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Osteoporosis and Cardiovascular Disease Care in SLE According to New Quality Indicators

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Abstract

Objectives—Quality indicators (QIs) for assessment of care of patients with systemic lupus erythematosus (SLE) have been proposed. We evaluated care according to these proposed QIs for osteoporosis and cardiovascular disease (CVD) in patients with SLE in our rheumatology practice.

Methods—We selected 200 patients with SLE according to American College of Rheumatology (ACR) Criteria and ≥ 2 visits to our practice in 2007–8. We performed a structured medical record review and collected demographics, SLE and past medical history, medications, laboratories and data concerning osteoporosis and CVD management. We employed univariable analyses and multivariable regression analyses to test for factors associated with care meeting the proposed QIs.

Results—94% of patients were female and 64% white. Mean age was 46.3 years and mean lupus duration was 15.3 years. 29% were taking ≥ 7.5 mg prednisone per day for ≥ 3 months. The proportions of patients for whom care met the proposed QIs were: 57% for bone mineral density (BMD) testing, 62% for calcium and vitamin D supplementation, and 86% for anti-resorptive or anabolic osteoporosis medications. Only 3% had 5 cardiac risk factors assessed within the year and 26% had 4 cardiac risk factors assessed annually. Smoking, fasting lipid panels and diabetes mellitus were rarely assessed annually. Having a primary care physician (PCP) within our healthcare network increased care meeting QIs.

Conclusions—Care according to newly proposed QIs for osteoporosis and CVD was suboptimal in our academic center. In order to standardize and improve care of patients with SLE, we suggest specific changes to the proposed QIs.

Keywords

systemic lupus erythematosus; quality indicator; osteoporosis; cardiovascular disease; bone mineral density; screening; cholesterol; blood pressure; management; risk factor; calcium and vitamin D

INTRODUCTION

Although survival among patients with SLE is increasing, long-term comorbidities and complications of prolonged use of glucocorticoids, including osteoporosis and cardiovascular disease, remain extremely important^{1, 2}. Several studies have demonstrated

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suboptimal screening and management of osteoporosis in patients with SLE, despite the various treatment options proven to decrease osteoporosis risk^{1, 3–6}. In 2001, the American College of Rheumatology (ACR) developed recommendations for the prevention and treatment of glucocorticoid-induced osteoporosis³, but it is not known how well these guidelines are followed for the care of patients with SLE. Cardiovascular disease (CVD) is also highly prevalent among patients with SLE and is a major cause of morbidity and mortality^{7–10}. The best strategy for the reduction of CVD risk in patients with SLE remains unclear, but it is recommended that physicians maintain a high index of suspicion for cardiovascular disease and annually screen for, address, and evaluate traditional CVD risk factors in SLE patients^{1, 11}.

The Measures Subcommittee of the ACR Quality of Care Committee has designated the development and validation of treatment guidelines and management recommendations and of quality indicators (QIs) and data collection systems as priorities in rheumatic diseases¹². QIs for rheumatic disease care are being developed to provide for evaluating whether appropriate and sufficient care is being delivered and for targeting improvement and promoting optimal practices. According to the Institute of Medicine, quality is defined as the “degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with the current professional knowledge”¹³. A set of QIs for care of patients with SLE, recommending the minimum acceptable standard of care for multiple aspects of SLE patient management, has recently been proposed¹⁴. The proposed QIs will require field testing and refinement.

Our goals were: 1) to assess the proportion of care meeting the newly proposed QIs for osteoporosis and CVD prevention in the large SLE patient population followed at our academic teaching hospital by rheumatologists with a range of experience, and 2) to identify subject, physician or health system factors predictive of osteoporosis and CVD care meeting these QIs.

METHODS

Patient Population

Of 1759 patients followed for SLE in the Brigham and Women’s Hospital Arthritis Center, we identified 867 seen in Brigham and Women’s Hospital Arthritis Center from June 2007 to July 2008 who had SLE ($\geq$ four of 11 of the updated 1997 ACR Classification Criteria for SLE^{15,16} previously confirmed by medical record review by board-certified rheumatologists) and $\geq$ 2 outpatient visits to the rheumatology clinic in the year prior to the date of medical record review. The first 200 of these 867 subjects (in alphabetical order) were arbitrarily selected for medical record review. All aspects of this study were approved by the Partners’ Healthcare Institutional Review Board.

QIs

We assessed care meeting the newly proposed QIs for osteoporosis and CVD prevention and management¹⁴(Table 1). According to the new QIs, only certain SLE patient groups are required to have osteoporosis care, (QI 1A, B and C), but all patients are required to have annual assessment of cardiac risk factors (CRFs) (QI 2). We performed separate analyses for the three QIs for osteoporosis and one QI for CVD management. We defined glucocorticoid dosage categories in two ways according to the proposed QIs¹⁴: 1) $\geq$ 7.5 mg/day of prednisone for $\geq$ 3 consecutive months, and 2) $\geq$ 7.5 mg/day for > 1 month (for QIs in Table 1).

Data collection

A structured data abstraction form was used to collect data from electronic medical records for the 12 months prior to the index date (the most recent visit in 2008). Information was collected concerning patient characteristics (age, sex), type of medical insurance (Medicaid, Medicare, private insurance or uninsured), race and ethnicity (Caucasian, Black, Hispanic, Asian, other), marital status, comorbid illnesses (heart disease, hypertension, lung disease, diabetes, ulcer or stomach disease, kidney disease, liver disease [hepatitis, cirrhosis], anemia or other blood disease, cancer, depression, osteoarthritis/degenerative or rheumatoid arthritis, back pain, seizures, prior organ transplant^{17, 18}, SLE disease variables (duration of disease, number of SLE criteria, and current SLE medications).

Medication data abstracted from the medical records included dates of therapy and doses of glucocorticoids, osteoporosis, cholesterol-lowering, and diabetes mellitus medications. Glucocorticoids included prednisone, prednisolone, hydrocortisone (IV), methylprednisolone, and dexamethasone. Glucocorticoid dosages were converted into prednisone equivalents. Osteoporosis medications were classified as anti-resorptive (risedronate, pamidronate, ibandronate, etidronate, zoledronate, alendronate, micalcalin, raloxifene, and estrogen); anabolic parathyroid hormone) and calcium and vitamin D supplements. Prescription of cholesterol-lowering medications, including rosuvastatin, atorvastatin, lovastatin, pravastatin, simvastatin, niacin, cholestyramine, and ezetimibe, was recorded.

All rheumatologist notes in the medical records from the 12 months prior to the index date were searched for details of osteoporosis and CVD risk screening and management. All radiology reports in the medical records were searched to determine if the patient had received BMD testing in the past 24 months by dual x-ray absorptiometry (DXA) or if they had a prior diagnosis of osteopenia or osteoporosis. We noted whether the BMD had been ordered and/or obtained within the Partners' Healthcare System (including the Brigham and Women's Hospital, Massachusetts General Hospital and many community affiliates in the Boston area that share an electronic medical record), or elsewhere. We noted whether the patient had been counseled about weight-bearing exercise. Blood pressure, body weight, height, and body mass index (BMI), and history of previous fragility fractures were recorded from the electronic medical record if available.

We collected the following information pertaining to CVD risk factors: hypertension, smoking, obesity, hyperlipidemia, and diabetes mellitus. Definitions of abnormal CVD risk factor status were taken from the literature^{3, 19–21}. Hypertension was defined as blood pressure $\geq 140/80$, hyperlipidemia as fasting total cholesterol ≥ 200 ; LDL ≥ 130 ; HDL ≤ 35 ^{20, 21}. Cigarette smoking was categorized as assessed or not, and never, past, current. Pre-existing diabetes was noted if diabetes mellitus was previously diagnosed diabetes mellitus taking medications.

Data Analysis

We examined the demographic characteristics of patients selected for the study and their rheumatologists. For analysis purposes, we examined race as Caucasian vs. other, health insurance as private vs. other and employed as a count of the total number of comorbidities listed above. We compared the demographic characteristics of the 200 subjects selected for medical record review with the others who had met criteria (SLE by ACR criteria and ≥ 2 visits in 2007–8), but were not selected for medical record review using t-tests and Chi-squared tests.

In univariable analyses, t-tests for continuous variables and Chi-squared or Fisher's exact tests for categorical variables were used to determine significant predictors of receiving care

according to the four proposed QIs (Table 1). Those variables that were considered as possible predictors ($p < 0.15$) were fit into a multivariable logistic regression model. A stepwise selection method was used to determine which variables remained significant predictors after adjusting for the effects of the other variables.

In addition to the QIs presented in Table 1, we performed sensitivity analyses of the osteoporosis QIs, including three other definitions of glucocorticoid use: 1) no glucocorticoid use, 2) ≥ 5 mg/day of prednisone for ≥ 3 months (the ACR-recommended threshold for screening and/or treatment³ and 3) a higher dose cut off of ≥ 20 mg/day of prednisone for ≥ 3 months. Controversy remains as to the use of bisphosphonates in women of child-bearing age and potential harms to a developing fetus years later. Thus, to further investigate this, we have stratified the women in the osteoporosis QI analysis into those less than and $>$ age 50, in order to separately investigate bone density testing and the use of bisphosphonates and other osteoporosis agents in women of potentially child-bearing age compared to those who were older. Furthermore, in sensitivity analyses, we considered two other possible QIs for CVD: 1) having at least 3 of the 4 CVD risk factors measured (smoking excluded) and 2) having 4 risk factors measured, with *at least one* of the serum lipid measurements (LDL, HDL, total cholesterol, triglycerides) recorded considered sufficient for assessing lipid levels.

For the percentages of subjects meeting and receiving appropriate care according to the proposed QIs, we present the appropriate asymptotic or exact 95% confidence intervals. A p -value of < 0.05 was considered statistically significant in all analyses. All data were analyzed using SAS software (SAS Institute, Cary, NC).

RESULTS

The demographics of our patient population are shown in Table 2. The mean cumulative dose of prednisone was 2702.5 mg in the 12 months prior to review, equal to a mean of 7.4 mg/day of prednisone among glucocorticoid users. Seventeen ($n=185$ patients) rheumatology attendings and 9 ($n=15$ patients) rheumatology fellows at the Brigham and Women's Hospital were involved in the care of these patients. It took one full-time reviewer approximately 200 hours to complete the medical record reviews. There were no significant differences in terms of age ($p=0.44$), sex ($p=0.43$), race ($p=0.11$), private vs. public health insurance ($p=0.06$) between the 200 patients chosen for medical record review and the others who met criteria but were not reviewed.

Among the 200 SLE subjects, all had primary care physicians (PCPs) noted, 40% of whom were within the Partners' Healthcare network. Thirty-four percent had received BMD testing, 60% were receiving calcium and vitamin D supplementation, and 35% were receiving anti-resorptive or anabolic therapy for osteoporosis. Table 1 demonstrates the proportions of these SLE subjects meeting the specifications for osteoporosis and CVD QIs¹⁴, and receiving indicated care according to them. Among subjects who had BMD tests performed, 26 (39%) had T scores below -2.0 SD and 7 (10%) had T scores below -2.5 SD. However, when restricted to the 58 subjects meeting the specifications of QIs 1A and 1B (having received ≥ 7.5 mg of prednisone for ≥ 3 months during that year), 34 (59%) had received BMD testing or were receiving an osteoporosis medication (according to QI 1A). For 36 (62%) of these subjects, there was record of calcium and vitamin D supplementation, meeting QI 1B for osteoporosis.

Only seven of the 200 patients had received ≥ 7.5 mg of prednisone for ≥ 1 month during the past year *and* had a central T score ≤ -2.5 SD or a history of a fragility fracture, and thus, according to proposed QI 1C for osteoporosis, should have prescription of anti-

resorptive or anabolic therapy for osteoporosis. We found that 6 (86%) had care meeting this QI in the medical record. Additionally, for the patients with BMD T score ≤ -2.5 SD and/or fragility fracture regardless of recent glucocorticoid intake ($n=20$), 15 (75%) had prescription of an anti-resorptive or anabolic therapy for osteoporosis and 10 (50%) had counseling to increase weight-bearing exercise. When care according to the proposed QI for osteoporosis care was examined in analyses among women stratified by age less than or equal to compared to greater than 50 years, we found that the proportions of subjects who were eligible for the QI and that had received indicated BMD testing, calcium and vitamin D and antiresorptive testing were similar. In the younger group of women, 13 of 29 (45%, 95% CI 26–64%) subjects had had indicated BMD testing, whereas 17 of 24 (71%, 95% CI 49–87%) of the older women had. Nineteen of the younger women (66%, 95% CI 46–82%) and 14 of the older women (58%, I 37–78%) had been counseled to take calcium and vitamin D. Similarly, both of the two younger women eligible for QI 1C had received antiresorptive therapy, and 4 of 5 of the older women had.

Table 3 displays the results of analyses of potential predictors of having care according to the proposed osteoporosis QIs. In univariable analyses, only increasing age and having a primary care physician (PCP) within our healthcare network were found to be significant predictors of BMD screening according to QI 1A. Subject sex, race, duration of SLE, number of comorbidities, cigarette smoking, BMI, prior diagnosis of osteopenia or osteoporosis, previous fragility fractures, marital status, medical insurance type and number of rheumatology appointments over the past year, were not significantly related to having BMD testing in our SLE subjects. In multivariable analyses, only age remained a significant predictor of receiving BMD testing or receipt of anti-resorptive or anabolic medication (QI 1A). We did not identify any strong subject, physician or healthcare system factors associated with receiving counseling to take calcium and vitamin D supplements. We did observe that non-Caucasian race, longer SLE duration and increased number of recent rheumatology visits were potentially related to calcium and vitamin D supplementation according to QI 1B, but these relationships did not reach statistical significance. We were not able to investigate potential predictors of care according to proposed QI 1C, anti-resorptive or anabolic therapy for osteoporosis, given the small number of subjects meeting the guideline inclusion.

In sensitivity analyses using alternate thresholds for glucocorticoid usage, we identified 50 subjects with *no* glucocorticoid usage. Of these subjects, 19 had BMD testing or appropriate therapies. Twenty-four were receiving supplemental calcium and vitamin D and 11 were receiving anti-resorptive or anabolic therapies. Of the 12 patients who had BMD testing, four had a central T score of < -2.0 SD and one had a central T score < -2.5 SD. Ninety-seven subjects had received ≥ 5 mg/d of prednisone or its equivalent for ≥ 3 months, according to ACR guidelines. Of these, 54 had BMD testing or anti-resorptive or anabolic therapy. Sixty-three had been counseled to receive supplemental calcium and vitamin D. Forty-one subjects were receiving anti-resorptive or anabolic therapy. Of these, 33 had obtained BMD testing, 15 had central T scores of < -2.0 SD and three had central T scores of < -2.5 SD. According to our last alternate definition, 11 SLE subjects had received ≥ 20 mg of prednisone or its equivalent for ≥ 3 months. Of these, 5 had BMD testing, 9 had been counseled to take supplemental calcium and vitamin D; and 5 were taking anti-resorptive or anabolic therapies for osteoporosis. Overall, three patients received BMD testing: two had T scores < -2.0 SD and one had a T score < -2.5 SD.

The newly proposed QI for CVD states that all patients with SLE should have annual assessment of five CRFs including cigarette smoking, hypertension, body mass index, hyperlipidemia and diabetes mellitus. We found that only 25 (12.5%) of these subjects had smoking assessment within the past year, and all of these were current smokers. All five

CVD risk factors, including smoking, had been assessed during the one year period for only six of the 200 SLE subjects. In secondary analyses, we excluded cigarette smoking as a risk factor to be assessed annually in all subjects. We found that 51 (26%) of the 200 patients had been screened within the past year for all of the other four CVD risk factors, and 119 (60%) had been assessed for at least three of the four risk factors. This large disparity is primarily the result of missing BMI and not having *all* indicated lipid levels measured (fasting LDL, HDL, total cholesterol, and triglycerides). We found that 64 (32%) of our SLE subjects had had 4 CVD risk factors, including *any* lipid level checked within the past year. Fifty-three (27%) patients were taking anti-hypertensive medications, and 69 (35%) had received cholesterol-lowering medications (45% of these were statin medications). Twelve (6%) individuals had pre-existing diabetes mellitus and were receiving insulin or oral diabetes therapy.

Table 4 includes potential predictors of receiving CRF screening according to the proposed QIs. In univariable analyses, pre-existing hypertension and diabetes, more comorbidities and having a within-system PCP were significant predictors of receiving CRF management. In multivariable analyses, diabetes, more comorbidities, and having a within-system PCP remained significant predictors of receiving CVD screening meeting to the proposed QIs. When employing an alternate definition of having $\geq$ three CVD risk factors assessed within the year, multivariable modeling revealed that hypertension and increased number of visits to the rheumatologist were significant predictors of this screening.

DISCUSSION

In this study of 200 patients with SLE actively followed at our teaching hospital, we assessed care for osteoporosis and CVD management according to newly proposed QI set for care of patients with SLE. Other areas covered in the QI set included SLE diagnosis, general preventive strategies, drug toxicity monitoring, renal disease and reproductive health QIs. Given the importance of osteoporosis and CVD prevention for patients with SLE and the time it took to review medical records, we focused on these two QIs.

We found that approximately 60% of SLE patients meeting the criteria received osteoporosis care according to QI, while only 3% met the CVD QI guideline of five CRFs being assessed annually and 26% of patients met the CVD QI of four CRFs, excluding smoking, assessed annually, and 60% had $>$ three of the specified CRFs assessed. Rates of BMD testing and recommendations for daily calcium and vitamin D for osteoporosis (QIs 1A and 1B) were not significantly different among patients above and below indicated glucocorticoid cutoffs, while prescription medications use for osteoporosis was significantly more common in those above the QI 1C glucocorticoid threshold ($p=0.008$).

Although we did not identify many significant predictors of appropriate osteoporosis management meeting the QIs, we did find a suggestion that older age of the patient, having a PCP within the same healthcare system, white race, longer duration of SLE and more rheumatology visits per year all were potentially related to increased osteoporosis care. Whether bisphosphonates should be prescribed to young women and those of child-bearing potential is controversial²². Practitioners may not even perform BMD testing if anti-resorptive agents are not considered. When our analyses were stratified by age, however, we found that osteoporosis care of women with SLE under age 50 was very similar to that older women in this population.

The presence of CVD risk factors such as hypertension and diabetes, a higher number of comorbidities, and having a PCP within the network, were important predictors of appropriate CRF screening according to the QI. These associations may be due to improved

provider communication within the same network, and/or better access to medical records for our review. (Medical data from outside our healthcare system are not systematically incorporated into the electronic record.)

The Brigham and Women's Hospital belongs to Partners' Healthcare Systems, which has invested in the development of an advanced electronic medical record, linking inpatient and outpatient data from two main academic hospitals, several smaller area hospitals and outpatient clinical sites in the greater Boston area. Our large SLE patient volume and academic setting, in which rheumatologists have been well educated about osteoporosis and CVD management in inflammatory rheumatic diseases, make our results most generalizable to other academic institutions. This is an ideal situation in which to test the newly proposed QI sets. Nonetheless, collection of this data was time-consuming and care meeting the newly proposed QIs was often lacking. We hypothesized *a priori* that medical record documentation, and thus care of SLE patients according to the proposed QIs, would be superior among those subjects with a PCP within the healthcare network, and more records available and perhaps better inter-provider communication. To some extent, we did find this, although this factor was not a strong predictor of care.

Documentation in the medical record, of course, does not always reflect what has happened in the physician's office, nor does it necessarily equal better care. Moreover, the rheumatologists involved were not aware of the newly proposed QIs for SLE patient care at the time they were delivering their care. In this age of increasing demand from health insurance companies to meet standards of care, developing these quality standards is extremely important. Abstracting and analyzing data from medical records has limitations, however, such as the availability of medical records and the quality of documentation. We did not review the PCPs notes, as the majority of patients had PCPs outside of our healthcare system and thus notes were not available in the electronic medical record (and not available without written informed consent of the subjects, which was not feasible for this project).

Ideally, QIs for SLE patient care should represent the minimal standard of care and the use of QIs should ultimately improve the quality of care and outcomes for SLE patients. Refinement of the clinical content of these proposed QIs appears necessary before further studying or implementing them. In particular, we propose changes to the recommendations for annual CRF screening. It has been suggested that SLE patients should be considered as being in a CVD risk category equivalent to that of patients with diabetes, and similar aggressive management of traditional risk factors is advocated²³⁻²⁸. Further evidence is needed to ascertain whether such an aggressive screening strategy will lead to improved outcomes. It is possible that only certain high-risk populations with SLE will prove to benefit from such aggressive risk factor management. Some medical insurance companies, in particular Medicare, do not allow for screening for hyperlipidemia or diabetes mellitus without a pre-existing (and billed) diagnosis of these conditions. We found that current smoking was only assessed for 25 patients who were actively smoking and not in others. Although asking patients about smoking on an annual basis has gained national prominence as a potential quality measure²⁹, annual assessment of continued non-smoking does not represent minimum standard and is unlikely to be related to SLE outcomes among non-smokers. Similarly, the practice of checking an entire panel of fasting lipids in all SLE patients on an annual basis was not routinely observed by our rheumatologists and may not represent a minimum standard of care. Recommendations for screening for hyperlipidemia are in evolution after the JUPITER trial revealed that statin medications are effective regardless of lipid levels in healthy subjects³⁰. Random LDL and HDL cholesterol assessments are likely acceptable CVD screening strategies in SLE subjects.

Developing, field testing, refining and validating these QIs are critical methodological steps in efforts to improve SLE patient care and outcomes. Although these QIs were based on comprehensive literature reviews and a formal expert panel consensus process, this does not ensure the feasibility of their use nor their validity in improving care or outcomes. Our study demonstrates that while the necessary data was for the most part contained in the medical records, the data collection burden was high (200 hours). In the future, standardized quality measures will likely be incorporated into SLE clinical care prospectively, assisting hospitals and practices in internal QI efforts. Additionally, as clinical registries such as that recently developed by the ACR³¹ are accepted and implemented, important QI data should be collected easily and prospectively.

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Table 1

QI Definitions (1)

	Eligible patients, N (%)	Receiving care per QI, N (%; 95% CI)
I. Osteoporosis		
A. IF a patient with SLE has received prednisone ≥ 7.5 mg/day (or other glucocorticoid equivalent) for ≥ 3 months, THEN the patient should have BMD (BMD) testing recorded in the medical record [*] , unless the patient is currently receiving anti-resorptive ^{**} or anabolic therapy [†] .	58 (29%)	34 (59%, 46–71%)
B. IF a patient with SLE has received prednisone ≥ 7.5 mg/day (or other glucocorticoid equivalent) for ≥ 3 months, THEN supplemental calcium and vitamin D [‡] should be prescribed or recommended.	58 (29%)	36 (62%, 50–74%)
C. IF a patient with SLE has received prednisone ≥ 7.5 mg/day (or other glucocorticoid equivalent) for ≥ 1 month, and has a central t-score ≤ -2.5 or a history of fragility fracture, THEN the patient should be treated with an anti-resorptive or anabolic agent, unless patient refusal or contraindications are noted.	7 (3.5%)	6 (86%, 42–100%)
II. Cardiovascular Disease		
A. IF a patient has SLE, THEN risk factors for cardiovascular disease, including smoking status, blood pressure, BMI, diabetes, and serum lipids (including total cholesterol, HDL, LDL and triglycerides), should be evaluated annually.	200 (100%)	6 (3%, 1–5%)
B [‡] . IF a patient has SLE, THEN risk factors for cardiovascular disease, including blood pressure, BMI, diabetes mellitus, and serum lipids (including total cholesterol, HDL, LDL and triglycerides), should be evaluated annually.	200 (100%)	51 (26%, 19–32%)

* The interval for BMD testing was increased to 24 months in place of 18 months as recommended by the panel due to common health insurance restrictions.

** Anti-resorptive/bisphosphonate medications included risedronate, pamidronate, ibandronate, etidronate, zoledronate, alendronate, raloxifene, any hormone replacement therapy (Prempro, estrogen) and miacalcin.

† Anabolic agents included parathyroid hormone.

‡ Calcium and vitamin D supplements included calcium citrate, calcium carbonate, vitamin D low dose (<800 IU/day), vitamin D high dose (50,000 IU/week), ergocalciferol, and calcitriol. (A multivitamin was not sufficient.)

‡ Our proposed QI definition, excluding smoking

Table 2

SLE Subject Demographics, n=200

Mean age in years (SD)	46.3 (14.1)
Female (%)	188 (94.0)
Caucasian (%)	127 (63.5)
Mean number of ACR* Criteria for SLE	5.4 (1.4)
Mean duration of SLE in years (SD)	15.3 (11.1)
Cigarette Smoker (in past year)	25 (12.5)
Mean BMI (kg/m ² , SD)	26.9 (5.8)
Receiving glucocorticoids (≥ 7.5 mg/day prednisone or equivalent for ≥3 months during the past year)	58 (29.0)
Receiving glucocorticoids (≥ 7.5 mg/day prednisone or equivalent for ≥1 months during the past year and T-score < -2.5 or history of fracture)	7 (3.5%)
Private Health Insurance (%)	126 (63.0%)
Medicaid, Medicare, free care or no health insurance	74 (37%)
PCP** within healthcare network	79 (39.5%)
Married (%)	110 (55.0%)
BMD*** testing	67 (33.5%)
Calcium and Vitamin D supplementation	119 (59.5%)
Anti-resorptive or anabolic therapy	70 (35.0%)

* ACR= American College of Rheumatology

** PCP= primary care physician

*** BMD= bone mineral density

Table 3

Univariable Predictors of Care According to Proposed QIs for Osteoporosis

Predictor	Care per QI 1A ^A		p [*]	Care per QI 1B ^B		p [*]
	Yes	No		Yes	No	
Total	34	24		36	22	
Age, mean years	49.6 (±14.4)	40.4 (±14.5)	0.02	43.4 (±16.3)	49.7 (±12.0)	0.12
Female	88.2% (72.6–96.7)	95.8% (78.9–99.9)	0.39	91.7% (77.5–98.3)	90.9% (70.8–98.9)	1.00
Caucasian	64.7% (48.6–80.8)	45.8% (25.6–67.2)	0.15	47.2% (30.9–63.5)	72.7% (54.1–91.3)	0.06
SLE duration, mean years	17.2 (±11.6)	13.4 (±10.7)	0.24	13.2 (±9.6)	19.2 (±12.9)	0.06
Comorbidities, mean number	1.5 (±1.3)	0.9 (±1.1)	0.08	1.0 (±1.0)	1.6 (±1.6)	0.12
Current smoker (in past year)	17.7% (6.8–34.5)	16.7% (4.8–37.4)	1.00	16.7% (6.4–32.8)	18.2% (5.2–40.3)	1.00
BMI, mean kg/m ²	27.1 (±4.3)	27.0 (±4.5)	0.93	26.8 (±3.6)	27.8 (±6.0)	0.65
Prior diagnosis osteopenia/osteoporosis (T score < -2.0)	26.5% (11.6–41.3)	16.7% (4.7–37.4)	0.38	27.8% (14.2–45.2)	13.6% (2.9–34.9)	0.33
Prior fragility fracture	8.8% (1.9–23.7)	0.0% (0.0–14.3)	0.26	8.3% (1.8–22.5)	0.0% (0.0–15.4)	0.28
Married (vs. single or divorced)	47.1% (30.3–63.8)	45.8% (25.6–67.2)	0.93	41.7% (25.6–57.8)	54.5% (33.7–75.4)	0.34
Rheumatology visits per year, mean	4.7 (±2.4)	4.6 (±2.3)	0.86	5.1 (±2.6)	4.0 (±1.6)	0.07
Private vs. other type health insurance	55.9% (39.2–72.6)	41.7% (21.9–61.4)	0.29	47.2% (30.9–63.5)	54.5% (33.7–75.4)	0.59
PCP* within healthcare network (vs. without)	52.9% (36.1–69.7)	25.0% (7.7–42.3)	0.03	44.4% (28.2–60.7)	36.4% (16.3–56.5)	0.54

* t test for continuous predictors; Chi squared test or Fisher's exact tests for categorical comparing those receiving care to those not receiving care

^A QI for Osteoporosis 1A: Appropriate BMD testing or receipt of anti-resorptive or anabolic medication per Yazdany

^B Quality Indicator for Osteoporosis 1B: Appropriate receipt of Calcium and Vitamin D supplementation per Yazdany

* BMI= Body mass index,

** PCP= primary care physician

Table 4

Univariable Predictors of Care According to the Proposed QI for CVD

Predictor	Care per QI [†]		p [*]
	Yes	No	
Total	51 (25.5%)	149 (74.5%)	
Age, mean, years (SD)	47.3 (±14.0)	45.9 (±14.1)	0.53
Female	94.1% (83.8–98.8)	94.0% (88.8–97.2)	1.00
Caucasian	64.4% (56.7–72.1)	60.8% (47.4–74.2)	0.64
SLE duration, mean, years	15.2 (±12.1)	15.3 (±10.8)	0.96
Number of comorbidities [*]	2.0 (±1.7)	1.1 (±1.3)	<0.01
Current smoker (within past year) ^{**}	11.8% (2.9–20.6)	12.8% (7.4–18.1)	0.85
BMI ^{**} , mean kg/m ² (SD)	27.5 (±5.7)	26.4 (±5.8)	0.33
Hypertension	47.1% (33.4–60.8)	22.8% (16.4–30.4)	<0.01
Diabetes Mellitus	15.7% (7.0–28.6)	2.7% (0.7–6.7)	<0.01
≥ 7.5 mg prednisone or equivalent for ≥ 3 months	23.5% (11.9–35.2)	30.9% (23.5–38.3)	0.32
Married (vs. single or divorced)	58.8% (45.3–72.3)	53.7% (45.4–61.9)	0.52
Rheumatology visits per year, mean (SD)	4.5 (±2.3)	4.4 (±2.3)	0.83
Private health insurance (vs. other type)	58.8% (45.3–72.3)	64.4% (56.7–72.1)	0.47
PCP within network (vs. without)	64.7% (51.6–77.8)	30.9% (23.5–38.3)	<0.01

^{*} t test for continuous predictors; Chi squared test or Fisher's exact test for categorical predictors, comparing those receiving care to those not receiving care

[†] Annual assessment of blood pressure,

^{**} body mass index, diabetes mellitus, serum lipid profiles. Cigarette smoking was not included as it was only assessed for current smokers.

PCP= primary care physician