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Quality of Care for Patients With Systemic Lupus Erythematosus: Data From the American College of Rheumatology RISE Registry

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Abstract

Objective.—Although multiple national quality measures focus on the management and safety of rheumatoid arthritis, few measures address the care of patients with systemic lupus erythematosus (SLE). Our objective was to apply a group of quality measures relevant to the care of patients with SLE, and we used the American College of Rheumatology's Rheumatology Informatics System for Effectiveness (RISE) registry to assess nationwide variations in care.

Methods.—The data derived from RISE and included patients who had ≥2 visits with SLE codes ≥30 days apart in 2017–2018. We calculated performance on 5 quality measures: renal disease screening, blood pressure assessment and management, hydroxychloroquine (HCQ) prescribing, safe dosing for HCQ, and prolonged glucocorticoid use at doses of >7.5 mg/day. We reported performance on these measures at the practice level. We used logistic regression to assess independent predictors of performance after adjusting for sociodemographic and utilization factors.

Results.—We included 27,567 unique patients from 186 practices; 91.7% were female and 48% White, with a mean age of 53.5 ± 15.2 years. Few patients had adequate screening for the development of renal manifestations (39.5%). Although blood pressure assessment was common (94.4%), a meaningful fraction of patients had untreated hypertension (17.7%). Many received

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AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Dr. Schmajuk had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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HCQ (71.5%), but only 62% at doses of ≤5.0 mg/kg/day. Some received at least moderate-dose steroids for ≥90 days (18.5%). We observed significant practice variation on every measure.

Conclusion.—We found potential gaps in care for patients with SLE across the US. Although some performance variation may be explained by differences in disease severity, dramatic differences suggest that developing quality measures to address important health care processes in SLE may improve care.

INTRODUCTION

The movement to measure quality of care in rheumatology has accelerated in the past decade, with new quality measures being developed, especially for patients with conditions such as rheumatoid arthritis and gout (1). The primary purpose of measuring and reporting quality in these conditions is to facilitate evidence-based practice that can improve patient outcomes, and to encourage the accountability of providers, health systems, and health plans. Development of quality measures for systemic lupus erythematosus (SLE) has lagged, in large part because it is a heterogenous, multiorgan-system disease with few evidence-based guidelines.

In 2009, Yazdany et al published the first set of quality indicators for patients with SLE, which addressed lupus-specific processes of care, including timely diagnosis and treatment of lupus nephritis, appropriate serologic monitoring, teratogenic drug counseling, drug toxicity monitoring, glucocorticoid management, and sun avoidance counseling (2). As evidence has grown around the comorbid conditions associated with SLE, quality measures that address cardiovascular disease, osteoporosis, and infectious risk (vaccinations) have also been considered applicable to this patient population (3). However, only 2 performance measures that address outcomes germane to patients with SLE have been tested using administrative data: in-hospital mortality and 30-day hospital readmission rate. Unfortunately, these measures are not relevant to the ambulatory setting, where most patients with SLE receive their care.

In this study, our objectives were to specify a series of quality measures for outpatients with SLE and to assess performance on these measures nationally using data from a large electronic health record (EHR)–based registry in the US.

PATIENTS AND METHODS

Quality measure specification.

We defined a series of quality measures relevant to the outpatient care of patients with SLE based on existing evidence-based recommendations and taking into account the feasibility of assessing measures using structured data from the EHR (Table 1). The first 4 were process measures addressing important features of the care of patients with SLE, including screening for renal disease and hypertension, and the universal and safe use of hydroxychloroquine (HCQ) (4-6).

We defined a single intermediate outcome measure to address blood pressure control based on an existing National Quality Forum–endorsed measure (7): for patients with at least 2

blood pressure measurements recorded, we assessed whether systolic blood pressure was >140 mm Hg or diastolic blood pressure was >90 mm Hg on at least 2 occasions and ≥30 days apart (8).

We also defined an exploratory measure around glucocorticoid use that assessed whether patients were receiving moderate- or high-dose glucocorticoids at a dose of >7.5 mg prednisone (or equivalent) daily for at least 90 days during the calendar year. The rationale for this exploratory measure was to provide clinicians with a measure that could provide insight into the proportion of patients who could meet glucocorticoid criteria for the lupus low disease activity state (LLDAS) (9).

Data source.

The data derived from the American College of Rheumatology's Rheumatology Informatics System for Effectiveness (RISE) registry. RISE is a national, EHR-enabled registry that passively collects data on all patients seen by participating practices, reducing the selection bias present in single-insurer claims databases (10). As of December 2018, RISE held validated data from 1,113 providers in 226 practices, representing approximately 32% of the US clinical rheumatology workforce.

Study population.

Patients included in this study were age >18 years and had at least 2 SLE diagnoses ≥30 days apart, during calendar year 2017 (January 1 to December 31) or calendar year 2018 (January 1 to December 31). Patients with visits in both years were only included in the analysis of 2018 data (n = 12,292). We excluded patients from practices in which laboratory data were not available (patients [n = 189]; practices [n = 28]).

Quality measure assessment in the RISE registry.

Each of the measures in Table 1 was assessed across all patients in the RISE registry who entered the study population, according to the denominator, numerator, and exclusion definitions above. In the primary analysis, renal disease screening could occur via urinalysis alone or a quantitative assessment of urine protein. In a sensitivity analysis, we required a quantitative assessment of urine protein (i.e., the numerator definition included quantitative assessment such as urine protein or a urine protein:creatinine ratio, but a patient with a urinalysis result alone would not enter the numerator). Safe HCQ dosing was defined as a dose of ≤5.0 mg/kg/day. We also examined HCQ doses of ≤6.5 mg/kg/day (see Supplementary Tables 1 and 2, available on the *Arthritis Care & Research* website at http://onlinelibrary.wiley.com/doi/10.1002/acr.24446/abstract). Patients prescribed HCQ who were missing or had an invalid weight (i.e., weight below the first percentile or higher than the 99th percentile weight of the general US population) were counted as a "No Pass" (n = 431) (11).

For the prolonged glucocorticoid use measure, prednisone equivalents included oral cortisone, hydrocortisone, prednisolone, triamcinolone, methylprednisolone, dexamethasone, and betamethasone. Pill sizes (in milligrams) were calculated based on National Drug Code codes, where available, or drug name and route, and an equivalence

dose table using prednisone as the reference. Due to the complexity of prednisone dosing, we used a commercially available tool (12) in combination with manual review to determine the total prednisone dose based on the medication instruction ("sig") fields. If a patient was given 2 prescriptions of different amounts during the same 90-day period, the total daily dose reflected the sum of the 2 amounts. If a patient was given 2 prescriptions of the same amount during the same 90-day period, this amount was considered an extension of the same prescription, so amounts were not summed. Patients with a "sig" field that only said "as directed" were assumed to be taking 1 pill once per day (n = 562), given that this dosage would likely be the most conservative (lowest dose) interpretation of the order. Patients without any glucocorticoids prescribed were considered to have a dose of "0" and counted as "Pass" for this measure. The total number of days with a dose of >7.5 mg was calculated during the calendar year; patients with ≥90 days were counted as a "No Pass" for the measure. The 90 days were not required to be continuous.

We defined a composite measure to assess performance on the combination of process measures listed in Table 1 (renal disease screening, blood pressure assessment, HCQ prescription, and safe HCQ dosing). Performance was calculated as the number of measures fulfilled divided by the number of measures for which each patient was eligible. All patients were eligible for the first 3 measures, and patients with at least 1 prescription for HCQ were assessed for all 4. Performance was aggregated by practice.

Covariates and clinical manifestations.

We extracted information on patient and practice characteristics from RISE. Patient characteristics included age, sex, race/ethnicity, insurance, number of visits during the study period, Area Deprivation Index (an area-level measure of socioeconomic status [range 1–100], with lower scores meaning higher socioeconomic status) (13), Charlson comorbidity index (based on the Deyo protocol as a measure of comorbidity [14]), and functional status measure scores (including the Multidimensional Health Assessment Questionnaire [MDHAQ], the Health Assessment Questionnaire [HAQ], and HAQ-II). Additional medication data were also extracted, including use of biologics (abatacept, belimumab, denosumab, rituximab, and other), JAK inhibitors (tofacitinib), mycophenolate or mycophenolic acid, azathioprine, methotrexate, and tacrolimus. Diagnoses were defined using International Classification of Diseases (ICD) codes for each of the following during the study period: SLE (710.0, 710.00, or M32x [except M32.0]); lupus nephritis (ICD codes 580.0–586.0 and 791.0); and end-stage renal disease (N18.6, 585.6, Z99.2, or Current Procedural Terminology code for dialysis 90951-90970) (15). We extracted information on antinuclear antibody (ANA) and anti–double-stranded DNA (anti-dsDNA) antibodies at any time prior to the measurement year; ANA and dsDNA were classified as positive if the results included "positive," "detected," or "reactive," or if titers were >1:40 for ANA or ≥1:40 for dsDNA antibodies.

Practice characteristics included practice type (single-specialty, solo practitioner, multispecialty, health system, and other), practice size (number of providers, number of eligible patients in each practice), EHR vendor, geographic division, and the number of

years contributing data to RISE. The latter variable was used to account for the possibility that data completeness may improve the longer a practice participated in the registry.

Statistical analysis.

Descriptive statistics were used to examine patient and practice characteristics. Patient-level quality measures were reported as the proportion of eligible individuals meeting criteria for the measures according to Table 1. Practice-level performance aggregated information from all patients seen within a given practice, examining the proportion of patients fulfilling each quality measure among all those eligible; interquartile ranges (IQRs) were reported. Practices reporting on <20 patients were excluded from the practice-level analyses. We used multilevel logistic regression models that included age, sex, race, insurance, Area Deprivation Index, number of visits, and geographic region to assess independent predictors of performance on each measure, accounting for clustering by practice. Analyses were performed using SAS software, version 9.4. The Western Institutional Review Board and University of California, San Francisco Committee on Human Research approved this study.

RESULTS

There were 27,567 patients with SLE included in this study. The majority (91.7%) were female, with a mean ± SD age of 53.5 ± 15.2 years (Table 2). Almost half (48%) of the patients were White, 18.8% were African American, and 9.6% were Hispanic. Most patients had private or Medicare insurance (35% and 21%, respectively), with a small number of patients on Medicaid (3.9%); a large proportion of patients had unknown insurance coverage (34%). The mean ± SD number of visits was 3.9 ± 2.7 during the study period. The median for Area Deprivation Index was 46 (IQR 25–69). Patients had a mean ± SD Charlson comorbidity index score of 1.4 ± 1.1. Overall, mean ± SD scores of MDHAQ, HAQ, and HAQ-II were 2.0 ± 2.4, 0.8 ± 0.7, and 0.8 ± 0.7, respectively. A total of 71.5% of patients were receiving HCQ, 45% receiving glucocorticoids, and 17% receiving biologics or JAK inhibitors. Other medications used are listed in Table 2. In all, 1,585 patients (5.7%) had a diagnosis of lupus nephritis and 151 (0.5%) were diagnosed with end-stage renal disease.

Among the 186 practices represented, 59.1% were single-specialty groups, followed by 26.3% solo practitioners, and 12.4% multispecialty groups (Table 3). The median number of providers per practice was 2 (range 1–35; IQR 1–5) and the median of eligible patients per practice was 104. NextGen and eClinicalWorks made up almost 60% of the EHRs used by these practices (40.3% and 17.2%, respectively).

Performance on the proposed quality measures is shown in Table 4: fewer than 40% of patients with SLE had adequate screening for renal disease. Although blood pressure screening was common (94.4%), a meaningful fraction of patients (17.7%) had undertreated hypertension. A total of 71.5% of patients had received at least 1 prescription for HCQ, and 38% were prescribed doses of >5.0 mg/kg/day. Nearly 20% of patients were receiving at least moderate-dose glucocorticoids for at least 90 days during the calendar year, signaling that they had not achieved LLDAS.

Analysis of the composite of the 4 process measures revealed that 27.7% of patients received all services for which they were eligible. Among patients with any kind of renal disease (n = 1,662), performance on the composite measure was 42.5%. As with the individual measures, we observed wide practice variation on the composite measure, ranging from 1% to 93.3% among practices reporting on at least 20 patients (Figure 1).

In a sensitivity analysis where we required a quantitative assessment of renal protein for the renal disease screening measure, overall performance was only 24.3% (6,645 of 27,369) with a practice performance median of 9.5% (IQR 0–33.9). Using this version of the renal disease screening measure resulted in a composite measure performance of 17.3%, with a practice performance median of 6.1% (IQR 0–23.5). In multilevel logistic regression models, we found that patients who were older, female, and White were less likely to receive all process measures for which they were eligible (Table 5). As expected, patients with fewer visits were less likely to receive all services.

DISCUSSION

This is the first nationwide examination of a series of electronically specified quality measures applicable to patients with SLE using a large EHR-based registry in the US. While some aspects of care were standardized across rheumatology practices, such as blood pressure monitoring, others demonstrated significant gaps in care, including moderate use of HCQ, low rates of screening for renal disease, and a significant portion of patients with uncontrolled hypertension. We also found that approximately one-fifth of patients received >7.5 mg of prednisone for >90 days, suggesting that they would not have achieved LLDAS.

The purpose of developing and assessing the measures defined here was 3-fold. First, some measures could be used for quality reporting. Existing rheumatology-specific measures address the care of rheumatoid arthritis and gout, but none specifically address SLE, a disease that disproportionately affects vulnerable populations, so including these measures is an important step in expanding quality programs. Second, there has been at least 1 study linking performance on process measures with reduced damage in SLE, so improving performance on these measures may reduce damage going forward (16). Third, some measures, especially the blood pressure control and prolonged glucocorticoid use measures, could be used for population health management across clinics or health systems and may facilitate the creation of tools that can be used directly to improve care. For example, implementing the prolonged use of the glucocorticoids measure in the RISE registry dashboard would facilitate the creation of reports showing lists of patients who may need closer follow-up or more aggressive glucocorticoid management plans.

We demonstrated the feasibility of assessing these measures by extracting information from structured fields in the EHR. Abstracting information about tests for urine protein, blood pressure and weight values, and medication doses was possible through structured EHR data fields. Calculations of prednisone dose presented a significant challenge, as this calculation required extraction of information from the medication instruction field (“sig”) where available, and many instructions read only “as directed.” To accomplish this calculation at scale and in real time, alternate methods that estimate dose based on the

number of pills dispensed might be easier, although such a method could sacrifice accuracy (17). Future work should test a variety of methods to accurately extract this information, including creating more standardized instruction options or having standardized fields where a clinician can designate whether a patient is receiving >7.5 mg prednisone/day at any given visit. We did not attempt to assess measures such as vaccination status, HCQ eye screening, or lipid monitoring. The feasibility of extracting this information, which may not be routinely documented in the rheumatology EHR at all, or captured only in the text of the clinical note, was substantially lower than those measures we did focus on. Future work should address these additional, important features of SLE care.

We observed significant variations in care across patients and practices. We found that patients who were older, female, and White were less likely to receive all services for which they were eligible, which likely reflects less intensive monitoring of patients with mild disease. Interestingly, practice variation in performance on the composite measure was not completely explained by these differences in patient case mix (unadjusted performance range 0–100%; adjusted performance range 3–63%) and may be due to differences in care provided, in documentation, or in workflows across practices. Although our data strongly suggest that there is a significant gap in the care of patients with SLE, the magnitude of the gap may be smaller than is reported here, reflecting inadequate EHR documentation. For example, some patients may have been screened or monitored for lupus nephritis or hypertension by clinicians outside the rheumatology practice, in which case these data would not have entered the participating rheumatologist's EHR. Work linking RISE data to administrative claims (e.g., Medicare claims) is ongoing and will improve our understanding of the magnitude of this underestimation. Nevertheless, most patients with SLE with access to rheumatology care (i.e., all patients included in this study), are likely to have HCQ prescribed by their rheumatologist.

Our finding that 70% of patients have at least 1 prescription for HCQ during the calendar year is similar to other recent reports of HCQ use, even among patients seeing a rheumatologist (18-20). Ultimately, inclusion of these quality measures in the RISE dashboard (or, potentially, in national pay-for-performance programs) will necessitate agreement from relevant stakeholders that these aspects of care are important to measure and improve. Moreover, improvement in these aspects of care will require accurate assessment of these measures, which may entail changes to documentation workflows at the practice level, and for RISE practices, more customized mapping of data elements by the registry clinical informatics team.

Most prior studies of quality of care in SLE have examined care for SLE outside of the specialty care setting. In these studies, racial/ethnic minorities were less likely to access subspecialty care for SLE, and those with low socioeconomic status were more likely to travel long distances to see a rheumatologist (21). Moreover, those with no health insurance were less likely to receive high-quality care (22). In the Medicaid population, those with low socioeconomic status were less likely to receive timely care for lupus nephritis and less likely to receive HCQ (17). We did not see previously observed differences in RISE data, suggesting that the largest sociodemographic disparities in health care may occur prior to patients accessing rheumatology care. Whether these observations remain consistent when

more academic medical centers join the RISE registry, so that there will be greater diversity across socioeconomic status, will be interesting to see.

The main strength of this study is its description of the actual care received by patients; the data were derived from the RISE registry, were collected passively from the EHR, and reflect all patients seen in practices, thereby reducing selection bias. However, there are also several limitations: as mentioned above, the measures only capture care provided by the rheumatologist, so we may have underestimated the actual care received by patients across all of their providers. We were unable to capture reasons why care did not occur; for example, some patients may have declined HCQ or antihypertensives altogether. For the glucocorticoid measure, patients may have been prescribed prednisone for non-SLE conditions by nonrheumatology clinicians. Finally, RISE includes very few academic centers, so although it provides an important and unique picture of community-based rheumatology practice, data may not be generalizable to large health systems.

In summary, we evaluated a series of quality measures applicable to the care of patients with SLE. We found significant gaps in care among patients with SLE in a large US EHR-based registry. Implementing these measures to assess these gaps and feed information back to providers is likely to help improve the quality of care for patients with SLE.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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SIGNIFICANCE & INNOVATIONS

- We calculated performance on 5 quality measures relevant to the outpatient care of patients with systemic lupus erythematosus (SLE): renal disease screening, blood pressure assessment and management, hydroxychloroquine (HCQ) prescribing, safe dosing for HCQ, and prolonged glucocorticoid use at doses of >7.5 mg/day.
- We found potential gaps in care for patients with SLE across the US. Although some performance variation may be explained by differences in disease severity, dramatic differences across practices suggest that developing quality measures to address important health care processes in SLE may improve quality of care.

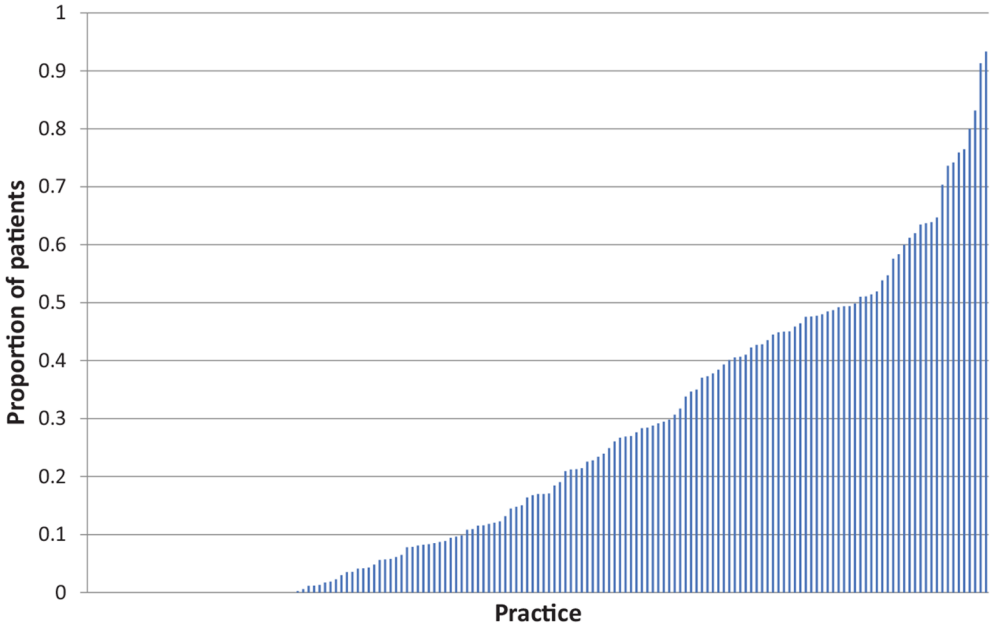

Figure 1.

Proportion of patients with systemic lupus erythematosus in practices in the Rheumatology Informatics System for Effectiveness registry who passed the composite process measure, by practice (n = 165). Composite measures included renal disease screening, blood pressure assessment, hydroxychloroquine prescription, and safe hydroxychloroquine dosing (<5.0 mg/kg/day). Practices reporting on <20 patients were not included.

Table 1.

Specification of proposed SLE quality measures*

Quality measure description	Denominator†	Numerator	Exclusions, exceptions	Measurement period
Renal disease screening: proportion of patients with SLE who had urinary screening for lupus nephritis at least once per year	Patients with ≥2 face-to-face encounters with ICD codes for SLE, ≥30 days apart	Patients with ≥1 documented urine study (urinalysis, urine protein, or urine protein:creatinine ratio)	ESRD (585.6, N18.6, Z99.2, CPT 90951-90970)	1 calendar year (e.g., 1/1/2018–12/31/2018)
Blood pressure assessment: proportion of patients with SLE who had at least 2 blood pressure readings per year	Patients with ≥2 face-to-face encounters with ICD codes for SLE, ≥30 days apart	Patients with ≥2 blood pressure readings recorded ≥30 days apart	None	1 calendar year (e.g., 1/1/2018–12/31/2018)
Blood pressure uncontrolled: proportion of patients with SLE without adequate blood pressure control	Patients with ≥2 face-to-face encounters with ICD codes for SLE, ≥30 days apart, AND ≥2 blood pressure readings, ≥30 days apart	Patients with systolic blood pressure of >140 mm Hg or diastolic blood pressure of >90 mm Hg on ≥2 occasions, ≥30 days apart	None	1 calendar year (e.g., 1/1/2018–12/31/2018)
HCQ prescription: proportion of patients with SLE who were prescribed HCQ	Patients with ≥2 face-to-face encounters with ICD codes for SLE, ≥30 days apart	Patients with at least 1 prescription for HCQ	Toxic maculopathy of retina (H35.0, 381–383, 362.55) or poisoning, adverse effect of other specified systemic antiinfectives and antiparasitics (T37.8x, T37.9x, E931.4)	1 calendar year (e.g., 1/1/2018–12/31/2018)
Safe HCQ dosing: proportion of patients with SLE receiving HCQ prescribed doses associated with less retinal toxicity	Patients with ≥2 face-to-face encounters with ICD codes for SLE, ≥30 days apart, AND at least 1 prescription for HCQ	Patients prescribed ≤5.0 mg/kg/day of HCQ on their most recent prescription	None	1 calendar year (e.g., 1/1/2018–12/31/2018)
Glucocorticoid use of >7.5 mg/day for ≥90 days: proportion of patients with SLE who do not meet the Lupus Low Disease Activity Index glucocorticoid criteria (≤7.5 prednisone mg/day).	Patients with ≥2 face-to-face encounters with ICD codes for SLE, ≥30 days apart	Patients prescribed >7.5 mg of prednisone (or equivalent) for ≥90 days (not required to be continuous days)	None	1 calendar year (e.g., 1/1/2018–12/31/2018)

*CPT = Current Procedural Terminology; ESRD = end-stage renal disease; HCQ = hydroxychloroquine; ICD = International Classification of Diseases; SLE = systemic lupus erythematosus.

†SLE was defined using ICD codes 710.0, 710.00, or M32x (except M32.0).

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Table 2.

Patient characteristics (n = 27,567) *

Characteristic	Value
Female	25,284 (91.7)
Age, mean ± SD years	53.5 ± 15.2
Race/ethnicity	
White	13,235 (48.0)
African American	5,168 (18.8)
Hispanic	2,633 (9.6)
Asian	609 (2.2)
Other/mixed	1,758 (6.4)
Unknown/declined	4,164 (15.1)
Insurance	
Private	9,783 (35.5)
Medicare	5,719 (20.8)
Any Medicaid	1,082 (3.9)
Other	1,506 (5.5)
Unknown	9,477 (34.4)
Area Deprivation Index, median (IQR)	46 (25–69)
Geographic division	
New England	438 (1.6)
Mid-Atlantic	2,601 (9.4)
East North Central	2,908 (10.6)
West North Central	1,867 (6.8)
South Atlantic	10,172 (36.9)
East South Central	3,337 (12.1)
West South Central	2,575 (9.3)
Mountain	1,191 (4.3)
Pacific	2,478 (9.0)
Clinical characteristics	
Number of visits, mean ± SD	3.9 ± 2.7
Charlson comorbidity index, mean ± SD	1.4 ± 1.1
ANA positive (n = 11,994)	8,414 (70.2)
Anti–double-stranded DNA positive (n = 17,908)	8,229 (46.0)
Lupus nephritis †	1,585 (5.7)
End-stage renal disease	151 (0.5)
Functional status assessment scores, mean ± SD	
MDHAQ (n = 5,324; range 0–10)	1.98 ± 2.4
HAQ (n = 2,597; range 0–3)	0.78 ± 0.7
HAQ-II (n = 739; range 0–3)	0.78 ± 0.7
Medications	
Hydroxychloroquine	19,647 (71.5)

Characteristic	Value
Glucocorticoids	12,299 (44.6)
Biologics or JAK inhibitors‡	4,660 (16.9)
Methotrexate	2,713 (9.8)
Azathioprine	2,044 (7.4)
Mycophenolate or mycophenolic acid	2,029 (7.4)
Tacrolimus	23 (0.1)

*Values are the number (%) unless indicated otherwise. ANA = antinuclear antibody; HAQ = Health Assessment Questionnaire; IQR = interquartile range; MDHAQ = Multidimensional Health Assessment Questionnaire.

†Lupus nephritis was defined by International Classification of Diseases, Ninth Revision codes 580.0–586.0 and 791.0.

‡Biologics included abatacept, belimumab, denosumab, rituximab, and other; JAK inhibitors included tofacitinib.

Table 3.

Practice characteristics (n = 186)*

Characteristic	Value
Practice type	
Single-specialty group practice	110 (59.1)
Solo practitioner	49 (26.3)
Multispecialty group practice	23 (12.4)
Health system	4 (2.2)
Number of providers per practice	
Median (IQR)	2 (1–5)
Range	1–35
Number of eligible patients in each practice	
Median (IQR)	104 (42–205)
Range	1–1,125
EHR vendor	
NextGen	75 (40.3)
eClinicalWorks	32 (17.2)
Amazing Charts	16 (8.6)
eMDs	10 (5.4)
Aprima	8 (4.3)
Other	45 (24.2)
Years contributing data to RISE	
Median (IQR)	2.68 (1.73–3.58)
Range	0.32–5.37

* Values are the number (%) unless indicated otherwise. EHR = electronic health record; IQR = interquartile range; RISE = Rheumatology Informatics System for Effectiveness.

Table 4.

Quality measures, number of eligible patients, and overall performance

Quality measure	Eligible patients, no.	Overall performance, no. (%)	Practices included in practice-level analysis, no.*	Practice-level performance, 25th–75th percentile
Renal disease screening	27,369	10,823 (39.5)	164	4.1–60.9
Blood pressure assessment	27,567	26,037 (94.4)	165	96.7–100
Blood pressure uncontrolled	26,037	4,612 (17.7)	152	7.9–26.0
Hydroxychloroquine prescription	27,486	19,647 (71.5)	165	64.9–80.0
Safe hydroxychloroquine dosing	19,647	12,172 (62.0)	163	77.3–95.5
Prolonged glucocorticoid use of >7.5 mg	27,567	5,085 (18.5)	165	10.7–22.1
Composite process measure†	27,567	7,626 (27.7)	165	1.2–42.8

*Practice-level analysis included only practices reporting on ≥20 patients.

†Composite process measure includes renal disease screening, blood pressure assessment, hydroxychloroquine prescription, and safe hydroxychloroquine dosing.

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Table 5.

Composite measure, patient level analysis clustering by practice (n = 27,251) *

	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age, per 10 years	0.94 (0.93–0.96) †	0.95 (0.93–0.97) †
Male	1.31 (1.20–1.42) †	1.34 (1.23–1.47) †
Race/ethnicity		
White	Ref.	Ref.
Hispanic	1.13 (1.03–1.25) †	1.09 (0.98–1.22)
African American	1.37 (1.28–1.47) †	1.34 (1.24–1.45) †
Asian	1.11 (0.94–1.32)	1.06 (0.89–1.28)
Other/mixed	1.11 (0.99–1.24)	1.11 (0.99–1.25)
Unknown	1.23 (1.13–1.35) †	1.20 (1.10–1.32) †
Insurance		
Private	Ref.	Ref.
Medicare	1.08 (0.94–1.23)	0.92 (0.80–1.07)
Any Medicaid	1.04 (0.97–1.11)	0.95 (0.88–1.03)
Other	1.22 (1.08–1.38) †	1.12 (0.97–1.30)
Unknown	0.90 (0.82–0.99) †	0.81 (0.73–0.89) †
Geographic division		
New England	Ref.	Ref.
Mid-Atlantic	0.59 (0.17–2.02)	0.78 (0.25–2.44)
East North Central	2.59 (0.87–7.76)	2.47 (0.84–7.28) †
West North Central	4.60 (1.40–15.11) †	4.63 (1.43–14.97)
South Atlantic	1.74 (0.61–4.92)	1.66 (0.60–4.59)
East South Central	2.06 (0.68–6.22)	2.09 (0.71–6.16)
West South Central	2.44 (0.81–7.38)	2.17 (0.74–6.42)
Mountain	1.27 (0.34–4.84)	1.47 (0.42–5.20)
Pacific	0.97 (0.32–2.97)	0.93 (0.31–2.76)
Visits, no.	1.04 (1.03–1.05) †	1.04 (1.03–1.06) †
ADI	1.00 (1.00–1.00) †	1.00 (1.00–1.00)

* 95% CI = 95% confidence interval; ADI = Area Deprivation Index; OR = odds ratio; Ref. = reference.

† Patients missing ADI and from practices with <20 patients were not included in this analysis. Variables included in the multivariate models: age, sex, race/ethnicity, insurance, number of visits, geographic division, and ADI.