims for some organizational providers such as freestanding ambulatory surgical centers, independent clinical laboratories, and freestanding radiology centers. We used both the carrier claims file and the carrier line file. Each row in the carrier claims file represented a claim. Each row in the carrier line file represented an item or service for which a claim of payment was made to Medicare. Beneficiary information (residence ZIP code, age, race, and gender) came from the carrier claims file and visit information (service facility ZIP code, provider National Provider Identifier number, diagnosis code, procedure code, and cost) came from the carrier line file.

The final analytic data set (after the exclusions discussed below) included data on 15,622,341 visits and contained rows of data from the inpatient claims file, outpatient claims file, and carrier line file. We considered each group of rows with the same beneficiary ID, visit date, and provider National Provider Identifier (NPI) number to be a single patient visit. If a visit had more than one row or line item, we selected the row with the highest cost or payment amount.

We obtained provider specialty codes from the MD-PPAS file for 96.6% of the visits in the study. The MD-PPAS file assigns Medicare providers to medical practices based on tax numbers and elaborates on the Centers for Medicare & Medicaid Services (CMS) provider specialty classification. The provider-level dataset was built around the NPI and the tax identification number (TIN). For providers not in the MD-PPAS file, we used the Medicare specialty code from the claims files. If a provider was not in the MD-PPAS file and did not have a Medicare specialty code in the claims file, we removed all visits associated with that provider from the analytic data set. A specialty could not be determined for 12,439 providers, resulting in the exclusion of 386,923 visits.

We used the service facility ZIP code to identify where a visit took place. For carrier visits, we used the *Line Place of Service (POS) Physician ZIP Code* variable from the line file for provider location. For inpatient and outpatient visits, we used the *Claim Service Facility ZIP Code* variable for provider location. We used the *ZIP Code of Residence from Claim* variable from the three main claims files for beneficiary location.

Distance and Travel Time Calculations A SAS macro that accessed Google Maps allowed us to calculate one-way driving distance and travel time between beneficiary location (origin) and provider location (destination). We modified the macro so that we could calculate the distance between ZIP codes rather than addresses, as we did not have access to full addresses for beneficiary or provider locations. We calculated driving distance and travel time for the 217,715 unique ZIP code pairs for the five states in the study. We excluded 429,443 visits with a driving distance of 250 miles or more from the analytic data set.

For a number of reasons, we were not able to calculate driving distance and travel time for 94,800 visits. For example, Google Maps could not calculate driving distance for some locations in and around mountains or bodies of water. We were also not able to calculate driving distance for 33.3% of ZIP code pairs in Alaska. In addition, we were not able to determine driving distance for beneficiaries who travelled to a provider located in the same ZIP code in which the beneficiary lived. We excluded most visits for which we could not calculate driving distance from the data set except for visits where the beneficiary and provider were located in the same ZIP code. Since rural beneficiaries are more likely to have visits in their home ZIP codes than their urban counterparts, we chose to impute a mileage of zero for those visits. This helped facilitate comparisons with the previous study¹ and was also a more conservative approach to assessing rural/urban and intra-rural differences in distance traveled. A shadow analysis conducted without inclusion of imputed values found longer travel distances.

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