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Variations in radiographic procedure use for Medicare patients with rheumatoid arthritis

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Abstract

Background—In 2013, the American College of Rheumatology published its Choosing Wisely list, which identified 2 radiographic procedures (peripheral joint MRI and DXA scans) that were at risk for being overused.

Methods—We performed a retrospective cross-sectional cohort study to measure the use of peripheral joint MRI, peripheral joint x-rays, and DXA scans in a national cohort of Medicare patients with rheumatoid arthritis (RA) during 2008–2009, before the start of the Choosing Wisely campaign. Diagnoses were identified via ICD9 codes; utilization was calculated using CPT codes. Utilization was analyzed at the individual and regional level (hospital referral region (HRR)).

Results—8,051 patients with rheumatoid arthritis were included: 81% were women, mean age was 76 years. Over a 2-year period, the mean number of peripheral joint MRIs per beneficiary was 0.3 (median 0, range 0–50), peripheral joint x-rays per beneficiary was 2.6 (median 1, range 0–33), and DXA scans per beneficiary was 0.7 (median 0, range 0–11). Only 6.8% of patients received more than 1 peripheral joint MRI, and 6% of HRRs had a mean number of peripheral joint MRIs of greater than 1.

Conclusions—There is variation in the use of peripheral joint MRI, peripheral joint x-rays, and DXA scans among Medicare patients with rheumatoid arthritis, although only a small number of HRRs have consistently high utilization. Although we cannot judge the appropriateness of each procedure, variations in use across regions signal the need for investigations to examine potential overutilization.

Keywords

Rheumatoid arthritis; musculoskeletal imaging; health services research; population health

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

The goal of the American Board of Internal Medicine's Choosing Wisely campaign is to reduce medical services that are of questionable value or may be harmful. In 2013, the American College of Rheumatology published its Choosing Wisely list, which identified 5 tests or procedures that were perceived by rheumatologists as being overused.¹ Two out of the 5 items on this list related to radiographic procedure use: "Don't perform MRI of the peripheral joints to routinely monitor inflammatory arthritis;" and "Don't routinely repeat DXA scans more often than once every two years." These items were chosen to be on the "Top 5" list through an expert consensus process whereby items were proposed by rheumatologists and their evidence base was reviewed by an ACR Choosing Wisely Task Force. Specifically, the Task Force indicated that there is inadequate scientific evidence to support the use of serial peripheral joint MRIs to follow patients with inflammatory arthritis or short interval (<2 years) DXA scans in most patients. However, practice patterns around the use of these imaging procedures in Medicare patients with rheumatoid arthritis (RA) have not been comprehensively examined.

We sought to determine the utilization of radiographic procedures in a national cohort of Medicare patients with RA, and specifically to assess regional variation in use of MRI and DXA. Additionally, we compared the use of peripheral joint MRI to peripheral joint plain films to understand the relationship between utilization of these two modes of musculoskeletal imaging.

Methods

We performed a retrospective cross-sectional cohort study to measure the use of radiographic procedures in a national cohort of Medicare patients with RA (according to a validated, administrative definition using ICD9 codes, see below).

Data source

Claims from the 2008–2009 Medicare Part B (medical insurance) for the Medicare Chronic Condition Warehouse 5% rheumatoid arthritis/ osteoarthritis cohort were linked to the Medicare Beneficiary Summary File to determine patient sociodemographic characteristics. The 2000 US Census file was used 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.² Hospital Referral Region map boundaries files (2006 data) and HRR health care supply variables were obtained from The Dartmouth Atlas of Health Care.³

Study population

Included patients were 65 years or older who were continuously enrolled during 2008–2009 with at least 2 face-to-face claims for RA (ICD9 code 714.xx) between Jan 1 and Dec 31, 2009 and at least 1 face-to-face claim for RA (ICD9 code 714.xx) in 2008.

Primary outcomes

Number of claims for peripheral joint MRI and peripheral joint x-rays were identified via CPT codes during the 2-year study period (2008–2009). Claims for DXA scans were

similarly assessed, but only among women, in order to compare our results with previously published estimates using a 100% Medicare sample.⁴

Covariates

The cohort was characterized according to age, sex, race (white vs. non-white), Charlson comorbidity score, and counts of hospitalizations and outpatient visits, including the number of visits to a rheumatologist. Beneficiary ZIP codes were categorized according to 9 geographic census divisions (New England, Mid-atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific).

Analysis

We performed analyses at the level of the individual beneficiary and the regional level (hospital referral region (HRR)). In the individual-level analysis, counts were calculated for any peripheral joint MRI, plain film, or DXA per beneficiary and reported means, medians, and ranges for these outcomes. In addition, we reported the proportion of beneficiaries with more than 1 peripheral joint procedure and the proportion of beneficiaries with more than 1 peripheral joint procedure performed on the same joint.

To assess regional variation, we calculated mean procedure use per beneficiary aggregated by HRR. Mean of means and ranges of means for HRRs and the proportion of HRRs where the mean number of procedures per beneficiary was greater than 1 were reported. HRRs with fewer than 10 beneficiaries in this cohort were excluded from the analysis. Because some of the variation seen across HRRs could have been due to differences in patient case mix, we used a previously described method to adjust for case mix by calculating a directly standardized adjusted procedure count per beneficiary for each HRR, defined as the predicted procedure count per beneficiary for each HRR if every HRR had the same distribution of beneficiary characteristics.⁵ Case mix adjustments included variables for age, sex, and Charlson score. Correlations of utilization rates for different procedures within an HRR were examined, as were correlations with other measures of health care supply, including supply of physicians, supply of rheumatologists, supply of orthopedists, and supply of radiologists. Finally, we used the mapping function in SAS to create U.S. maps showing different levels of utilization, defined by the proportion of beneficiaries within the HRR with more than 1 peripheral joint MRI, more than 1 peripheral joint x-ray, and more than 1 DXA scan performed during the study period.

Statistical tests were 2-sided with $p < .05$ considered statistically significant. All analyses were performed using SAS (version 9.2, Cary, NC.). This study protocol was approved by the Institutional Review Boards of Stanford University and the University of California—San Francisco and by the CMS Privacy Board; an exemption to informed consent was granted because the dataset used was de-identified.

Sensitivity analyses

We performed several sensitivity analyses to test the robustness of these findings. We identified a set of ICD9 codes that would suggest some form of urgent or repeated musculoskeletal imaging – for example bone infections or fractures (see Appendix A). MRI

and x-ray analyses were repeated excluding procedures performed on the same day as a claim for one of these codes. In addition, in separate analyses, procedures performed 30 days before or 30 days after a visit with an orthopedic surgeon were excluded. These 3 sensitivity analyses were repeated, but this time excluding any patient (and therefore all of his or her procedures) with a procedure on the same day as a diagnosis listed in Appendix A or with a procedure 30 days before or 30 days after a visit with an orthopedic surgeon. In a final analysis, the original cohort was restricted to only patients who had at least 1 visit to a rheumatologist.

Results

We included 8,051 patients with rheumatoid arthritis in this analysis: 81% were women, mean age was 76 years, and 16% were non-white. Mean Charlson score was 1. Patients were widely distributed geographically, with the greatest number of patients residing in the South Atlantic division (20.1%). Additional characteristics are listed in Table 1.

Figure 1 shows the count distribution for the 3 types of procedures at the individual beneficiary level. Table 2 describes this utilization in greater detail: Over a 2-year period, the mean number of peripheral joint MRIs per beneficiary was 0.3 (median 0, range 0–50). One thousand and sixty two (13.1%) patients received at least 1 peripheral joint MRI and 548 (6.8%) patients received at least 2 peripheral joint MRIs. Almost all of these (518) received at least 2 MRIs on the same joint (range of same joint MRIs 2–26; mean (SD) 3.5 (2.8)). During the same period, 3,828 (47.5%) patients received at least 2 peripheral joint plain films. Again, the majority of these (3,340) received these on the same joint.

DXA was assessed only among female patients (N=6,545). Over a 2-year period, the median number of DXAs performed was 1, with a range of 0–11. 13.4% of women received more than 1 DXA scan during the 2-year study period.

Table 3 shows the utilization of 3 types of procedures at the regional level (HRR). 225 HRRs were included in the analysis with the mean number of beneficiaries per HRR of 33 (standard deviation 31). The mean for the number of peripheral joint MRIs across HRRs was 0.3 (SD 0.4 range 0–2) and mean for the number of peripheral joint x-rays was 2.6 (SD 1.0 range 0.5–7). There were 6% of HRRs where the mean for peripheral joint MRIs was greater than 1 and 47% with a mean for peripheral joint x-rays of greater than 1. Coefficients of variation were high (127 and 47 respectively). Estimates adjusted for case mix (age, sex, Charlson score) were not meaningfully different from unadjusted estimates (data not shown). HRR utilization was highly correlated across different procedure types; i.e., HRR with high rates of peripheral joint x-rays also had high rates of peripheral joint MRIs ($p<0.001$) and higher rates of DXA scans ($p=0.01$). Analyses to examine variables associated with high utilization, such as supply of physicians, specialists, radiologists, or other measures of utilization such as number of outpatient visits did not reveal any clear associations (data not shown).

Finally, in order to assess geographic patterns for HRR utilization, we calculated the proportion of beneficiaries in each HRR with more than 1 peripheral joint MRI (range 0–

41%), more than 1 peripheral joint x-ray (range 6–78%), and more than 1 DXA scan (range 0–72%) performed during the study period. These are mapped in Figures 2A – C. Of the HRRs with high utilization for both peripheral joint MRIs and peripheral joint x-rays (n=18), 28% were located the West South Central region and 22% in the South Atlantic region.

In the first set of sensitivity analyses, we excluded procedures performed on the same day as the diagnoses that would suggest a strong indication for imaging – for example, bone infections or fractures (see Appendix A). In the second set of sensitivity analyses, we excluded procedures performed 30 days before, or 30 days after, a visit to an orthopedic surgeon. As expected in all of these analyses, the mean number of peripheral joint MRIs or x-rays per beneficiary dropped. This change was most dramatic when procedures the 30 days after a visit to an orthopedic surgeon analysis were excluded: the mean number of peripheral joint MRIs for this group was 0.24 with only 4.8% of beneficiaries receiving at least 2 peripheral joint MRIs; the mean number of peripheral joint x-rays was 1.68 with 35% of beneficiaries receiving at least 2 peripheral joint x-rays. At the HRR level, if procedures in the 30 days after a visit to an orthopedic surgeon were excluded, 4.2% of HRRs had a mean number of peripheral joint MRI of greater than 1 and 34.8% of HRRs had a mean number of peripheral joint x-rays of greater than 1 (vs. 6.0% and 47.1% in the original analyses). Excluding any patient with any of the diagnoses from Appendix A or with any visit to an orthopedic surgeon within 30 days of a peripheral joint MRI or peripheral joint x-ray did not result in a meaningful change to the analyses that excluded procedures (data not shown). Lastly, restricting the analysis to patients with at least one visit to a rheumatologist (N=5445) did not meaningfully change any of the estimates (data not shown).

DISCUSSION

In this study of Medicare patients with rheumatoid arthritis, we found wide variation in radiographic procedure use across the U.S., including the 2 items identified in the American College of Rheumatology’s Choosing Wisely list - peripheral joint MRI and DXA scans. Although we cannot judge the appropriateness of each test, significant variations in use across regions suggest that these procedures may fall into the category of “supply sensitive care” and signal the need for investigations to examine potential overutilization.⁶

Few studies have described radiographic procedure utilization in patients with RA. One study of 650 RA patients based in Olmstead County, Minnesota reported that 28–35% of prevalent RA users had hand x-rays performed over a 2-year period.⁷ Our study found a somewhat higher rate of peripheral joint x-ray use over a 2-year period (47%), although this may be attributable to a higher mean age for our sample (76 years vs. 55 years). Investigators have also described an overall increase in the use of peripheral joint MRI among patients diagnosed with RA during the 10-year period from 1998–2007 compared to the 10 years prior; but specific rates of peripheral joint MRI were not reported.⁷

DXA scan use has previously been described using a national cohort of Medicare beneficiaries: 10% of DXAs reimbursed by Medicare were administered at inappropriately short intervals (less than 2 years apart) in a population of women without history of

fractures.⁸ Our study found a slightly higher rate of short-interval DXA scans (13%), perhaps because we did not exclude patients with a history of fracture or potentially because of more aggressive osteoporosis screening in this group of patients with RA, who may be more likely to be receiving glucocorticoids.

Despite significant variation in MRI use across HRRs, the absolute number of patients receiving repeated peripheral joint MRIs was small (6.8% of the study sample). In sensitivity analyses, we found a 20—40% reduction in number of peripheral joint MRIs when procedures related to specific high-risk diagnoses or orthopedics visits were excluded. In combination, these findings suggest that most of this utilization is unlikely to represent “routine monitoring of inflammatory arthritis” as defined by the ACR’s Choosing Wisely item. The small number of repeated peripheral joint MRI implies that targeted investigations of high utilization regions or hospitals may be the most efficient way to save health resources. Future research should explore factors such as physician preferences, availability of MRI machines, and financial incentives to use MRIs (eg practice-owned machines or high reimbursement rates for MRI scans) as potential explanations for high-utilization in some areas.

This is not the first example of a Choosing Wisely item where careful data analyses have revealed that an item may have less potential for cost savings than originally suspected. For example, 7 specialty professional societies identified routine preoperative stress testing before low risk surgery as an item on their Choosing Wisely lists. However, investigators subsequently found that the use of routine preoperative stress testing before low-risk surgery is very low and varied little across geographic regions.⁹ In order to improve the effectiveness of future iterations of Choosing Wisely lists and other guidelines around health care efficiency, we need robust, national health services studies to replace the use of expert consensus in the item generation phase.¹⁰

This study has several limitations, most notably that we do not know the clinical reasoning behind repeated imaging tests. It is possible that some variation was due to differences in disease severity and case mix, although we attempted to mitigate this by adjusting for case mix including the age, sex, Charlson comorbidity score. We may have overestimated the proportion of peripheral joint MRIs performed on the same joint because procedure (CPT) codes for peripheral joint MRI do not specify laterality, which would suggest that our assessment of low utilization of repeated peripheral joint MRI on the same joint represents an overestimate of actual use. Our definition for RA is not perfectly specific as we used 3 face-to-face encounters but did not include medication use in our inclusion criteria.¹¹ However, we required at least one of these encounters to take place in 2008 and 2 in 2009, which ensures that the diagnosis endured over time, and likely increases their specificity. We suspect that including patients with less severe (or no) disease, should bias our findings of variation toward the null. Furthermore, the majority of the patients we included in this cohort had at least 1 visit to a rheumatologist and therefore represent the spectrum of older patients seen by rheumatologists in the U.S. Finally, patients under 65 years old were not included in this study, so our results may not be generalizable younger patients or non-Medicare payers.

In summary, we found significant variation in the use of musculoskeletal imaging among Medicare beneficiaries with RA but the absolute number of patients with repeated procedures to be small. The finding that high utilization HRRs were consistent across all 3 procedure types suggests that studies of appropriateness and interventions targeted to those outlier regions or hospitals may be the most efficient way to reduce musculoskeletal imaging utilization in patients with RA.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Significance and innovation

- There is variation in the use of peripheral joint MRI and DXA scans among Medicare patients with rheumatoid arthritis (2 items identified by the American College of Rheumatology's Choosing Wisely campaign), although only a small number of regions have consistently high utilization.
- The small number of repeated peripheral joint MRIs and DXA scans implies that limiting their use via utilization reviews or other methods is unlikely to result in significant savings of health resources.

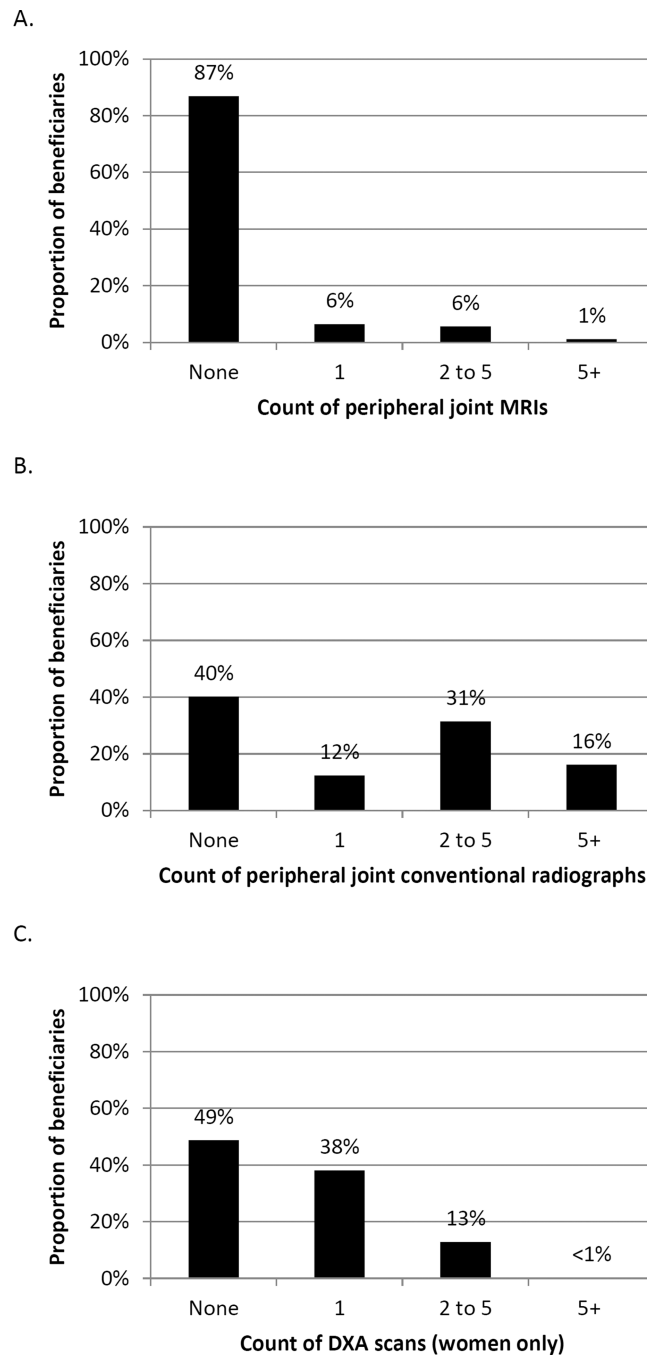
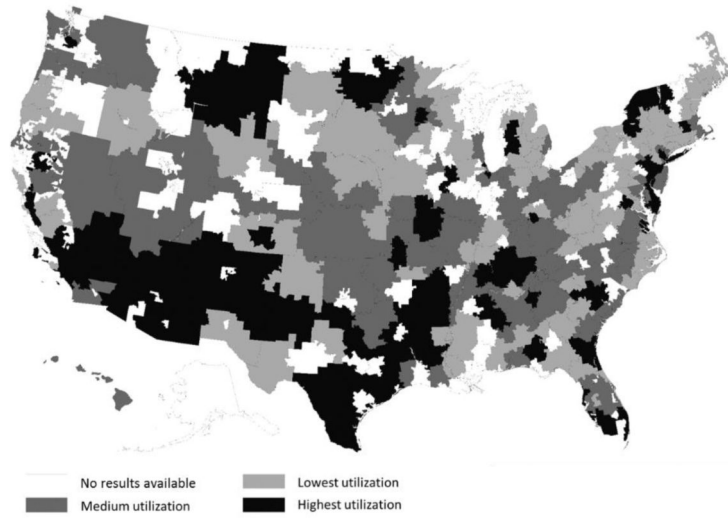


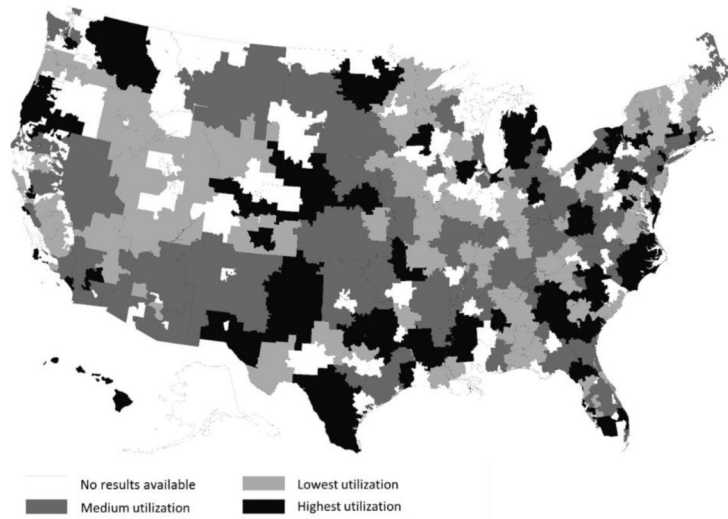
Figure 1.

Charts show distribution of radiographic procedure counts during 2008–2009 by Medicare beneficiaries with rheumatoid arthritis for (A) peripheral joint MRIs; (B) peripheral joint conventional radiographs; (C) DXA scans, among women only.

A. Map of the U.S. showing percent of Medicare beneficiaries with rheumatoid arthritis with greater than 1 peripheral joint MRI performed over a 2-year period, by Health Referral Region.



B. Map of the U.S. showing percent of Medicare beneficiaries with rheumatoid arthritis with greater than 1 peripheral joint x-ray performed over a 2-year period, by Health Referral Region.



C. Map of the U.S. showing percent of Medicare beneficiaries with rheumatoid arthritis with greater than 1 DXA scan performed over a 2-year period, by Health Referral Region.

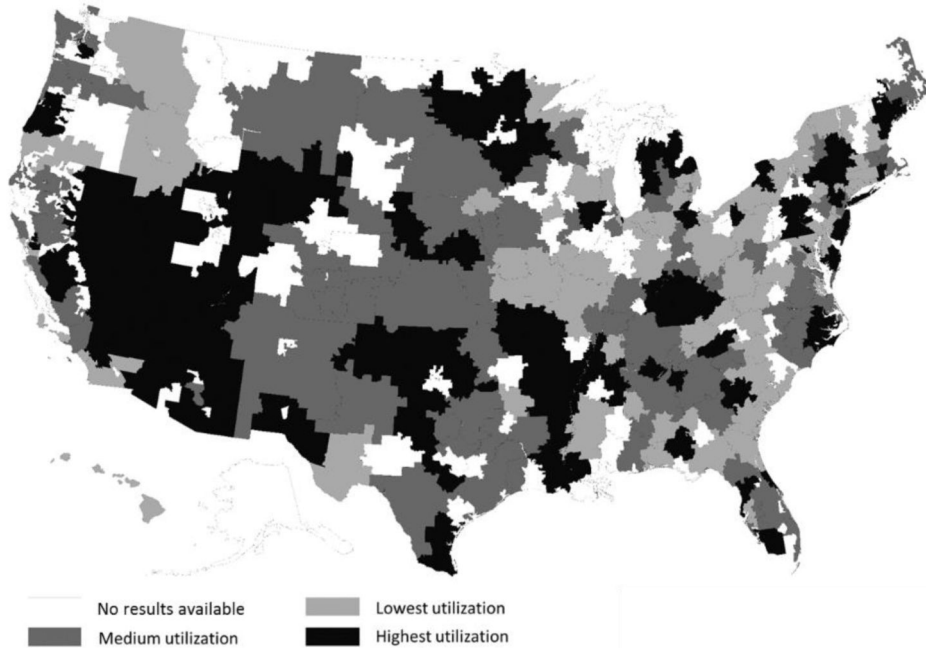


Figure 2.

Maps represent utilization of radiographic procedure according to health referral region, as defined by the Dartmouth Atlas of Healthcare.³ Each HRR is shaded according to percent of Medicare beneficiaries within that HRR with more than 1 of the specified procedures performed during the 2-year study period. Black shading (highest utilization) indicates that the HRR is in the highest tertile for this outcome; dark gray shading (medium utilization) indicates that the HRR is in the middle tertile for this outcome; light gray shading (lowest utilization) indicates that the HRR is in the lowest tertile for this outcome.; no shading indicates that results are not reported for the HRR due to small sample size (< 10 beneficiaries). Panel A (MRI): Tertile cutoffs are Lowest – 0%, Medium - 0.1 - 6.9%, Highest - 7.0 – 41%. Panel B (x-ray): Tertile cutoffs are Lowest - 6 - 40.9%, Medium - 41 – 51.9%, Highest - 52 – 78%. Panel C (DXA): Tertile cutoffs are Lowest – 0–7.9%, Medium – 8 - 14.9%, Highest – 15–72%.

Table 1

Characteristics of Medicare beneficiaries with rheumatoid arthritis.

	Total cohort (N=8051)	
	N	(%)
Female sex	6545	81.3
Age categories		
65–71	2546	31.6
72–78	2622	32.6
>=79	2883	35.8
Non-white race	1296	16.0
Charlson score		
1	5395	67.0
2	1698	21.1
>=3	958	11.9
Number of rheumatology visits		
None	2606	32.4
1 to 4	2981	37.0
>=5	2464	30.6
Number of outpatient visits		
None to 1	2444	30.4
2 to 6	2980	37.0
>= 7	2627	32.6
Number of hospitalizations		
0	6295	78.2
>=1	1756	21.8
Geographic division		
New England	380	4.7
Middle Atlantic	1163	14.5
East North Central Midwest	1160	14.4
West North Central Midwest	714	8.9
South Atlantic	1613	20.1
East South Central	585	7.3
West South Central	995	12.4
Mountain	438	5.5
Pacific	985	12.3
Missing	18	2.2

Table 2

Procedure utilization during 2008–2009 among Medicare beneficiaries with rheumatoid arthritis

	Peripheral joint MRI	Peripheral joint conventional radiograph	DXA scan
N	8051	8051	6545
Median number of procedures per beneficiary	0	1	1
Mean number of procedures per beneficiary	0.33	2.64	0.70
Range of procedures per beneficiary	0–50	0–33	0–11
N(%) with at least 1 procedure	1062 (13.1)	5093 (59.9)	3355 (51.3)
Median procedures among beneficiaries with at least 1 procedure	2	2	1
Mean procedures among beneficiaries with at least 1 procedure	2.50	4.14	1.36
N(%) with at least 2 procedures	548 (6.8)	3828 (47.5)	860 (13.4)
N(%) with at least 2 procedures on same joint*	518 (6.4)	3340 (41.4)	-

* CPT codes do not specify laterality, so some procedures “on the same joint” may represent contralateral exams

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Table 3

Procedure utilization during 2008–2009 among Medicare beneficiaries with rheumatoid arthritis aggregated by health referral region (HRR).

	Peripheral joint MRI	Peripheral joint conventional radiograph	DXA scan
Mean procedures per beneficiary, by HRR	0.30	1.20	0.70
Range of procedures per beneficiary, by HRR	0–2.3	0.5–6.6	0–2.1
% of HRRs where mean number of procedures per beneficiary was > 1	6.0	47.1	13.7
% of HRRs where mean number of procedures in same joint per beneficiary was > 1	5.7	41.3	-

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