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Lipid Testing and Statin Prescription among Medicaid Recipients with Systemic Lupus Erythematosus, Diabetes Mellitus and the General Medicaid Population

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Abstract

Objective—Cardiovascular disease (CVD) risks among patients with systemic lupus erythematosus (SLE) are similar to those in diabetes mellitus (DM). We investigated whether patients with SLE receive lipid testing and statin prescriptions comparably to DM patients and to individuals without either disease.

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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 publications. Dr. Chen had full access to all of the data in the study and takes responsibility for the integrity for the data and the accuracy of the data analysis.

Study conception and design
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Acquisition of data
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Analysis and interpretation of data
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DISCLOSURES

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Methods—We identified U.S. Medicaid beneficiaries ages 18–65, residing in 29 states from 2007–2010 with prevalent SLE. Each SLE patient was age- and sex-matched to two DM, and four general Medicaid recipients without either disease. We compared the proportions of patients in each cohort who received ≥ 1 lipid test and ≥ 1 statin prescription during one-year follow-up. We used multivariable logistic regression to calculate the odds of lipid testing and statin prescription and conditional logistic regression to compare matched cohorts.

Results—We identified three Medicaid patient cohorts: 25,950 SLE; 51,900 DM; and 103,800 with neither condition. In these cohorts, lipid testing was performed in 24% of SLE, 43% of DM and 16% with neither, and statin prescriptions were dispensed in 11%, 33% and 7%. SLE patients were 66% less likely (OR 0.34, 95% CI 0.34–0.35) to have lipids tested and 82% less likely (OR 0.18, 95% CI 0.18–0.18) to fill a statin prescription than DM patients. They were also less likely (OR 0.89, 95% CI 0.84–0.94) to fill a statin prescription than general Medicaid patients.

Conclusions—Despite elevated CVD risk, SLE patients receive less lipid testing and statin prescriptions than age- and sex-matched DM and general Medicaid patients and this gap should be a target for improvement.

Systemic lupus erythematosus (SLE), a multi-system autoimmune disease that affects young people, the vast majority of whom are women, is associated with high rates of atherosclerotic cardiovascular disease (CVD). Multiple past epidemiologic studies have estimated that risks of myocardial infarction and stroke are 2–3-fold higher than the general population[1]. SLE patients have recently been shown to have higher CVD risks than age- and sex-matched patients with diabetes mellitus (DM), a population at very elevated CVD risk[2,3]. Given the greatly elevated CVD risk among DM patients, DM is considered an independent CVD risk factor, and aggressive risk assessment with annual lipid screening and HMG-CoA reductase inhibitor (“statin”) prescription has led to improvements in CVD morbidity and mortality[4,5]. The proportion of DM patients receiving recommended lipid testing has been reported to be as high as 87% among patients seen in academic centers from 2000–2002[6].

Aggressive management of traditional CVD risk factors for SLE patients has been widely advocated, but it is not known how well this guidance has been accepted[7,8]. A 2009 expert opinion-based quality indicator set for SLE management recommended annual assessment of CVD risk factors, including annual lipid measurements[8]. Past studies showed poor uptake of this recommendation in academic centers[9–11]. Use of statins has been strongly advocated and shown to be safe in non-pregnant SLE patients[12]. Statins have both lipid-lowering and anti-inflammatory effects and are likely to be beneficial for CVD prevention in SLE, although the evidence from randomized trials is still not decisive[13].

Our goal was to examine rates of blood lipid concentration testing and statin prescription dispensing among SLE patients compared to age- and sex-matched DM and general non-SLE non-DM patients within Medicaid, the U.S. medical insurance program for the poor. We hypothesized that despite the greatly elevated CVD risk among SLE patients, lipid testing and statin prescription dispense rates would be lower than among age- and sex-matched DM patients, revealing poor uptake and acceptance of expert-based recommendations.

METHODS

Study Population and Cohort Assembly

Within Medicaid Analytic eXtract (MAX), a database that includes billing claims, demographic information and medication dispensing data, we identified adults of ages 18–65 years from the 29 most populated states in the U.S. who were enrolled in Medicaid for ≥ 18 months between January 1, 2007 and December 31, 2010.

Prevalent SLE Cohort

A cohort of prevalent SLE was defined as having ≥ 3 International Classification of Diseases, Ninth Revision (ICD-9) codes for SLE (710.0) from hospital discharge diagnoses or physician visit claims, each ≥ 30 days apart, as in prior studies[14,15]. We required a six-month period of continuous enrollment for collection of baseline covariable data prior to the index date (date that criteria for SLE was met) and ≥ 12 months of continuous follow-up for assessment of outcomes after the index date. In the event that the date of the third ICD-9 code occurred before the 6-month baseline period could be established, the next SLE-related claim thereafter that would allow for a 6-month baseline period was used to define the index date. Patients with ICD-9 codes for pregnancy during the follow-up period were excluded as statins are contraindicated in pregnancy. Among the SLE patients, lupus nephritis patients were defined as having ≥ 2 ICD-9 hospital discharge diagnoses or physician billing claims for nephritis, proteinuria, and/or renal failure, occurring ≥ 30 days apart, on or after the SLE criteria were met[16,17].

Age- and Sex-matched Prevalent Diabetes Mellitus Cohort and General Medicaid Population Cohort

We identified prevalent DM (type 1 or type 2) patients as those having ≥ 3 ICD-9 codes for DM (249.XX, 250.XX, 357.2, 362.01–.06, 366.41) from hospital discharge diagnoses or physician visit claims each separated by ≥ 30 days, without any claims for SLE[18,19]. We required 6 months of continuous enrollment prior to index date as the baseline period. The index date was the date of the third ICD-9 code, or in the event that the third ICD-9 code date occurred before the 6-month baseline period could be established, the next DM-related claim thereafter that would allow for a 6-month baseline period was used to define the index date. Among the DM patients, diabetic nephropathy patients were defined as having ≥ 2 ICD-9 hospital discharge or physician billing codes for nephritis, proteinuria, and/or renal failure ≥ 30 days apart on or after DM criteria was met[20].

We also identified age- and sex-matched general Medicaid population who had ICD-9 codes for any non-SLE, non-DM diagnoses from hospital discharge diagnoses or physician visit claims on the same index date as each SLE patient, with 6 months of continuous enrollment prior to the index date as the baseline period. Patients with ICD-9 codes for either SLE or DM during the baseline period were excluded from this cohort.

We required that all individuals had ≥ 12 months of continuous enrollment in Medicaid from the index date. Patients with ICD-9 codes for pregnancy during the follow-up period were

excluded. We then used a SAS matching greedy algorithm to match each SLE patient by age at index date and sex to two DM patients and to four general Medicaid population patients[21].

Data Collection

Baseline Covariables—Patient characteristics for all cohorts were collected during the baseline period: age, sex, self-reported race/ethnicity, U.S. region of residence, zip code-level socioeconomic status (SES) in quartiles using median household income from 2007–2010 U.S. Census data as a proxy.

Using ICD-9, Diagnosis Related Group code (DRG) and/or Current Procedural Terminology (CPT) codes, we collected covariables in the baseline period, including the number of outpatient physician visits, smoking, obesity, and hypertension. Hyperlipidemia was defined by ICD-9 codes without accounting for lipid lowering medication (Supplemental Table S1). CVD at baseline was defined as the presence of any of the following covariables during the baseline period: acute myocardial infarction (MI), old MI, angina, percutaneous coronary intervention (PCI), coronary atherosclerosis, coronary artery bypass graft (CABG), cerebrovascular accident (CVA), peripheral vascular disease (PVD), carotid artery stenosis, and heart failure (Supplemental Table S1).

We calculated a Charlson comorbidity index for all patients and SLE-specific risk adjustment index for SLE patients[22]. We identified filled prescriptions using National Drug Codes (NDC) and summed the number of unique medications filled per subject during the baseline period. For SLE patients, we assessed baseline prescriptions for glucocorticoid (prednisone, methylprednisolone, dexamethasone, hydrocortisone, prednisolone, and cortisone defined as prednisone equivalents), prescriptions for hydroxychloroquine, and immunosuppressive drugs (mycophenolate mofetil, mycophenolic acid, cyclophosphamide, azathioprine, cyclosporine, methotrexate, leflunomide, rituximab, and tacrolimus). We assessed insulin prescriptions during the baseline period. We used NDC to assess the baseline use of statins, which may alter the frequency of lipid testing.

Outcomes—We used CPT codes to identify lipid testing in billing claims, and NDC to identify statin prescription dispensing both at baseline and in follow-up for all subjects[23].

Statistical Methods

We examined the sociodemographic and clinical characteristics in each cohort and compared these using descriptive statistics. We calculated the proportion of patients with ≥ 1 lipid testing and ≥ 1 statin prescription dispensed during the 12-month follow-up period in each cohort, and compared these proportions with Chi-squared tests. Within the SLE cohort, we examined the odds ratios for lipid testing and statin prescription dispensing using multivariable logistic regression, adjusted for age, sex, race/ethnicity, U.S. region, SES, number of medications, number of outpatient visits, glucocorticoid use, SLE risk adjustment index[22], baseline CVD and lupus nephritis. We conducted similar logistic regression analyses within the DM cohort, adjusting for age, sex, race/ethnicity, U.S. region of residence, socioeconomic status, number of medications, number of outpatient visits, insulin use, Charlson comorbidity index, baseline CVD and diabetic nephropathy. Similar logistic

regression analyses were conducted within the general Medicaid population cohort, adjusting for the same factors except for insulin use and nephropathy.

In analyses comparing lipid testing and statin prescription fill rates between age- and sex-matched SLE, DM and general Medicaid population cohorts, conditional logistic regression analyses were used to preserve the matching. Sensitivity analyses were performed in separate logistic regression analyses adjusting for the matching factors and a) including only patients with baseline CVD, or excluding b) patients with baseline CVD, c) patients with baseline lipid testing and, d) patients with baseline statin prescriptions.

All analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC). Data were obtained from the Centers for Medicare and Medicaid Services (CMS) through an approved Data Use Agreement; cell sizes <11 were suppressed in accordance with CMS policies. The Partners' Healthcare Institutional Review Board approved this study.

RESULTS

Cohort Sociodemographic and Clinical Characteristics

The SLE cohort included 25,950 patients, of whom 92% were female with a mean age of 41.4 (±11.9) years (Table 1). The age- and sex-matched DM cohort was comprised of 51,900 patients, and the matched general Medicaid population cohort was comprised of 103,800 patients. During the cohort selection, 5,580 patients fulfilled both SLE cohort and DM cohort criteria and were not included in either cohorts. The SLE cohort had a higher proportion of Black patients compared to the DM and general Medicaid population cohorts. The geographic distribution was similar between the SLE and DM cohorts, but the general Medicaid population cohort included more patients in the West and fewer patients in the South.

The prevalence of baseline CVD was 14% in the SLE cohort, and 13% in the DM cohort, and lowest in the general Medicaid population (4%), $p<0.001$. A higher proportion of patients in the SLE cohort had renal involvement: 21% of the SLE patients had lupus nephritis and 7% of the DM patients had diabetic nephropathy by our definitions, $p<0.001$. Hypertension was prevalent in both SLE and DM cohorts (35% and 41%, $p<0.001$), and obesity and hyperlipidemia as identified by ICD-9 codes were more prevalent in the DM cohort and less prevalent in the general Medicaid population (Table 1).

Lipid Testing and Statin Prescriptions within each Cohort

Overall, 24% of SLE patients, 43% of DM patients and 16% of the age- and sex-matched general Medicaid population cohorts had received ≥ 1 lipid testing during the one year observation period (Table 2). In all age categories, more DM patients than SLE patients received lipid testing ($p<0.001$). The proportion of SLE patients tested increased with age, whereas the proportion of patients who had ≥ 1 lipid testing in the DM cohort did not. Among the patients with lupus nephritis, 27% had received lipid testing.

The proportion of SLE patients with ≥ 1 statin prescription dispensed during the year-long observation period was 11% compared to 33% for the DM patients, $p<0.001$ (Table 3). In

the general Medicaid population, 7% had ≥ 1 statin prescription dispensed. In all age categories, a higher proportion of DM patients compared to SLE patients were dispensed statins (p<0.001). A higher proportion of patients with renal involvement had ≥ 1 statin prescription: 17% of those with lupus nephritis (compared to 11% for SLE, p<0.001), and 35% of those with diabetic nephropathy (compared to 33%, p=0.001).

Within the SLE cohort, increased odds of having lipid testing were associated with older age, more outpatient visits and medications, glucocorticoid use, and presence of lupus nephritis (Table 4). Higher odds for undergoing lipid testing were also observed for Asian (OR 1.86, 95% CI 1.58–2.19), Hispanic (OR 1.37, 95% CI 1.25–1.50) and Black (OR 1.09, 95% CI 1.01–1.18) compared to White patients. Older age, Asian race, more medications, glucocorticoid use, and lupus nephritis were associated with an increased odds of statin prescription, as well as baseline CVD (Table 4). In multivariable models within the SLE cohort, lupus nephritis was associated with a higher odds of lipid testing (OR 1.39, 95% CI 1.29–1.51) and statin prescription filling (OR 2.39, 95% CI 2.16–2.65), and within the DM cohort, diabetic nephropathy was associated with a slightly increased lipid testing (OR 1.09, 95% CI 1.01–1.18) and statin prescription filling (OR 1.15, 95% CI 1.06–1.25) (Supplemental Table S2). Factors associated with lipid testing and statin prescription in patients with DM and the general Medicaid population cohorts are displayed in Supplement Table S2 and S3. The associations were similar in sensitivity analyses that excluded patients with baseline CVD (Table 4), baseline lipid testing, or baseline statin use in separate models.

Lipid Testing and Statin Use across Cohorts

In multivariable conditional logistic regression analyses, compared to age- and sex-matched DM patients, SLE patients were 66% less likely to have lipid testing (OR 0.34, 95% CI 0.34–0.35) and 82% less likely to have a statin prescription dispensed during the 12-month period (OR 0.18, 95% CI 0.18–0.18). The results remained similar in sensitivity analyses excluding patients with baseline CVD, baseline lipid testing and baseline statin use in separate models. Compared to the general Medicaid population, SLE patients had similar odds ratio of lipid testing, but were less likely to have a statin prescription dispensed during the 12-month period (OR 0.89, 95% CI 0.84–0.94) (Tables 5, 6). On the contrary, compared to the general Medicaid population, DM patients had a 2.79 increased odds of having their lipids tested (95% CI 2.71–2.87) and 4.93 increased odds of having a statin dispensed (95% CI 4.75–5.11). In examinations of age-stratified groups, SLE and DM patients aged 18–39 both had increased odds of lipid testing and statin prescription dispensed compared to the general Medicaid population (Tables 5, 6). However, within the 40–49 and 50–65 age groups, SLE had lower odds of lipid testing and statin prescription compared to the general Medicaid population, whereas the odds remained greater for DM compared to the general Medicaid population across all age groups. In sensitivity analyses, the lower odds among SLE patients compared to the general population was most pronounced in patients with baseline CVD for both lipid testing and statin prescription.

DISCUSSION

In this large cohort study within Medicaid, SLE patients had more prevalent CVD at baseline compared to age- and sex-matched DM patients, but were 66% less likely to have their lipids tested and 82% less likely to have a statin prescription dispensed during one year of follow-up. The proportion of patients who received lipid testing increased with age in the SLE cohort, but remained well below the proportion observed in the DM cohort. In contrast, testing in the DM cohort was high across the age ranges, suggesting that DM patients receive more consistent and frequent lipid testing regardless of age. These findings are consistent with a previous population-based cohort study of mortality and CVD among patients with SLE in Wisconsin in which low proportions of lipid testing and statin prescription among those who were diagnosed with hyperlipidemia were reported[24]. In that study, lipid tests were performed in only 66% of patients with SLE during mean follow-up of 7.7 years and less than 20% of patients with hyperlipidemia diagnosis were prescribed a statin.

As our primary analyses do not distinguish between primary and secondary prevention in comparing lipid testing and statin prescriptions in each cohort, we performed sensitivity analyses excluding those with history of CVD during baseline period, which showed similar results in each cohort. Of note, while baseline CVD was associated statin prescriptions in all cohorts, the presence of CVD among SLE and DM patients was not associated with increased lipid testing, as it was for the general Medicaid population. In fact, the presence of baseline CVD was associated with lower odds of lipid testing among DM patients, suggesting that, for secondary prevention, DM patients may be prescribed statins without repeat lipid testing. For SLE patients, there was no association seen with baseline CVD and lipid testing and this remained the same in sensitivity analysis in which those with baseline statin use were excluded. In sensitivity analyses across cohorts, excluding patients with baseline CVD, the odds of both lipid testing and statin prescription were more similar to general Medicaid patients for SLE, while the ORs became slightly higher for DM compared to general Medicaid population. On the other hand, including only patients with baseline CVD, the odds of lipid testing and statin prescription decreased even further for SLE compared to general Medicaid, and remained elevated for DM, though to a lesser extent.

Among the patients who were excluded from our study as they fulfilled criteria for both SLE and DM, the rates of lipid testing was 40% and statin prescription was 29%. Both these rates were higher than those among SLE patients, but slightly lower than those among DM patients, as expected. Both lupus nephritis and diabetic nephropathy have been associated with higher CVD risk than SLE or DM without renal involvement[25,26]. We found that both lupus nephritis and diabetic nephropathy were associated with higher odds of lipid testing and statin prescriptions dispensed compared to those without renal involvement. However, the presence of lupus nephritis increased the odds of lipid testing and statin prescription by higher ratios in SLE patients compared to diabetic nephropathy in DM patients. This suggests that renal involvement may lead to more awareness and confers more aggressive CVD risk prevention in both cohorts though to a lesser extent in DM patients. Additionally, polypharmacy was associated with higher odds ratios for lipid testing and statin prescription dispensing within all cohorts. This may be a provider effect in that those who prescribe more

medications may also provide more testing and statin prescriptions. It may also be that these patients are more willing to have testing and take medications, or that they have more comorbidities, putting them at higher CVD risk.

In this study to assess CVD risk management in SLE patients, we identified a comparison age- and sex-matched population of DM, a condition considered to be a CVD risk equivalent in which aggressive CVD risk management efforts, including annual lipid testing[27–30], have led to decreased mortality[5]. SLE has not been similarly established as a recognized independent risk factor for CVD, although CVD risks are greatly elevated and even higher than those of age- and sex-matched DM patients and general Medicaid population[1–3,31]. The 2009 SLE quality indicator set recommendation for annual lipid testing for CVD risk assessment is based on expert consensus rather than clinical trial evidence, as the benefits and cost-effectiveness of yearly lipid testing compared to less frequent screening labs have not been demonstrated[8]. In our sensitivity analyses, when patients who received baseline lipid testing were excluded, the proportion of SLE patients who received lipid testing during follow-up decreased from 24% to 18%, demonstrating that 25% of the patients who received lipid testing in follow-up had received lipid testing during the baseline period as well.

Statins decrease CVD risk in the general population and in DM patients[5,32,33]. SLE patients tolerate statins well, experience lipid-lowering effects similar to those of the general population, and have been shown to have significant mortality benefit with statin use in one retrospective study in Taiwanese SLE patients with hyperlipidemia[12,34]. It has been postulated that SLE patients may additionally benefit from anti-inflammatory effect of statins for CV risk modification, however this has not been proven. No statin trials in SLE have yet examined CVD hard outcomes as enrollment in prevention trials has proven challenging in this population[35]. Previous trials looking at the effects of atorvastatin on coronary artery calcium scores as a surrogate for CVD outcome have not been conclusive. Furthermore, changes in coronary artery calcium may not be appropriate surrogates for statin efficacy, as statins have a well-established track record in reducing major CV events in patients with and without established CVD, and yet have been shown to increase coronary artery calcium[36–38]. One possible explanation for this observation is that statins may increase coronary artery calcium content as they stabilize plaques and decrease CVD events.

In one trial of 60 SLE patients randomized to atorvastatin 40 mg daily or placebo, coronary artery calcium deposits increased in the placebo group, but not in the intervention group at one year[39]. Another trial involving 200 SLE patients randomized to atorvastatin 40 mg daily versus placebo showed no significant difference in coronary artery calcium score or SLE disease activity after two years[40]. However, in a *post hoc* analysis, fewer SLE subjects randomized to atorvastatin had progression of carotid intimal media thickness(CIMT)/ plaque compared to those on placebo[40]. Among pediatric SLE patients randomized to atorvastatin (versus placebo), a non-significantly reduced progression of CIMT in the atorvastatin group was reported[41]. Additionally, subgroup analysis revealed that patients with higher baseline high sensitivity C-reactive protein had lower progression on atorvastatin[42]. However, a meta-analysis of 3 statin trials including 493 SLE patients reported no statistical improvement in CIMT, although this surrogate for CVD is controversial[43]. Unfortunately, as past trials have been limited and inconclusive, there are no

current clear guidelines for statin therapy in SLE for CVD risk, which may be reflected in the low rates of lipid testing and statin use observed in this high-risk population.

Our study has a number of strengths and limitations that merit discussion. First, MAX database provides a very large, racially and ethnically diverse population. However, generalizability of these findings to populations of higher socioeconomic status and private medical insurance is unknown. While we used published methods to identify SLE[16,44–46], and DM[18], the possibility of misclassification exists. There may also be possible misclassification of covariables, in particular obesity and smoking, using ICD-9 codes[47,48], as well as the possibility of incompletely capturing baseline covariates such as CVD within a 6-month covariate assessment period. Disease duration may influence lipid testing and statin prescription rates, but we were not able to assess for this effect in these prevalent cohorts. Claims data lack information about lipid testing results, which would have allowed for evaluation of whether patients are receiving appropriate statin therapy based on traditional risk factors. Additionally, as our data only extends only through 2010, we were unable to assess uptake of the 2009 quality indicator recommendations for SLE and the effect of these recommendations on CVD outcomes[8].

Our study demonstrates that despite recommendations for annual CVD risk assessment, only 24% of these Medicaid beneficiaries with SLE received lipid testing during a one year period. Additionally, despite more prevalent CVD at baseline compared to age- and sex-matched DM patients, SLE patients received significantly less lipid testing and filled fewer statin prescriptions. Preventive CVD care for SLE patients with Medicaid is not consistently performed and efforts should be made to establish and to disseminate clear evidence-based guidelines to improve care and outcomes for this high-risk population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Significance and Innovation

- SLE patients have similar risk of CVD compared to age- and sex-matched DM patients, but whether CVD risk assessment and management is performed among SLE patients is unknown.
- In this large cohort study, only 24% of U.S. Medicaid recipients with SLE received lipid testing during a one-year follow-up period.
- SLE patients were 66% less likely to have lipid testing, and 82% less likely to fill a statin prescription compared to age- and sex-matched patients with diabetes mellitus.
- Despite consensus-based recommendation for annual CVD risk assessment, this study demonstrates low rates of intervention of CVD preventive care among Medicaid recipients with SLE.

Table 1

Baseline Characteristics for SLE, age- and sex-matched DM and age- and sex-matched general Medicaid cohorts through index date

	SLE	DM	General Medicaid
Cohort size (N)	**25,950**	**51,900**	**103,800**
Female (N, %)	23,903 (92%)	47,806 (92%)	95,612 (92%)
Mean age in years (age, SD)	41.4 (±11.9)	41.4 (+11.9)	41.4 (11.9)
Age 18–39 (N, %)	11,674 (45.0%)	23,295 (45%)	46,646 (45%)
Age 40–49 (N, %)	7,305 (28%)	14,636 (28%)	29,259 (28%)
Age 50–65 (N, %)	6,971 (27%)	13,969 (27%)	27,895 (27%)
Outpatient visits (mean #, SD)	4.5 (±4.6)	3.5 (±3.9)	1.8 (±2.9)
U.S. Region of Residence			
West (N, %)	5,352 (21%)	10,023 (19%)	28,888 (28%)
Northeast (N, %)	5,567 (21%)	10,657 (21%)	22,162 (21%)
South (N, %)	9,975 (38%)	19,789 (38%)	30,810 (30%)
Midwest (N, %)	5,056 (19%)	11,431 (22%)	21,940 (21%)
Race/Ethnicity			
White (N, %)	8,944 (35%)	24,001 (46%)	49,855 (48%)
Black (N, %)	11,108 (43%)	15,835 (31%)	23,430 (23%)
Hispanic (N, %)	4,072 (16%)	8,311 (16%)	23,640 (23%)
Asian (N, %)	805 (3%)	1,554 (3%)	3,061 (3%)
American Indian/Alaskan Native (N, %)	262 (1%)	638 (1%)	985 (1%)
Lupus nephritis/Diabetic nephropathy (N, %)	5,333 (21%)	3,606 (7%)	
Baseline Comorbidities			
Hypertension (N, %)	8,978 (35%)	21,018 (41%)	13,686 (13%)
Obesity (N, %)	924 (4%)	5,650 (11%)	2,445 (2%)
Hyperlipidemia (N, %)	2,532 (10%)	12,624 (24%)	6,524 (6%)
Smoking (N, %)	1,564 (6%)	2,855 (6%)	4,229 (4%)
Presence of CVD * (N, %)	3,729 (14%)	6,628 (13%)	4,541 (4%)
Mean total number of medications (#, SD)	10.1 (±9.4)	10.6 (±9.7)	3.6 (±5.6)
Hydroxychloroquine use (N, %)	9,795 (38%)	130 (<1%)	173 (<1%)
Immunosuppressants † (N, %)	5,580 (22%)	516 (1%)	517 (1%)
Glucocorticoid use ≥ 10 mg/day ever (N, %)	10,071 (39%)	3,603 (7%)	4,400 (4%)
Insulin (N, %)	117 (1%)	13,405 (26%)	
SLE risk adjustment index (mean, SD)	1.0 (±1.9)		
Charlson Comorbidity Index (mean, SD)	1.8 (±1.3)	1.7 (±1.3)	0.4 (±1.2)
Baseline lipid testing (N, %)	4,590 (18%)	18,294 (35%)	10,082 (10%)
Baseline statin prescription (N, %)	2,204 (9%)	13,605 (26%)	4,457 (4%)

Baseline period: 6 months of continuous Medicaid enrollment through index date

Index date: For SLE and DM cohorts, defined as when third ICD-9 code for either SLE or DM were met, each ≥ 30 days apart; For general Medicaid cohort, date of any ICD-9 code for non-SLE and non-DM diagnoses on same index date as each age- and sex-matched SLE patient

[*] CVD: Baseline presence of any cardiovascular disease (CVD) by ICD-9 codes for angina, MI, old MI, PCI, atherosclerosis, CVA, CABG, PVD, carotid stenosis, heart failure

[†] Immunosuppressant: mycophenolate mofetil, mycophenolic acid, cyclophosphamide, azathioprine, cyclosporine, methotrexate, leflunomide, rituximab and Tacrolimus

Abbreviations: SLE, systemic lupus erythematosus; DM, diabetes mellitus; CVD, cardiovascular disease

Table 2

Proportion of patients* with ≥1 lipid testing during one year from index date for all cohorts, general and stratified by baseline covariables

	SLE	DM	General Medicaid
Cohort size (N)	**25,950**	**51,900**	**103,800**
General	**6,310 (24%)**	**22,389 (43%)**	**16,454 (16%)**
Sex			
Female	24%	43%	16%
Male	23%	41%	16%
Age			
18–39	22%	42%	10%
40–49	25%	45%	19%
50–65	28%	44%	22%
Outpatient Visits†			
High	32%	54%	20%
Low	14%	25%	10%
Race/ethnicity			
White	23%	41%	16%
Black	22%	39%	16%
Hispanic	29%	52%	14%
Asian	37%	63%	26%
American Indian/Alaskan Native	19%	35%	13%
U.S. Region of residence			
West	29%	52%	13%
Northeast	25%	44%	19%
South	25%	43%	18%
Midwest	20%	35%	14%
SES Quartile			
1st	23%	43%	18%
2nd	24%	42%	16%
3rd	25%	44%	16%
4th	25%	44%	14%
Lupus nephritis/Diabetic nephropathy	27%	38%	
Cardiovascular disease (CVD)			
Present	28%	45%	33%
Not present	24%	43%	15%
# Medications†			
High	35%	57%	24%
Low	14%	31%	9%
Charlson comorbidity index†			
High	27%	43%	24%
Low	23%	43%	14%

	SLE	DM	General Medicaid
Glucocorticoid Use ≥10 mg/day ever			
Yes	31%	54%	27%
No	20%	42%	15%

*Proportion described as percentage of patients with variable in cohort who received lipid testing at one year (i.e., 24% of females in the SLE cohort received lipid testing at one year).

†High: Equal to and higher than median; Low: lower than median

Abbreviations: SLE, systemic lupus erythematosus; DM, diabetes mellitus; CVD, cardiovascular disease

Table 3

Proportion of patients* with ≥1 statin prescription during one year from index date for all cohorts, general and stratified by covariables

	SLE	DM	General Medicaid
Cohort size (N)	**25,950**	**51,900**	**103,800**
General	**2,777 (11%)**	**17,045 (33%)**	**6,926 (7%)**
Sex			
Female	11%	33%	7%
Male	12%	31%	7%
Age			
18–39	7%	24%	1%
40–49	10%	38%	7%
50–65	17%	43%	15%
Outpatient Visits†			
High	14%	39%	8%
Low	7%	23%	4%
Race/ethnicity			
White	11%	31%	7%
Black	10%	29%	7%
Hispanic	11%	40%	4%
Asian	16%	51%	9%
American Indian/Alaskan Native	6%	29%	5%
U.S. Region of residence			
West	11%	37%	4%
Northeast	12%	38%	8%
South	10%	29%	8%
Midwest	12%	31%	8%
SES Quartile			
1st	11%	33%	8%
2nd	10%	32%	7%
3rd	11%	33%	6%
4th	11%	34%	6%
Lupus nephritis/Diabetic nephropathy	17%	35%	
Cardiovascular disease (CVD)			
Present	22%	44%	30%
Not present	9%	31%	6%
# Medications†			
High	18%	49%	12%
Low	4%	19%	2%
Charlson comorbidity index†			
High	14%	34%	14%
Low	8%	32%	5%

	SLE	DM	General Medicaid
Glucocorticoid Use ≥10 mg/day ever			
Yes	15%	42%	15%
No	8%	32%	6%

*Proportion described as percentage of patients with variable in cohort who received statin prescription at one year (i.e., 11% of females in the SLE cohort received statin prescription at one year).

†High: Equal to and higher than median; Low: Lower than median

Abbreviations: SLE, systemic lupus erythematosus; DM, diabetes mellitus; CVD, cardiovascular disease

Table 4

Multivariable logistic regression analyses for odds ratios of lipid testing and statin prescription for SLE cohort

	Lipid Testing			Statin Prescription		
	SLE Cohort*	SLE Cohort Excluding Baseline CVD†	SLE Cohort with Baseline CVD‡	SLE Cohort*	SLE Cohort Excluding Baseline CVD†	SLE Cohort with Baseline CVD‡
	N=25,950	N=22,221	N=3,729	N=25,950	N=22,221	N=3,729
	Odds ratio (95%CI)	Odds ratio (95%CI)	Odds ratio (95%CI)	Odds ratio (95%CI)	Odds ratio (95%CI)	Odds ratio (95%CI)
Age						
18–39	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
40–49	**1.28 (1.19–1.38)**	**1.27 (1.17–1.37)**	**1.38 (1.23–1.69)**	**1.71 (1.53–1.91)**	**1.71 (1.51–1.95)**	**1.68 (1.33–2.12)**
50–65	**1.57 (1.46–1.69)**	**1.57 (1.45–1.71)**	**1.58 (1.30–1.92)**	**3.15 (2.83–3.50)**	**3.42 (3.03–3.86)**	**2.41 (1.93–3.01)**
Sex						
Female	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Male	1.04 (0.93–1.17)	1.02 (0.90–1.16)	1.12 (0.88–1.44)	**1.23 (1.06–1.43)**	**1.23 (1.03–1.47)**	1.20 (0.91–1.57)
Race/ethnicity						
White	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Black	**1.09 (1.01–1.18)**	**1.10 (1.02–1.19)**	1.04 (0.87–1.26)	**0.87 (0.79–0.97)**	0.90 (0.79–1.01)	**0.81 (0.66–0.99)**
Hispanic	**1.37 (1.25–1.50)**	**1.37 (1.24–1.52)**	**1.34 (1.05–1.72)**	1.06 (0.93–1.21)	1.11 (0.95–1.29)	0.93 (0.71–1.23)
Asian	**1.86 (1.58–2.19)**	**1.85 (1.56–2.20)**	**1.88 (1.15–3.06)**	**1.56 (1.25–1.95)**	**1.68 (1.32–2.14)**	1.08 (0.62–1.87)
American Indian/Alaskan Native	0.74 (0.54–1.03)	0.80 (0.57–1.12)	0.35 (0.10–1.25)	**0.57 (0.34–0.96)**	0.58 (0.33–1.03)	0.51 (0.14–1.81)
Outpatient visits[c]	**1.06 (1.05–1.07)**	**1.06 (1.05–1.07)**	**1.06 (1.05–1.08)**	1.00 (0.99–1.01)	0.99 (0.98–1.00)	**1.02 (1.00–1.03)**
Number of medications[c]	**1.04 (1.04–1.05)**	**1.04 (1.04–1.05)**	**1.05 (1.04–1.06)**	**1.07 (1.06–1.07)**	**1.07 (1.06–1.07)**	**1.06 (1.05–1.07)**
Glucocorticoid use ≥ 10 mg/day ever	**1.07 (1.00–1.15)**	**1.09 (1.01–1.17)**	1.01 (0.84–1.20)	**1.22 (1.11–1.34)**	**1.21 (1.08–1.35)**	**1.24 (1.02–1.50)**
SLE risk adjustment index[c]	0.98 (0.96–1.00)	0.98 (0.95–1.00)	0.98 (0.95–1.01)	0.98 (0.96–1.01)	1.00 (0.97–1.04)	0.98 (0.95–1.01)
Presence of CVD	1.06 (0.97–1.17)	-	-	**2.04 (1.82–2.29)**	-	-
Presence LN	**1.39 (1.29–1.51)**	**1.44 (1.32–1.57)**	**1.22 (1.02–1.47)**	**2.39 (2.16–2.65)**	**2.88 (2.55–3.24)**	**1.44 (1.18–1.75)**

*SLE cohort multivariable logistic regression analysis adjusted for age, sex, race, US region of residence, socioeconomic status, # outpatient visits, # medications, glucocorticoid use, SLE risk adjustment index, presence of CVD, presence of LN

†SLE Cohort sensitivity analysis excluding patients with baseline presence of CVD, multivariable logistic regression analysis adjusting for age, sex, race, US region of residence, socioeconomic status, # outpatient visits, # medications, glucocorticoid use, SLE risk adjustment index, presence of LN

‡SLE Cohort sensitivity analysis including only patients with baseline presence of CVD, multivariable logistic regression analysis adjusting for age, sex, race, US region of residence, socioeconomic status, # outpatient visits, # medications, glucocorticoid use, SLE risk adjustment index, presence of LN

Abbreviations: SLE, systemic lupus erythematosus; CVD, cardiovascular disease; LN, lupus nephritis

Table 5

Odds ratio of lipid testing for SLE and DM compared to general Medicaid population, overall and stratified by age groups and baseline CVD status

		General Medicaid	SLE	DM
	N	(Reference)	OR (95% CI)	OR (95% CI)
Overall	181,650	1.0	**0.96 (0.92–1.00)**	**2.79 (2.71–2.87)**
Age 18–39	81,615	1.0	**1.31 (1.23–1.40)**	**4.22 (4.02–4.44)**
Age 40–49	51,200	1.0	**0.83 (0.78–0.89)**	**2.39 (2.26–2.51)**
Age 50–65	48,835	1.0	**0.77 (0.71–0.82)**	**1.89 (1.80–2.00)**
Excluding baseline CVD	166,752	1.0	0.98 (0.94–1.03)	**2.98 (2.89–3.07)**
With baseline CVD	14,898	1.0	**0.55 (0.49–0.61)**	**1.26 (1.15–1.38)**

Conditional multivariable logistic regressions with all three cohorts (SLE, DM, general Medicaid population) combined, adjusted for age, sex, race, U.S. region of residence, socioeconomic status, # outpatient visits, # medications, Charlson comorbidity index, presence of CVD, lupus nephritis/diabetic nephropathy—overall, stratified by age groups, and by baseline CVD status (did not adjust for presence of CVD when stratified by baseline CVD status).

Abbreviations: SLE, systemic lupus erythematosus; DM, diabetes mellitus; CVD, cardiovascular disease; OR, odds ratio

Table 6

Odds ratio of statin prescription for DM and SLE compared to general Medicaid population, overall and stratified by age groups and baseline CVD status

		General Medicaid	SLE	DM
	N	(Reference)	OR (95% CI)	OR (95% CI)
Overall	181,650	1.0	**0.89 (0.84–0.94)**	**4.93 (4.75–5.11)**
Age 18–39	81,615	1.0	**2.52 (2.23–2.84)**	**13.66 (12.46–14.97)**
Age 40–49	51,200	1.0	**0.87 (0.79–0.96)**	**5.60 (5.24–5.97)**
Age 50–65	48,835	1.0	**0.58 (0.53–0.63)**	**2.83 (2.67–2.99)**
Excluding baseline CVD	166,752	1.0	**0.91 (0.86–0.97)**	**5.83 (5.60–6.07)**
With baseline CVD	14,898	1.0	**0.52 (0.47–0.59)**	**1.49 (1.36–1.63)**

Conditional multivariable logistic regressions with all three cohorts (SLE, DM, general Medicaid population) combined, adjusted for age, sex, race, U.S. region of residence, socioeconomic status, # outpatient visits, # medications, Charlson comorbidity index, presence of CVD, lupus nephritis/diabetic nephropathy—overall, stratified by age groups, and by baseline CVD status (did not adjust for presence of CVD when stratified by baseline CVD status).

Abbreviations: SLE, systemic lupus erythematosus; DM, diabetes mellitus; CVD, cardiovascular disease; OR, odds ratio