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Factors associated with access to rheumatologists for Medicare patients

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Abstract

Objective—Despite looming rheumatologist shortages and a growing number of patients with arthritis and other rheumatic conditions, nationwide estimates of access to rheumatology care have never been reported. We aimed to measure travel times as a proxy to access to care and to determine the individual and area-level factors associated with long travel times to rheumatologists in the U.S.

Methods—We used Medicare Part B claims for the 2009 Medicare Chronic Condition Warehouse 5% rheumatoid arthritis/osteoarthritis cohort. Using Google Maps we estimated driving time from the center of a beneficiary's home ZIP code to the center of their rheumatologist's office ZIP code. We examined predictors of travel time ≥ 90 minutes in a series of generalized linear mixed models adjusting for rheumatologist supply, rurality, and individual patient characteristics including age, race, gender, and income.

Results—We included 41,693 Medicare beneficiaries with one or more visits to a rheumatologist in 2009. The median estimated beneficiary travel time to a rheumatologist was 22 minutes (interquartile range (IQR) 12–40 minutes). Seven percent of beneficiaries travelled 90 minutes or longer to visit a rheumatologist. Even after adjusting for covariates, independent predictors of long travel times included living in areas with no or low supply of rheumatologists and living in the Mountain region of the U.S.

Conclusions—A small but significant proportion of patients in the U.S. travelled very long distances to visit a rheumatologist, and most of these individuals resided in areas with no or low supplies of rheumatologists. These data suggest that addressing shortages in rheumatology care for patients in low-supply areas is a key target for improving access to rheumatologists.

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All authors had access to the data and participated in the drafting of the manuscript.

Keywords

Rheumatology; access to care; distance

Many areas in the U.S. lack a practicing rheumatologist despite a growing number of patients with arthritis or other rheumatic conditions.[1] This shortage is problematic because geographic proximity to physicians or diagnostic services has been shown in other areas of healthcare to be correlated with quality of care.[2] Increased distance to the nearest rheumatologist has been associated with a lower likelihood of carrying a diagnosis of rheumatoid arthritis, which suggests that a regional shortage of rheumatologists could affect outcomes, if diagnoses were missed or delayed.[3] However, nationwide estimates of access to rheumatology care (regardless of diagnosis) have never been reported.

We used national Medicare data to examine the travel times undertaken by patients to visit a rheumatologist and to determine the individual and area-level factors influencing travel time to rheumatologists. We hypothesized that patients travelling longest would reside in areas with the lowest supply of rheumatologists.

Patients and Methods

The study was approved by the Centers for Medicare and Medicaid Services and by the Institutional Review Board of the University of California, San Francisco.

Study design

This is a retrospective, population-based observational study of access to rheumatology care for Medicare patients in the U.S. We performed 3 primary analyses: 1. We assessed travel times for all patients in our sample with at least 1 visit to a rheumatologist, examining their most frequently seen rheumatologist; 2. We identified important area-level predictors of long travel times to rheumatologists; 3. We aggregated beneficiaries according to hospital service area (HSA) region in order to determine regions with the poorest access and most pressing need for improved rheumatologist access. Finally, in a secondary analysis, we explored the diagnoses given to patients by the rheumatologists to see if there were potential differences in the diagnosis of systemic inflammatory diseases among the patients travelling the longest.

Data sources

We used 2009 Medicare Part B (medical insurance) claims for the Medicare Chronic Condition Warehouse 5% rheumatoid arthritis/osteoarthritis cohort. We linked these claims to the Medicare Beneficiary Summary File to determine patient sociodemographic characteristics.

Medicare reimbursement rates (2009 data), Medicare beneficiary and total resident populations (most recent data available, 2006), and Hospital Service Area map boundaries files (most recent data available, 2006) were obtained from The Dartmouth Atlas of Heath Care. We used information from the 2000 US Census to calculate the Agency for Healthcare

Research and Quality (AHRQ)'s ZIP-code based socioeconomic status (SES) index score as a proxy for patients' socioeconomic status.[4] Additionally, we acquired the Health Resources and Services Administration's Rural-Urban Commuting Area codes (RUCA) that classify geographic areas based on urbanization, population density, and daily commuting information (most recent data available for ZIP codes, 2006).[5]

Population

43,400 Medicare beneficiaries met our inclusion criteria, i.e. were ≥18 years residing in the 50 U.S. states with continuous enrollment in Medicare Parts A and B during 2009 and had at least 1 outpatient office visit to a rheumatologist. We excluded 1,707 (3.9%) beneficiaries whose ZIP codes were not identified in the AHRQ ZIP-code based SES index data set or by Google Maps. Our final sample included 41,693 Medicare beneficiaries.

Outcome

The outcome of interest was beneficiaries travel time to an outpatient rheumatology office visit. Using SAS and Google Maps, we estimated driving time from the center of a beneficiary's home ZIP code to the center of the rheumatologist's office ZIP code.[6] If a beneficiary had more than one visit to a rheumatologist, we used the ZIP code of their most frequently-seen rheumatologist during the study period. We dichotomized travel time ≥ 90 minutes vs. less than 90 minutes; this represents one-way travel time, with an equivalence round trip travel time of ≥ 3 hours vs. less than 3 hours. We chose the cut point of traveling ≥ 90 minutes because this represents the amount of time that likely requires a patient to spend a full day on a doctor's visit.

Covariates

We grouped covariates into 3 categories: individual beneficiary characteristics, area-level characteristics including rheumatology workforce supply, and health care market characteristics.

Beneficiary characteristics—Beneficiary-level sociodemographic characteristics included age, sex, race/ethnicity and receipt of a Medicare buy-in program (yes/no) for eligible beneficiaries with limited income.

Area-level characteristics

Socioeconomic status: We calculated each beneficiary's ZIP-code based socioeconomic status using their 5-digit ZIP code and an index score developed by the Agency for Healthcare Research and Quality.[4] AHRQ developed the SES index specifically for use with Medicare data because Medicare files lack person-level SES data. The index is based on the beneficiary's zip code of residence and includes the following 7 Census variables: percentage of people in the labor force who are unemployed, percentage of people living below poverty level, median household income, median value of owner-occupied dwellings, percentage of people ≥25 years of age with less than a 12th-grade education, percentage of people ≥25 years of age completing ≥4 years of college, and percentage of households that

average ≥1 people per room. Higher index scores indicate higher SES. Our calculations of the AHRQ SES index were based on Census 2000 variables.

Rheumatology workforce supply: We calculated the number of rheumatologists per total number of residents for each Hospital Service Area represented in our sample of beneficiaries. A Hospital Service Area (HSA) is a geographic area defined by the local health care market for hospital care.[7] For each HSA, we counted the number of unique rheumatologists who filed claims for one or more Part B services during an outpatient ambulatory encounter in 2009. We divided this count by the total resident population of the HSA (data obtained from Dartmouth Atlas) to determine the number of rheumatologists per 100,000 residents. We then categorized HSA into 3 rheumatology supply categories: the first category included HSAs with no rheumatologists. The remaining HSAs were split into 2 categories at the median value: HSA with a supply of less than 0.65 rheumatologists per 100,000 residents, and HSAs with ≥ 0.65 rheumatologists per 100,000 residents.

Rural/urban status: To control for effects of urban/rural population density at the ZIP-code level, we categorized beneficiary ZIP code using rural-urban continuum codes that were developed by the Economic Research Services of the Department of Agriculture in collaboration with the Rural Health Research Center at the University of Washington.[8] We collapsed 10 possible Rural-Urban Commuting Area (RUCA) Code categories (ranging from “Metropolitan area core: primary flow within an urban area” to “Rural areas: primary flow to a tract outside an urban area or urban cluster (including self)) into 4 categories (“Metropolitan,” “Micropolitan,” “Small town,” and “Rural areas”) due to sample size limitations. We used this variable to account for baseline travel patterns that are likely to exist even if the density of rheumatologists (supply per 100,000 residents) were equitable across different geographic areas.[9]

Healthcare utilization intensity: We attempted to capture other, regional factors besides provider supply and distance to providers that could affect referral patterns to rheumatologists. For example, several studies suggest that geographic variations exist in the intensity of diagnostic testing and referrals to specialty providers that are unrelated to underlying patient characteristics.[10,11,12] Medicare reimbursement rates which have been adjusted for age, gender, race, and regional price differences, have been reported to correlate with the intensity of health care utilization in a region.[13] Thus, to account for this effect, we used the Dartmouth Atlas of Health Care’s Medicare reimbursement rates that are adjusted for age, sex, race and regional differences in prices.

Geographic division: To describe which regions had the highest proportion of beneficiaries travelling long distances, we categorized beneficiaries by location into 9 geographic census division (New England, Mid-atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific).

Diagnoses associated with rheumatology office visits

For use in a secondary analysis, we obtained the diagnosis codes associated with claims to a beneficiary’s most frequently-seen rheumatologist. We assigned one diagnosis code per

beneficiary in three ways: 1. Diagnosis code associated with the first annual claim to the rheumatologist; 2. Diagnosis code associated with a random claim to the rheumatologist; 3. Most frequently listed diagnosis code among all claims to their rheumatologist. We then grouped these ICD9 codes according to Clinical Classification Software (CCS) codes, a categorization scheme that allows multiple ICD9 codes to be collapsed into a smaller number of clinically meaningful categories.[14]

Statistical analysis

We examined predictors of travel time ≥ 90 minutes in a series of generalized linear mixed models with logit link function that accounted for the cluster of beneficiaries by rheumatologist practice. All variables were tested for non-colinearity. Models were fit by adding groups of potential predictors – Model 1 included individual beneficiary characteristics. Model 2 included all variables from Model 1 with the addition HSA-level rheumatologist supply, ZIP-code based RUCA category, and ZIP-code based SES. Model 3 included all variables from Model 3 with the addition of HSA Medicare reimbursement rate. Multicolinearity diagnostics were run for all variables included models (including Tolerance, Variance Inflation Factor (VIF), and Condition Index), which showed no indication of multicolinearity (VIF ranged from 1.00 to 1.37; Condition Index = 16.7).

However, geographic division and rural/urban status could not be included in the same model because of multicolinearity. Therefore, we fit a final model (Model 4) that was identical to Model 3 except that it replaced RUCA status with U.S. geographic division in order to allow conclusions about regional differences in travel times.

In order to facilitate interpretation, all adjusted results were presented as adjusted proportions (with 95% CI) – these represent the proportion of patients at each variable category with a travel time ≥ 90 minutes, as calculated from the parameter estimates from the models described above. We assessed model fit using the C statistic calculated from logistic regression models. Finally, we performed sensitivity analyses with travel time dichotomized at ≥ 60 minutes vs. less than 60 minutes. In a secondary analysis which focused on the diagnostic codes associated with rheumatology visits, we compared the most common diagnosis codes according to travel time using chi-squares in order to see if patients with long travel times differed in their diagnoses from those with shorter travel times. Analyses and the mapping were performed using SAS statistical software (version 9.2; Cary, North Carolina).

Results

41,693 Medicare beneficiaries across 3,436 HSAs saw 3,598 unique rheumatologists during 2009. The median beneficiary travel time to a rheumatologist was 22 minutes (interquartile range (IQR) 12–40 minutes), corresponding to a median distance travelled of 9.3 miles (IQR 4–22 miles). 2,978 beneficiaries (7%) travelled 90 minutes or longer to visit a rheumatologist. Figure 1 shows a histogram of travel times for all included beneficiaries. Table 1 describes the unadjusted sociodemographic characteristics of all included beneficiaries Most patients were elderly, female, and white and saw a rheumatologist an average of 3.4 (SD 2.8) times during 2009. Table 2 describes the unadjusted area-level

characteristics for individual beneficiaries. Beneficiaries lived in HSAs with, on average, 0.61 rheumatologists per 100,000 residents. Most lived in metropolitan areas and on the east coast (South and Middle Atlantic). In order to explore the effects of geography on travel time we aggregated beneficiaries into hospital service areas (HSAs). Figure 2 shows a map of the U.S. in which shaded HSAs represent areas where the mean travel time to a rheumatologist was ≥ 90 minutes. Next, we tabulated the proportion of patients in a given HSA travelling ≥ 90 minutes to a rheumatologist, stratified according to RUCA category and rheumatologist supply category (Figure 3). The effect of rural/urban status was similar across the 3 categories of rheumatologist supply: the most rural areas had consistently higher proportions of patients travelling ≥ 90 minutes. There was a "dose dependent" effect in all 3 supply categories – as the level of urbanity increased (moving left to right within each supply stratum), the proportion of beneficiaries travelling ≥ 90 minutes decreased. Still, the largest number of patients with long travel times lived in metropolitan areas. Interestingly, 17% of patients in HSAs with no rheumatologists (1,798/10,431) had travel times ≥ 90 minutes compared with 3% (516/15,634) and 4% (663/15,627) in low and high supplies, respectively.

Table 3 shows the results of unadjusted analyses and a series of multivariate models that adjust for both individual and area-level characteristics. We reported the adjusted proportions, i.e., the percent of beneficiaries in each variable category who had a travel time ≥ 90 minutes. Model 1 shows results adjusting for individual characteristics only. Model 2 includes the key geographic variables of rheumatologist supply and rural/urban status: even after accounting for individual characteristics, 13% (95% CI (12%, 15%)) of beneficiaries residing in HSAs with no rheumatologists travelled ≥ 90 minutes for rheumatology care. Model 2 also reveals the independent effects of the other covariates on travel time. Even after adjusting for other factors, beneficiaries of younger age and white race were slightly but significantly more likely to travel ≥ 90 minutes to see a rheumatologist. Additional adjustment for overall healthcare utilization (via Medicare reimbursement rates) in Model 3 did not materially change these estimates. Similarly, a sensitivity analysis using ≥ 60 minutes as the travel time cutoff showed essentially unchanged parameter estimates (data not shown).

In order to confirm the pattern suggested by Figure 2, in which shaded areas were clustered in the Mountain region, we fit Model 4, which included all individual-level factors as well as supply of rheumatologists, Medicare reimbursement rate, and U.S. geographic division (but not RUCA category, which was excluded due to multicolinearity). Model 4 revealed that the Mountain division was by far the area with the highest proportion of beneficiaries with long travel times (0.13, 95% CI (0.11, 0.16)), followed by West North Central Midwest 0.06 (0.05, 0.06) and West South Central 0.05 (0.04, 0.06). The South Atlantic and Middle Atlantic had the lowest proportion of beneficiaries with long travel times (at 0.02 (0.02, 0.03). A list of the poorest access HSAs are listed in Appendix 1.

Finally, as a secondary analysis, we determined the most frequent diagnosis codes associated with a rheumatologist office visit among the included beneficiaries. Rheumatoid arthritis was the most common diagnosis code (included in 29.8% beneficiaries' visits). Osteoarthritis (18.7%) and other connective tissue diseases (10.7%) accounted for the next 2

most frequent sets of codes. Beneficiaries traveling ≥ 90 minutes were more likely to have a code for rheumatoid arthritis compared with those travelling less (38.8% vs. 29.1%, p <. 0001). First diagnosis, random diagnosis, and most frequent diagnosis analyses showed no significant differences.

Discussion

In this study of Medicare beneficiaries, we found that a small but significant proportion of patients in the U.S. travelled long distances to visit a rheumatologist. Of the 7% of patients who travelled at least 90 minutes to their rheumatologist, many resided in areas with no or low supplies of rheumatologists. To our knowledge, this is the first study to assess travel times to rheumatologists at a population level in the U.S. A study from the American College of Rheumatology Committee on Rheumatology Training and Workforce Issues documented the regional distribution of rheumatologists across the U.S. but did not use patient claims to measure actual travel times.

Although living in an area with a low supply of rheumatologists was a critical determinant of long travel times, other factors, including being male, white, and living in lower-SES areas were also important. Other studies of rheumatology care have reported similar findings. One analysis of driving distances to rheumatologists among Medicare beneficiaries with rheumatoid arthritis found similar patterns across sex and race.[3] A study from Ontario, Canada, that examined variations in visits to rheumatologists found that in addition to rheumatologist supply, area-level SES was a key factor in access to care.[15]

We identified the Mountain region in the U.S. as the area in which the proportion of beneficiaries with long travel times was especially high. A recent nationwide study of supply of gastroenterologists and radiation oncologists reported similar findings.[9] Addressing shortages in rheumatology care for patients in low-supply areas is likely to improve access and potentially improve patient outcomes.[3] Strategies might include increasing the number of rheumatologists willing to live in rural areas through loan forgiveness, recruiting medical students and residents whose homes or families are in rural locations to pursue rheumatology, or training primary care or non-physician providers to deliver musculoskeletal care. Telemedicine, video conferencing, or otherwise improving access to existing practices, such as extending hours, may also play important roles in reducing travel times and thus improving access.[16,17,18] Interestingly, we found that some beneficiaries living in high-supply areas also traveled long distances to see a rheumatologist. Although more research is needed, we suspect that several factors may explain this paradox, including tertiary care referral patterns, patient preferences for particular, far-away clinicians, or lack of acceptance of public insurance. Our analysis of diagnosis codes also suggests that patients referred for suspected rheumatoid arthritis are more likely than others to travel long distances for consultation. This is not surprising given the documented discomfort of primary care physicians in managing rheumatoid arthritis.[19] Additional explanations could include increased pain or disease severity among these patients, which we were unable to measure.

Our study has several limitations. We measured rheumatologist supply by tabulating the number of rheumatologists with claims in our sample during 2009, so some rheumatologists may not have been included. However, our data accounted for 3,685 unique rheumatologists compared to 3,920 rheumatologists registered in the 2010 American College of Rheumatology membership directory, a difference of less than 10%. The calculated driving time may not represent true travel time for a variety of reasons, including beneficiaries or physician locations being far from the geographic center of ZIP codes employed in the analysis, or beneficiaries travelling via public transportation. Patients with low SES may be more likely to travel via public transportation, so we may have underestimated travel times for these patients, although this would bias our results toward the null.[20] We were not able to account for primary care or other provider types that may have offered care for rheumatologic or other musculoskeletal complaints. Not all data sources were available for the same time periods as our Medicare sample (2008–2009) – for example, we used Census 2000 for the ZIP-code based SES variable, and 2006 data for RUCA categories. However, because ZIP-based SES is relatively stable over time[21] and because our analysis collapsed these variables into tertiles or quartiles, we believe it is unlikely that this introduced any systematic bias in our analyses. Finally, we did not assess beneficiaries with non-Medicare insurance, so our findings may not be generalizable to patients with other sources of insurance.[22]

In conclusion, this study confirms that a small but significant proportion of patients in the U.S. have long travel times to visit a rheumatologist, and that the most important determinant of long travel times was supply of rheumatologists. Future studies should assess whether other factors such as physician participation in health plans, tertiary care referral patterns, proximity to an academic center, or patient preferences affect choice of physician and hence travel time to rheumatologists.[23] Assessing the best methods for attracting and retaining rheumatologists to low-supply areas and providing high quality care to rural beneficiaries will be crucial challenges for policy-makers and professional societies.

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References

1. American College of Rheumatology Committee on Rheumatology Training and Workforce Issues. FitzGerald JD, Battistone M, Brown CR Jr, Cannella AC, Chakravarty E, et al. Regional distribution of adult rheumatologists. Arthritis Rheum. 2013 Dec; 65(12):3017–25. [PubMed: 24284967]
2. Meilleur A, Subramanian SV, Plascak JJ, Fisher JL, Paskett ED, Lamont EB. Rural residence and cancer outcomes in the United States: issues and challenges. Cancer Epidemiol Biomarkers Prev. 2013 Oct; 22(10):1657–67. [PubMed: 24097195]
3. Polinski JM, Brookhart MA, Ayanian JZ, Katz JN, Kim SC, Lii J, et al. Relationships between driving distance, rheumatoid arthritis diagnosis, and disease-modifying antirheumatic drug receipt. Arthritis Care Res (Hoboken). 2014 Nov; 66(11):1634–43. [PubMed: 24664991]
4. Bonito, AJBC.; Eicheldinger, C.; Carpenter, L. Creation of new race- ethnicity codes and socioeconomic status (SES) indicators for medicare beneficiaries. 2008. ch 3

5. http://depts.washington.edu/uwruca/ Accessed on 11/4/2014
6. http://www.sascommunity.org/wiki/Driving_Distances_and_Drive_Times_using_SAS_and_Google_Maps Accessed on 8/4/2014
7. http://www.dartmouthatlas.org/tools/faq/researchmethods.aspx Accessed on 11/4/2014
8. United States Department of Agriculture. Measuring rurality: rural-urban commuting area codes. 2008. http://depts.washington.edu/uwruca/ruca-download.php. Accessed July 7, 2015
9. Aboagye JK, Kaiser HE, Hayanga AJ. Rural-Urban Differences in Access to Specialist Providers of Colorectal Cancer Care in the United States: A Physician Workforce Issue. JAMA Surg. 2014 Apr 16.
10. Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder EL. The implications of regional variations in Medicare spending. Part 1: the content, quality, and accessibility of care. Ann Intern Med. 2003 Feb 18; 138(4):273–87. [PubMed: 12585825]
11. Sirovich B, Gallagher PM, Wennberg DE, Fisher ES. Discretionary decision making by primary care physicians and the cost of U.S. Health care. Health Aff (Millwood). 2008 May-Jun;27(3): 813–23. [PubMed: 18474975]
12. Song Y, Skinner JS, Bynum JPW, Sutherland JM, Wennberg JE, Fisher ES. Regional variations in diagnostic practices. N Engl J Med. 2010; 363(1):45–53. [PubMed: 20463332]
13. http://www.dartmouthatlas.org/downloads/reports/PA_Spending_Report_0611.pdf Accessed on 12/25/2014
14. http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp. Accessed on 12/25/2014.
15. Badley EM, Canizares M, Gunz AC, Davis AM. Visits to rheumatologists for arthritis: The role of access to primary care physicians, geographic availability of rheumatologists, and socioeconomic status. Arthritis Care Res (Hoboken). 2014 Jul 21.
16. Poulsen KA, Millen CM, Lakshman UI, Buttner PG, Roberts LJ. Satisfaction with rural rheumatology telemedicine service. Int J Rheum Dis. 2015 Mar; 18(3):304–14. [PubMed: 25530007]
17. Jong M, Kraishi M. A comparative study on the utility of telehealth in the provision of rheumatology services to rural and northern communities. Int J Circumpolar Health. 2004 Dec; 63(4):415–21. [PubMed: 15709316]
18. Roberts LJ, Lamont EG, Lim I, Sabesan S, Barrett C. Telerheumatology: an idea whose time has come. Intern Med J. 2012 Oct; 42(10):1072–8. [PubMed: 22931307]
19. Garneau KL, Iversen MD, Tsao H, Solomon DH. Primary care physicians' perspectives towards managing rheumatoid arthritis: room for improvement. Arthritis Res Ther. 2011; 13(6):R189. [PubMed: 22098699]
20. Arcury TA, Gesler WM, Preisser JS, Sherman J, Spencer J, Perin J. The effects of geography and spatial behavior on health care utilization among the residents of a rural region. Health Serv Res. 2005 Feb; 40(1):135–55. [PubMed: 15663706]
21. Akinyemiju TF, Soliman AS, Copeland G, Banerjee M, Schwartz K, Merajver SD. Trends in breast cancer stage and mortality in Michigan (1992–2009) by race, socioeconomic status, and area healthcare resources. PLoS One. 2013 Apr 29.8(4):e61879. [PubMed: 23637921]
22. Gillis JZ, Yazdany J, Trupin L, Julian L, Panopalis P, Criswell LA, et al. Medicaid and access to care among persons with systemic lupus erythematosus. Arthritis Rheum. 2007 May 15; 57(4): 601–7. [PubMed: 17471527]
23. Patterson BM, Draeger RW, Olsson EC, Spang JT, Lin FC, Kamath GV. A regional assessment of medicaid access to outpatient orthopaedic care: the influence of population density and proximity to academic medical centers on patient access. J Bone Joint Surg Am. 2014 Sep 17.96(18):e156. [PubMed: 25232086]

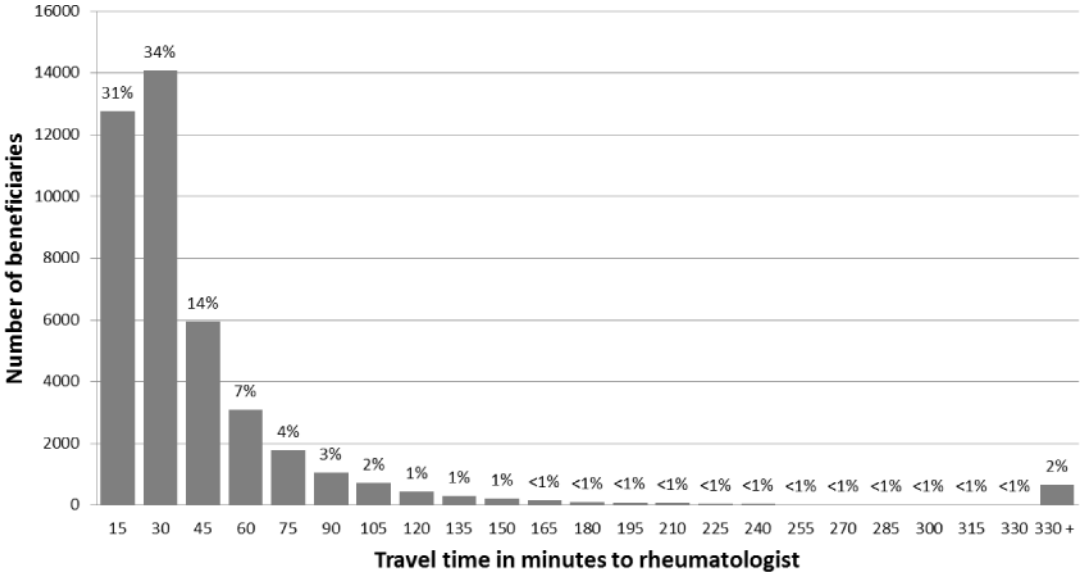

Figure 1.

Number and percent of Medicare patients with at least 1 visit to a rheumatologist vs. minutes travelled to rheumatologist in 2009.

Total number of Medicare beneficiaries included in this study was 41,693. Proportion of total number of beneficiaries in each category is designated at the top of each bar.

Figure 2.

U.S. Hospital Service Areas (HSAs), with shaded areas representing HSAs with mean beneficiary travel time of ≥ 90 minutes.

Shaded areas represent HSAs where the mean drive time to the rheumatologist was ≥ 90 minutes. Alaska and Hawaii were included in our analyses but not shown in this figure.

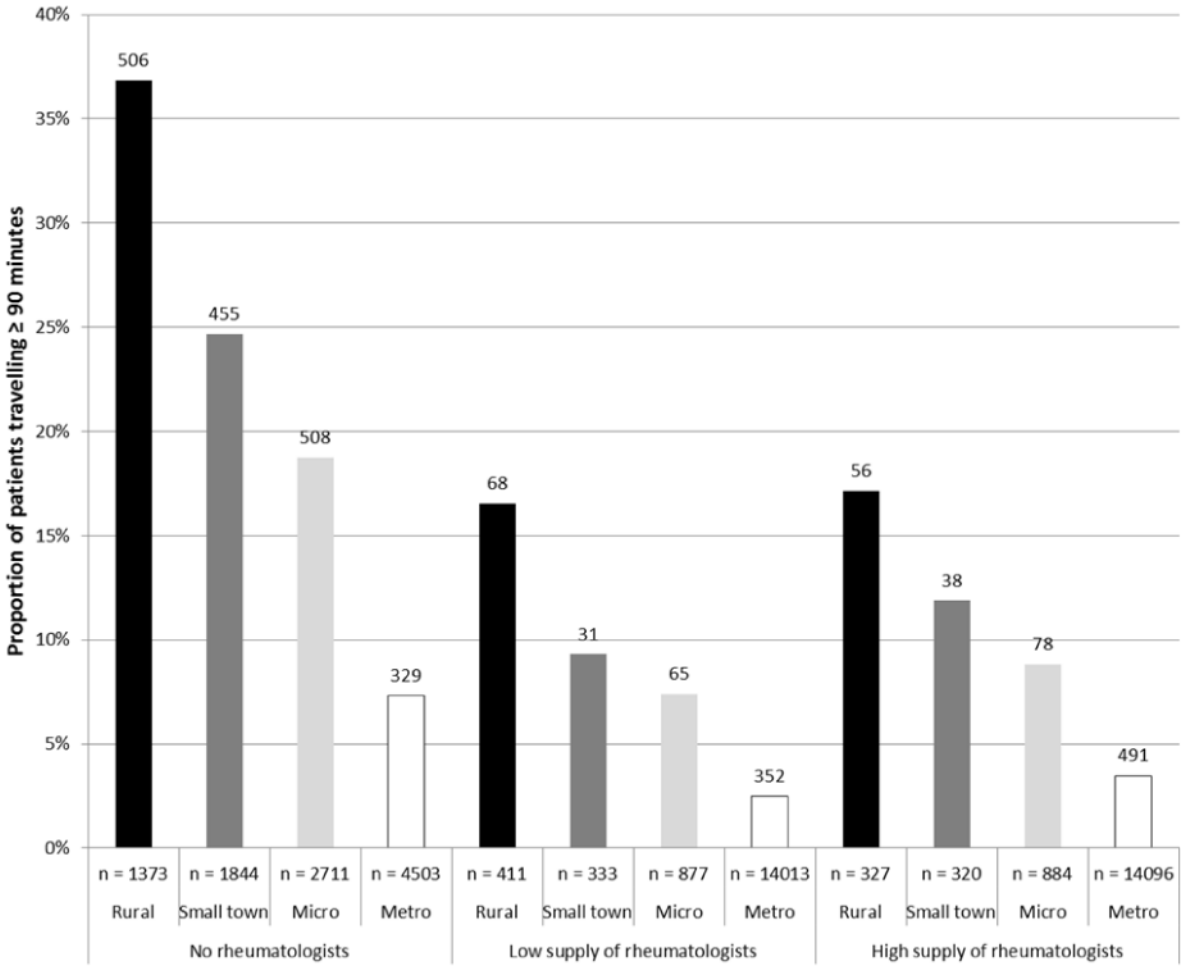

Figure 3.

Proportion of patients travelling 90 minutes or greater to visit a rheumatologist, stratified by rheumatologist supply and urban/rural status.

"Rural, small town, micro, and metro" indicate Health Resources and Services Administration's Rural-Urban Commuting Area (RUCA) code categories. "No rheumatologists" refers to HSAs with no rheumatologists; "Low supply of rheumatologists" refers to HSAs with ≤ 0.65 rheumatologists / 100,000 residents; "High supply of rheumatologists" refers to HSAs with > 0.65 rheumatologists/100,000 residents. N's on the x-axis refer to denominator of beneficiaries in each supply – RUCA category. Data labels at the top of each bar indicate the numerator of beneficiaries travelling ≥ 90 minutes to a visit with a rheumatologist.

Table 1

Characteristics of entire sample of Medicare beneficiaries, stratified by travel time to outpatient rheumatology office visits.

Characteristics, n(%)	Entire sample n = (41,693)	< 90 minutes n = (38,715)	≥ 90 minutes n = (2,978)
Age, mean (SD)	73.3 (10.4)	73.3 (10.4)	71.2 (10.8)
Age category (years)			
18–64	6134 (15)	5601 (14)	533 (18)
65–74	15753 (38)	14487 (37)	1266 (43)
≥75	19806 (48)	18627 (48)	1179 (40)
Women Race/ethnicity category	33042 (79)	30794 (80)	2248 (75)
White	36078 (87)	33353 (86)	2725 (92)
African American	3782 (9)	3658 (9)	124 (4)
Hispanic	785 (2)	729 (2)	56 (2)
Asian	440 (1)	425 (1)	15 (1)
Other	608 (1)	550 (1)	58 (2)
Proportion with state buy-In	6319 (15)	5894 (15)	425 (14)
Number of rheumatology office visits, mean (SD)	3.4 (2.8)	3.4 (2.8)	2.8 (2.0)
Driving distance in miles, median (SD)	9.2 (49.4)	8.3 (14.2)	102.8 (111.4)
Travel time in minutes, median (SD)	22.0 (52.9)	20.0 (19.1)	136.0 (102.5)

Table 2

Area-level characteristics of entire sample of Medicare beneficiaries, stratified by travel time to outpatient rheumatology office visits.

	Entire sample n = (41,693)	< 90 minutes n = (38,715)	≥ 90 minutes n = (2,978)
ZIP-based SES indicator[a], mean (SD)	51.1 (4.0)	51.2 (3.9)	49.4 (3.7)
ZIP-based SES indicator[a], category			
Tertile 1 (low)	13900 (33)	12343 (32)	1557 (52)
Tertile 2	13895 (33)	12984 (34)	911 (31)
Tertile 3 (high)	13898 (33)	13388 (35)	510 (17)
Supply of rheumatologists in beneficiary HSA[b], category			
None	10432 (25)	8633 (22)	1799 (60)
>0 – < 0.65	15634 (38)	15118 (39)	516 (17)
≥0.65	15627 (37)	14964 (39)	663 (22)
Rural-Urban Area category of beneficiary ZIP code[c]			
Rural	2111 (5)	1481 (4)	630 (21)
Small Town	2497 (6)	1973 (5)	524 (18)
Micropolitian area	4472 (11)	3821 (10)	651 (22)
Metropolitan area	32612 (78)	31440 (81)	1172 (39)
Medicare reimbursement rate of beneficiary HSA[d], mean $ (SD)	9668 (1570)	9701 (1557)	9243 (1671)
Medicare reimbursement rate of beneficiary HSA[d], category			
Quartile 1 (low)	10385 (25)	9228 (24)	1157 (39)
Quartile 2	10416 (25)	9807 (25)	609(20)
Quartile 3	10488 (25)	9906 (26)	582 (20)
Quartile 4 (high)	10404 (25)	9774 (25)	30 (21)
US geographic division of beneficiary ZIP code			
New England	2515 (6)	2388 (6)	127 (4)
Middle Atlantic	6474 (16)	6278 (16)	196 (7)
East North Central Midwest	6419 (15)	6111 (16)	308 (10)
West North Central Midwest	2436 (6)	2074 (5)	362 (12)
South Atlantic	10509 (25)	9966 (26)	543 (18)
East South Central	3054 (7)	2794 (7)	260 (9)
West South Central	4635 (11)	4115 (11)	520 (17)
Mountain	1724 (4)	1329 (3)	395 (13)
Pacific	3927 (9)	3660 (9)	267 (9)

[a] Values refer to the Agency for Healthcare Research and Quality's socioeconomic (SES) indicator variables based on ZIP code.

[b] Values refer to number of Medicare Fee-for-service rheumatologists per 100,000 residents per Hospital Service Area.

[c] Values refer to the Health Resources and Services Administration's Rural-Urban Commuting Area (RUCA) codes.

[d] Values refer to the Dartmouth Atlas of Health Care's Medicare Reimbursement rate. Reimbursement rates are calculated from Medicare claims files for fee-for-service patients enrolled in Medicare Parts A and B. The rates are adjusted for the age, sex and race of the underlying Medicare population and for regional differences in prices.

Table 3

Unadjusted and adjusted proportions of Medicare beneficiaries travelling ≥ 90 minutes to visit a rheumatologist (row percents).

	Characteristics	Unadjusted proportion (95% CI)	Adjusted Proportion (95% CI)[¥]		
			Model 1	Model 2[§]	Model 3[§]
Individual-level factors	Age				
	18–64 (ref)	0.09 (0.08, 0.09)	0.08 (0.07, 0.09)	0.09 (0.08, 0.11)	0.09 (0.08, 0.10)
	65–74	0.08 (0.08, 0.08)	0.07 (0.06, 0.07)*	0.08 (0.07, 0.09)*	0.08 (0.07, 0.09)*
	≥75	0.06 (0.06, 0.06)*	0.05 (0.04, 0.05)*	0.07 (0.06, 0.08)*	0.07 (0.06, 0.07)*
	Sex				
	Male (ref)	0.08 (0.08, 0.09)	0.07 (0.06, 0.08)	0.08 (0.07, 0.10)	0.08 (0.07, 0.09)
	Female	0.07 (0.07, 0.07)*	0.06 (0.05, 0.06)*	0.08 (0.07, 0.09)*	0.07 (0.06, 0.08)*
	Race/ethnicity				
	White (ref)	0.08 (0.07, 0.08)	0.08 (0.08, 0.09)	0.09 (0.08, 0.10)	0.09 (0.08, 0.10)
	Non-white	0.05 (0.04, 0.05)*	0.05 (0.04, 0.05)*	0.07 (0.06, 0.08)*	0.07 (0.06, 0.08)*
	State Buy-In				
	No (ref)	0.07 (0.07, 0.07)	0.06 (0.06, 0.07)	0.09 (0.08, 0.10)	0.08 (0.07, 0.09)
	Yes	0.07 (0.06, 0.07)	0.06 (0.06, 0.07)	0.07 (0.06, 0.09)*	0.07 (0.06, 0.08)*
Area-level factors	ZIP-based SES indicator[a]				
	Tertile 1 (low; ref)	0.11 (0.11, 0.12)		0.09 (0.08, 0.10)	0.09 (0.08, 0.10)
	Tertile 2	0.07 (0.06.0.07)*		0.08 (0.07, 0.09)*	0.07 (0.06, 0.08)*
	Tertile 3 (high)	0.04 (0.03, 0.04)*		0.07 (0.06, 0.09)*	0.07 (0.06, 0.08)*
	Supply of rheumatologists in beneficiary HSA[b]				
	None (ref)	0.12 (0.12, 0.14)		0.13 (0.12, 0.15)	0.13 (0.11, 0.14)
	> 0 – < 0.65	0.02 (0.02, 0.02)*		0.05 (0.05, 0.06)*	0.05 (0.04, 0.06)*
	≥0.65	0.03 (0.03, 0.03)*		0.07 (0.06, 0.08)*	0.07 (0.06, 0.08)*
	Rural-Urban Area category of beneficiary ZIP code[c]				
	Rural (ref)	0.27 (0.24, 0.30)		0.18 (0.16, 0.21)	0.17 (0.15, 0.19)
	Small Town	0.19 (0.17, 0.21)*		0.11 (0.10, 0.13)*	0.11 (0.09, 0.12)*
	Micropolitian area	0.13 (0.12, 0.14)*		0.08 (0.07, 0.10)*	0.08 (0.07, 0.09)*
	Metropolitan area	0.02 (0.02, 0.02)*		0.02 (0.02, 0.02)*	0.02 (0.02, 0.02)*

Characteristics	Unadjusted proportion (95% CI)	Adjusted Proportion (95% CI)¥		
		Model 1	Model 2§	Model 3§
Medicare reimbursement rate of beneficiary HSA[d]				
Quartile 1 (low; ref)	0.08 (0.07, 0.08)			0.10 (0.09, 0.12)
Quartile 2	0.04 (0.04, 0.05)*			0.07 (0.06, 0.08)*
Quartile 3	0.04 (0.03, 0.04)*			0.07 (0.06, 0.08)*
Quartile 4 (high)	0.04 (0.04, 0.04)*			0.06 (0.05, 0.07)*
C statistic		0.57	0.75	0.75

¥Values represent the adjusted proportion of patients travelling ≥ 90 minutes at each variable level (row percents). In each column, proportions were adjusted for the variables listed; additionally, Models 2 and 3 adjust for clustering of patients within provider ZIP code. Starred values are significantly different from the other variable levels.

[a]Agency for Healthcare Research and Quality's socioeconomic (SES) indicator variables based on ZIP code.

[b]Number of Medicare Fee-for-service rheumatologists per 100,000 residents per Hospital Service Area.

[c]Health Resources and Services Administration's Rural-Urban Commuting Area (RUCA) codes.

[d]Dartmouth Atlas of Health Care's Medicare Reimbursement rate.