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Quality of Care for the Screening, Diagnosis, and Management of Lupus Nephritis Across Multiple Healthcare Settings

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Abstract

Objective: We examined quality measures for screening, diagnosis and treatment of lupus nephritis (LN) among participants of the California Lupus Epidemiology Study (CLUES) across 25 different clinical sites to identify gaps in quality of care.

Methods: Data from 250 lupus participants was analyzed across three sources (medical records, physician examination, and patient interviews). Overall performance on eight quality measures was calculated separately for participants with and without LN. We used generalized estimating equations in which the outcome was performance on measures, adjusting for participant demographics, lupus disease severity and practice characteristics.

Results: Of 148 patients without LN, 42% had screening labs for nephritis, 38% had lupus activity serologies and 81% had blood pressure checked every 6 months. Of 102 LN patients, 67% had a timely kidney biopsy, at least 81% had appropriate treatment and 78% achieved target blood pressure within 1 year of diagnosis. Overall performance in participants across quality measures was 54% (no LN) and 80% (LN). Significantly higher overall performance for screening measures for LN was seen at academic (63.4–73%) versus community clinics (37.9–38.4%). Similarly, among those with LN, higher performance in academic (84.1–85.2%) versus community clinics (54.8–60.2%) was observed for treatment measures.

Conclusion: In this quality of care analysis across 25 diverse clinical settings, we found relatively high performance on measures for management of LN. However, future work should focus on bridging the gaps in lupus quality of care for patients without nephritis, particularly in community settings.

Kidney involvement is seen in up to 60% of systemic lupus erythematosus (SLE) patients with progression to end stage kidney failure in lupus nephritis (LN) in 10–30% of patients within 15 years of diagnosis (1). Given the high morbidity and mortality of LN, early

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diagnosis and treatment are important. Prior studies examined treatment options and their toxicities for LN once LN is diagnosed, but no studies have evaluated performance on a comprehensive set of quality measures related to screening for, diagnosing, and managing LN (2).

A SLE quality indicator set was developed in 2009 using scientific evidence and expert consensus; these indicators have served as tools to assess SLE health care quality in cohort studies, clinic populations and administrative data (3–7). Subsequent American College of Rheumatology (ACR) guidelines in 2012 for monitoring and treating LN included additional recommendations, such as the use of hydroxychloroquine in patients with LN to decrease cumulative kidney damage (8). Combined with previous indicators, the ACR guidelines provide an opportunity to comprehensively examine quality of care for LN.

In this study, we sought to evaluate the quality of care for screening, diagnosing, and treating LN (class III, IV or V) among participants enrolled in the California Lupus Epidemiology Study (CLUES), a study that combines patients from the California Lupus Surveillance Project (CLSP) (a population sample from 2007 to 2009) with participants enrolled from community and academic practices. We investigated differences in performance on quality measures between patients with diverse socioeconomic and racial/ethnic backgrounds with a spectrum of disease severity in diverse clinical settings, with the goal of identifying gaps in quality of care for LN.

METHODS

Data Source

Data derive from CLUES, a multi-racial/ethnic cohort of individuals with physician confirmed SLE. Starting in 2015, participants in CLUES were recruited through the CLSP, which used outpatient, hospital, and laboratory records to identify all SLE patients residing in the City and County of San Francisco 2007–2009 (9). Additional participants in the nine counties of the San Francisco Bay Area were identified through academic and community rheumatology clinics, and from earlier studies of genetic risk factors for SLE outcomes. The cohort contains patients with diverse socioeconomic status who speak a number of different primary languages.

Study procedures include collection and review of medical records, an in-person research clinic visit consisting of a history and physical examination conducted by a physician specializing in SLE, collection of biospecimens for clinical and research purposes and a structured interview by a trained research assistant. Interviews are conducted in English, Spanish, Cantonese and Mandarin. However, for this study, we relied upon data derived from physician-assessments for confirmation of SLE diagnosis and presence of LN, and assessed performance on measures from chart review as patients did not always recall whether they had LN, dates of diagnosis and timing of treatments. All SLE diagnoses are confirmed by study physicians according to any of the following definitions: (a) meeting ≥ 4 of the 11 ACR revised classification criteria for SLE as defined in 1982 and updated in 1997 (10, 11), (b) meeting 3 of the 11 ACR criteria with SLE confirmed by a study rheumatologist, or (c) a

confirmed diagnosis of LN. This combined definition of SLE has been used in prior population-based studies (9).

Study population

In all, 332 patients completed in-person study visits from whom we obtained 250 complete medical records for review (Figure 1). 134 cases were identified in CLSP. Of the 82 patients excluded from the analysis, 46 patients had a remote diagnosis of LN (>10 years prior) without sufficient records to calculate measure performance; 24 patients were from medical practices that did not share medical records despite multiple requests; two had been diagnosed in other countries without relevant records available; and 10 others were excluded for reasons specified in Figure 1.

IRB approval

The research protocol was approved by the UCSF Committee on Human Research. All participants provided informed consent to be part of the study.

Outcome measures

The outcome measures were the receipt of screening, diagnosis, and treatment consistent with quality measures for LN (Table 2), as determined through medical records review. Medical records were collected prior to CLUES study enrollment, either through the electronic systems of academic medical centers, or from paper or electronic records from outside rheumatologists. If records were incomplete, multiple requests were sent to physicians' offices for follow-up information. For patients whose physicians' offices were part of EPIC's Care Everywhere, a data sharing platform across EPIC sites, we searched those records if the original records were insufficient. All outcome determinations were based on the data found in the medical charts; where none was found, we assumed that the patient had not received the screening or treatment for that measure. Overall, we obtained records from 25 distinct medical practices.

We examined eight quality measures across three categories: 1) screening measures for those participants without a previous diagnosis of LN, 2) diagnosis measures for those with LN to examine care at the onset of suspected LN, and 3) treatment measures once LN was diagnosed. For the screening measures, performance was evaluated in the one year period prior to the CLUES study visit. The three screening performance measures were: 1) LN labs (i.e., urinalysis with quantitative measurement of proteinuria, and serum creatinine levels); 2) SLE activity serologies indicated by anti-dsDNA levels plus either C3 or C4; and 3) blood pressure. To pass each measure, the participant had to have received care for all components of the measure every six months. For example, if only a urine creatinine was checked but a quantitative test for proteinuria in the measurement year was not done, that screening measure was counted as not performed. Those with class I or II LN on a renal biopsy were included in this group given that their treatment does not differ from those without LN.

For measures regarding diagnosis and treatment of LN, we first reviewed records for the year preceding the suspected LN diagnosis to determine if a kidney biopsy was performed within one year of suspected LN (Table 2). We defined suspected LN as increasing

proteinuria or worsening kidney function as outlined in ACR guidelines (4). All of the patients included in the LN cohort either had confirmed LN (class III, IV, or V) on their kidney biopsy or had a clinical diagnosis of LN by their rheumatologist or nephrologist. For those with incident or relapsed LN, we reviewed records for the one year following diagnosis of LN by biopsy or the date that the treating specialist diagnosed LN. The five primary outcomes for these patients were time to kidney biopsy, timely treatment initiation, and adequate blood pressure control (≤140/90 mmHg) in the year following diagnosis (Table 2). The three treatment measures were initiation of: 1) immunosuppressant agents (mycophenolate mofetil or mycophenolic acid, cyclophosphamide, azathioprine, cyclosporine, tacrolimus or rituximab) within 30 days of diagnosis; 2) antimalarial medications (hydroxychloroquine or chloroquine) within one year of diagnosis; and 3) ACE (angiotensin-converting-enzyme) inhibitor or ARB (angiotensin II receptor blocker) within one year of diagnosis. These measures were adapted from the SLE Quality indicators project and from the ACR guidelines for LN (7, 8).

We calculated an overall pass rate, defined as the number of measures passed as a percentage of the number of measures for which a participant was eligible. Each measure was given equal weight rather than assigning an *a priori* level of importance to the individual measures. The pass rates were calculated separately for patients with and without a diagnosis of LN at study entry.

Covariates

Potential predictors of quality of care were age, sex, race/ethnicity (Hispanic of any race, Non-Hispanic White, Non-Hispanic African American, Asian/Pacific Islander, Mixed/Other), education level (≤ high school vs. > high school), insurance type categorized as public (Medicaid, Medicare, county and Veterans Affairs health plans) or private (all other sources) and household income (above or below 125% of the Federal Poverty Limit). SLE specific factors were disease duration as well as disease severity, measured with the Lupus Severity Index, a validated measure based on weighted values assigned to ACR criteria at the time of CLUES study enrollment (12). Age, disease duration, and Lupus Severity Index were entered into models as continuous variables after determining that the linear form of these variables provided an adequate fit to the data. We included practice setting, categorized as academic rheumatology clinic, rheumatology clinic in a large staff-model health maintenance organization (HMO), and all other community providers (consisting of solo, or small to medium-sized single or multi-specialty offices). We also examined the number of years with the current provider, since this variable could potentially relate both to the completeness of the data available and the likelihood of completion of all screening measures.

Statistical analysis

We first described the sample's demographic, clinical, and practice characteristics. The differences between patients with LN and without LN were examined using chi-square tests for categorical variables and t-test for continuous variables. Then we calculated the pass rate for each individual quality measure, defined as the percentage of patients eligible for the measure who received the requisite care, as well as the overall pass rate as described above.

To model the overall pass rate as a function of the covariates, we used generalized estimating equations (GEE) with a logit function. In these models, each measure for which a patient was eligible was entered as a separate observation; the GEE model accounted for the multiple and varying number of observations across individuals. Specifically, each participant had a varying number of measures depending on their LN status; patients without LN were eligible for the three screening measures and therefore had up to three observations each. Those with LN were eligible for the other five treatment measures and so had up to five observations each. From the GEE models, the overall pass rates were calculated from predicted marginals for the following covariates: demographic characteristics (age, gender, race/ethnicity, education, insurance status), clinical characteristics (disease duration and severity), and practice characteristics (setting and years with current provider). Poverty status was not included in these models because of the large number of missing values for this variable. Instead, both education and insurance status were included as covariates to capture socioeconomic status. For each characteristic, we calculated the pass rates first from a bivariate model and then from a multivariable model with all nine covariates.

In the primary analysis, aspects of care that were missing from the records received were counted as not performed or ‘no pass’ for that measure. However, it is possible that in some cases the care was completed, but the records we received were incomplete (i.e. were done in another clinic or hospital that we were unaware of). This was a particular issue for the quality measures related to LN treatment, which required historical records that were sometimes more than five years old. To address this issue, we recorded our certainty (high/low) regarding completeness for each medical record and performed a sensitivity analysis in which we assigned a “passing” score on all records with low certainty. For example, one patient was diagnosed with LN in 1996 with some records from that period available; however we could not determine with certainty whether they had been treated with an anti-malarial agent or ACE-inhibitor (angiotensin-converting enzyme inhibitor). In the primary analysis, this patient would not have passed those two measures, but in the sensitivity analysis, they would have passed these measures, effectively increasing the measures’ pass rates.

RESULTS

The study sample of 250 patients was predominantly women, with a younger average age in LN patients (39.0) vs. those without LN (47.7, $p<0.05$; Table 1). LN patients had an average disease duration of 11.8 ± 8.3 years vs. 17.2 ± 10.8 years in those without LN ($p<0.05$). There was a large percentage of Asian/Pacific Islander (44.1%) and Hispanic (34.3%) patients in the LN group; whereas those without LN were predominantly Non-Hispanic White (36.5%) and Asian/Pacific Islander (31.7%) ($p<0.05$). Of those with and without LN, 29.4% and 22.3%, respectively, reported having a high school level education or less. Among LN patients, 31.8% were living in poverty, defined as <125% of the Federal Poverty Limit, compared to 15.4% of those without LN ($p<0.05$). Approximately half (54.9% LN, 43.2% LN negative) of the patients had public insurance (mostly Medicare and/or Medicaid). Approximately half of the LN patients were seen in a University clinic setting (53.9%) compared to 41.9% of the patients without LN ($p<0.05$). Roughly a quarter of the

patients had seen their provider for less than 1 year (25.3% in LN group, 28.5% in LN negative group).

Table 2 shows the number of patients who were eligible for and passed each quality measure. There were 148 patients without LN, all of whom were eligible for the three screening measures for LN. 41.9% of patients had the screening labs for LN done every 6 months, 37.8% had SLE activity serologies checked every 6 months and 81.1% had blood pressure checked every 6 months in the measurement year. Of the 102 LN patients, not all were eligible for the five diagnostic and treatment measures (Table 2). Among eligible patients, 66.7% had a kidney biopsy within one year of diagnosis, at least 81% passed each of the treatment initiation measures, and 77.5% achieved target blood pressure within a year of LN diagnosis.

Overall performance across quality measures in patients without LN was 53.6% (95% CI 48.9%, 58.2%; Table 3). Across all characteristics examined, the unadjusted pass rate ranged from 30% among men to 66.1% among university clinic patients. In the multivariable model, there was a significant difference between male and female patients, with females having higher adjusted pass rates (55.5% vs. 29.4%, $p<0.05$). There was also a significantly higher adjusted pass rate among patients with private insurance (60.3% vs. 44.4%, $p<0.05$). No significant differences were seen in performance across age, race/ethnicity, education level, or disease duration groups. Those with a higher lupus severity index (LSI) had higher pass rates (57.1% in the 3rd quartile of LSI vs 49.7% in 1st quartile) but this difference did not reach statistical significance ($p<0.05$) in the adjusted model. There were significantly higher adjusted pass rates for patients whose providers were in academic versus community clinics (63.4% academic private hospital, 73% academic county hospital vs. 38% among all community providers, $p<0.05$ for difference by practice setting).

For those with LN, the overall unadjusted performance across quality measures was 79.6% (95% CI 75.9%, 82.9%; Table 4), ranging from 55.2% among patients in a staff model HMO to 86.7% among those with no education past high school. In the multivariable model, however, the only significant difference was by provider practice setting. Similarly, patients with LN cared for at academic centers had higher adjusted pass rates (84–85%), compared to those seen in community settings (55–60%; $p<0.05$).

In the sensitivity analysis, in which patients with low certainty regarding the completeness of medical records were uniformly assigned a “pass” on measures, the overall pass rate for LN patients increased from 79.6% to 88.7%. For each of the demographic and clinical characteristics examined, there was no statistically significant difference in overall performance rates. There was still a significant difference by provider practice setting. The academic centers had adjusted pass rates of 90–92%; the staff model HMO was almost as high, at 88%, compared to community settings at 70% ($p<0.05$).

DISCUSSION

This study aimed to perform a comprehensive quality of care assessment for screening, diagnosis and treatment of LN among individuals with SLE across health care settings.

There were two major findings in the study. First, there was poor performance on measures for screening for LN; several predictors were found to be related to this poor performance. We found higher performance for screening amongst women and those with private insurance, after adjustment for covariates. Second, there was a notably higher performance on both LN screening and treatment measures in academic clinics versus community clinic settings. Overall, these findings provide the first detailed assessment of quality of care for one of the most serious manifestations of SLE across diverse health care settings.

There was low performance for screening for LN with only 54% of SLE patients without LN being screened appropriately. In contrast, almost 80% of LN patients were being monitored according to guideline recommendations. It is well known that the presence of LN increases mortality; survival was shown to drop from 92% at 10 years to 88% once LN was diagnosed (8). The difference in performance may reflect the more intensive monitoring in LN patients given known reductions in kidney failure and mortality with more aggressive treatment.

We found that men without LN were less likely to receive routine laboratory monitoring. SLE-related kidney disease is known to be more common as well as severe in men (13–15). In a 1996 study of 107 male lupus patients, men died more frequently from SLE-related complications than women, with LN being the principal cause (14). Our findings may reflect the fact that men utilize less healthcare than women in general (16) across medical conditions, that men with LN are less likely to follow-up with their providers, or that men receive lower quality of care when presenting for care. Rheumatologists should be aware that this gap exists and consider more intensive outreach to male patients with SLE.

Insurance status was also found to be related to performance rate. Patients without LN who had public insurance were also found to have lower LN screening rates. A growing literature suggests that individuals with Medicaid have poor outcomes from LN (7, 17). For example, having Medicaid or no insurance was associated with greater rates of ESRD (end stage renal disease) from SLE rather than private insurance (86% and 93% respectively, versus 72%) (17). This suggests that insurance, an indicator of access to care or other social determinants of health, identifies a population at risk for lower health care quality and progression to ESRD.

Duration of time with the same provider was also associated with performance on quality measures. In those without LN, we saw higher performance on screening measures with providers who had seen the patient for less than one year. This suggests that the initial work-up may be more robust in a patient without LN but is not maintained with the recommended frequency over time. In LN patients, the difference in adhering to quality measures was not statistically significant but there was a higher rate of performance the longer the patient had been with the same provider.

The differences observed on quality measure performance between academic and community settings are noteworthy. Academic centers had higher performance than community clinics for individuals with LN and without LN. Interestingly, performance was similar between the two academic sites, one of which is a county hospital, and the other a university private hospital. Although there is some physician staffing overlap between these

centers that might explain this finding, these centers are resourced very differently, including fewer support staff at the county hospital, suggesting that high quality of care is potentially attainable in low-resource settings. It is possible that there is better documentation of standardized disease activity measures at research centers that makes adherence to quality measures more readily identified in the charts. However, the academic centers in this study did not routinely collect measures such as the SLEDAI as part of clinical care; thus, we do not think this accounts for our findings. A similar difference was reported for management of hepatocellular carcinoma (HCC) among patients screened at a large academic center versus patients diagnosed in the community (18). In that study, it was proposed that the effect of early identification of HCC was likely multifactorial, but the academic center specialists were more likely to adhere to surveillance guidelines (18). Similarly, a study that assessed SLE quality measures in patients who were followed in a dedicated lupus clinic compared to a general rheumatology clinic within the same academic institution, found that more patients in the lupus clinic received care consistent with SLE quality measures (19). Physician experience with a higher volume of SLE patients may be associated with this increase in performance, as it has been linked to lower in-hospital mortality in a prior study (20). Academic centers are more likely to experience a higher volume of SLE patients, so this may partly account for this difference. By contrast, one surgical study examining the rate of post-operative complications after carotid endarterectomy found little difference in 30-day complication rates for community versus academic settings, suggesting that there may be more standardized practice for this common procedure (21). Our findings contribute to the literature examining differences in quality of care across settings, paving the way for studies that more closely evaluate workflow and organizational factors that aim to standardize management of complex, chronic diseases like SLE.

While we made exhaustive attempts to obtain complete medical records for each patient across the 25 clinical sites, a limitation of this study is there still may have been incomplete data capture. When no evidence of the targeted labs or therapies is found, patients may not have received the appropriate management, but it is also possible that they were managed by a different center or lost to follow-up. For the primary analysis, we assumed that the missing values represented procedures that were not performed. To evaluate the robustness of our results, we also conducted a sensitivity analysis in which the patient was given a pass if we were not certain of medical record completeness. While this resulted in a higher overall pass rate, the significant predictors of a high pass rate (i.e. practice setting) did not change. The reality is probably in between these two methods; however, either approach demonstrates that there are gaps in SLE quality of care that can be improved. A second limitation includes the lack of adjustment for disease activity at the time of treatment decisions made by the treating physician. With retrospective chart analysis, disease activity scores at time of management decisions is difficult to glean, especially because laboratories that make up indices such as the SLEDAI were often missing (as evidenced by low performance on some of the measures examined in this study).

CONCLUSION:

This study is one of the first to highlight that quality of care for LN varies significantly across different clinical settings. The 250 patients in this study received care from 25 clinical

sites, across a broad spectrum of practice settings. We found performance on measures related to the management and treatment of LN was high; our findings highlight that the largest opportunities for quality improvement are in upstream processes related to screening for LN among at-risk populations. Performance was significantly higher on quality measures related to LN in academic settings, suggesting that there are opportunities for quality improvement in community settings. Future work should focus on improvement initiatives that target gaps in quality of care for SLE in the health care system.

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Appendix

Table:

Sensitivity analysis of overall pass rates for the four quality measures in 102 CLUES patients with lupus nephritis, observations with incomplete data considered as pass.

Characteristics	Unadjusted Pass Rates (95% CI)	Adjusted Pass Rates (95% CI)	Adjusted Demographics Pass Rates (95% CI)
Overall pass rate	88.7 (85.6, 91.2)		
Demographics			
Age			
1st quartile (28 years)	89.0 (85.6,92.4)	89.5 (85.9,93.1)	88.9 (85.3,92.6)
Median (35 years)	88.8 (85.9,91.7)	89.0 (86.2,91.8)	88.8 (85.9,91.7)
3rd quartile (47 years)	88.5 (85.2,91.9)	88.1 (84.8,91.4)	88.6 (85.2,91.9)
Gender			
Male	85.1 (76.7,93.4)	82.4 (72.9,91.9)	85.0 (75.9,94.1)
Female	89.5 (86.5,92.4)	89.9 (87.1,92.6)	89.5 (86.5,92.5)
Race/Ethnicity			
Non-Hispanic White **	88.9 (79.4,98.4)	91.6 (84.3,99.0)	90.2 (81.2,99.1)
Hispanic	89.0 (84.1,93.9)	88.2 (82.8,93.6)	88.8 (83.3,94.3)
Non-Hispanic African American	89.6 (83.3,95.9)	92.0 (85.5,98.6)	89.1 (82.1,96.1)
Asian/Pacific Islander	88.3 (84.0,92.6)	87.1 (82.5,91.7)	88.1 (83.5,92.6)
Education			
≤High school graduate	90.7 (85.8,95.5)	91.1 (85.7,96.5)	90.8 (85.8,95.8)
>High school	87.9 (84.4,91.4)	87.6 (83.7,91.6)	87.8 (84.2,91.5)
Insurance			
public	89.3 (85.6,93.0)	87.9 (83.6,92.2)	88.8 (84.5,93.1)
non-public	87.9 (83.5,92.3)	89.5 (85.3,93.7)	88.6 (83.8,93.4)
Clinical and Practice Characteristics			
Disease duration			

Characteristics	Unadjusted Pass Rates (95% CI)	Adjusted Pass Rates (95% CI)	Adjusted Demographics Pass Rates (95% CI)
1st quartile (5 years)	88.3 (84.6,91.9)	88.2 (84.5,91.8)	
Median (11 years)	88.7 (85.8,91.5)	88.7 (86.0,91.3)	
3rd quartile (16 years)	89.0 (85.6,92.4)	89.1 (86.1,92.0)	
Lupus severity index			
1st quartile (score=8.2)	89.4 (86.6,92.2)	89.2 (86.6,91.9)	
Median (score=8.5)	88.5 (85.6,91.4)	88.6 (85.9,91.3)	
3rd quartile (score=8.8)	87.6 (83.9,91.3)	88.0 (84.5,91.5)	
Provider Practice Setting	*		*
University clinic	90.1 (86.7,93.4)	90.2 (86.5,93.9)	
County hospital clinic	91.4 (86.0,96.9)	91.9 (86.2,97.6)	
Community, staff model HMO	86.8 (76.3,97.3)	88.1 (77.8,98.4)	
Community, other clinics	76.4 (66.5,86.3)	70.0 (59.5,80.6)	
Number of years with current provider			
< 1 year	87.8 (82.2,93.4)	86.5 (80.7,92.2)	
1–5 years	90.2 (86.1,94.3)	88.8 (84.3,93.3)	
>5 years	87.7 (82.0,93.3)	89.9 (85.6,94.3)	

Based on generalized estimating equations (GEE) with an observation for each patient for eligible quality measure. Total observations = 502.

Models adjusted for all variables shown.

*
p<0.05

**
Mixed/other race included with whites, n=1

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Significance and Innovations

1. This is the first study to look at the quality of care for the screening, diagnosis and treatment of lupus nephritis across multiple clinical settings, including community and academic clinics.
2. Systematic application of quality measures allowed identification of gaps in care, particularly for screening for lupus nephritis among those with a confirmed lupus diagnosis.
3. Across measures examined, performance was higher in academic settings than in community settings, even after adjusting for patient characteristics and disease severity.

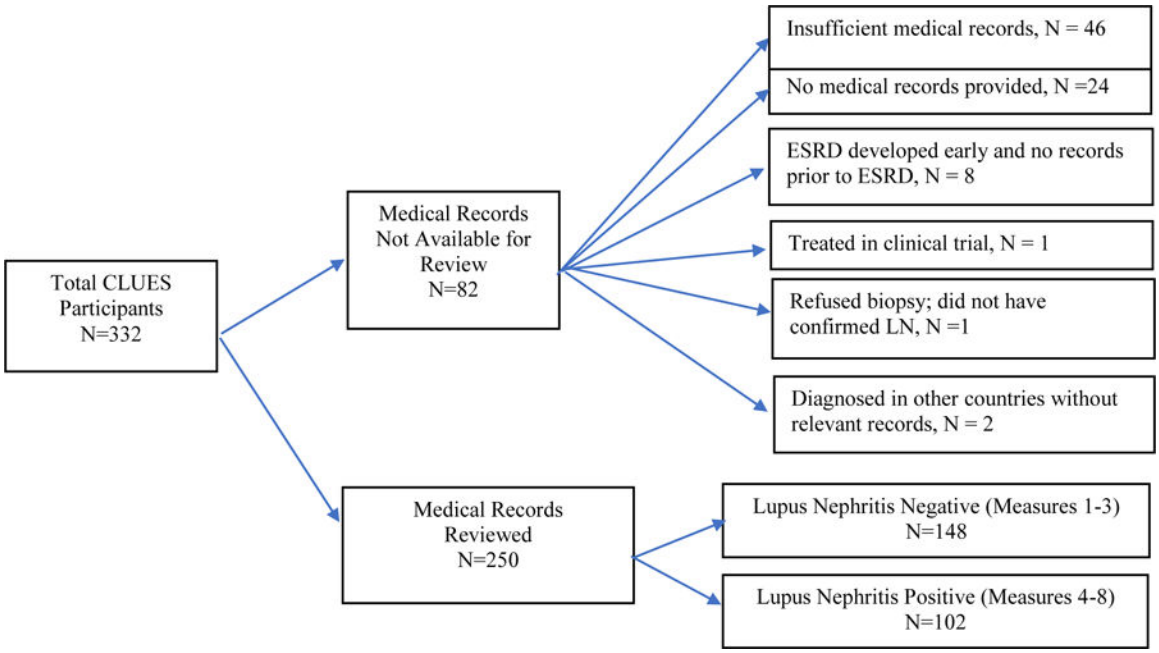

Figure 1.
Flowchart of selection of study participants

Table 1:

Baseline characteristics of participants in the California Lupus Epidemiology Study

Characteristics	Lupus Nephritis Positive (N=102)	Lupus Nephritis Negative (N=148)	
Age, years (mean±SD)	39.0±13.5	47.7±13.8	*
Women	84 (82.4)	138 (93.2)	*
Race/Ethnicity			*
Non-Hispanic White	12 (11.8)	54 (36.5)	
Hispanic	35 (34.3)	25 (16.9)	
Non-Hispanic African American	9 (8.8)	18 (12.2)	
Asian/Pacific Islander	45 (44.1)	47 (31.7)	
Mixed/other	1 (1.0)	4 (2.7)	
Education, high school graduate or less	30 (29.4)	33 (22.3)	
Insurance, public	56 (54.9)	64 (43.2)	
Living in poverty (LN positive n=88; negative n=136) **	28 (31.8)	21 (15.4)	*
Clinical and Practice Characteristics			
Lupus Severity Index, mean±SD	8.4±0.6	5.6±1.1	*
SLICC Damage Index, mean±SD	1.6±1.9	1.5±1.6	
Disease duration, years (mean±SD)	11.8±8.3	17.2±10.8	*
Provider Practice Setting			*
University clinic	55 (53.9)	62 (41.9)	
County hospital clinic	28 (27.5)	20 (13.5)	
Community, staff model HMO	8 (7.8)	20 (13.5)	
Community, other providers	11 (10.8)	46 (31.1)	
Number of years with current provider (positive n=99; negative n=144)			
< 1 year	25 (25.3)	41 (28.5)	
1–5 years	41 (41.4)	47 (32.6)	
>5 years	33 (33.3)	56 (38.9)	

Cells are n (%) unless indicated.

* $p<0.05$, were tested by chi-square tests for categorical variables and t-tests for continuous variables.

** Living in poverty defined as household income <125% of Federal Poverty Limit.

SLICC = Systemic Lupus International Collaborating Clinics

Table 2:

Description of Eight Lupus Nephritis Quality Measures, Eligibility, and Related Pass Rates

Quality Measure	Description	Eligible, n	Pass, n(%)
Screening measures (denominator population: prevalent SLE, no history of nephritis)			
1: Lupus nephritis (LN) labs	Urinalysis, urine protein/creatinine ratio, creatinine every 6 months in measurement year	148	62 (41.9)
2: SLE activity serologies	C3 or C4 and anti-DNA levels every 6 months in measurement year	148	56 (37.8)
3: Blood pressure	Blood pressure recorded every 6 months in measurement year	148	120 (81.1)
Diagnostic and treatment measures (denominator population: incident or relapsed LN)			
4: Renal biopsy *	Within 1 year of suspected LN unless contraindicated	99	66 (66.7)
5: Initiation of immunosuppressant **	Within 30 days of LN diagnosis	102	86 (84.3)
6: Initiation of anti-malarial treatment	Within 1 year	98	87 (88.8)
7: Initiation of ACE inhibitor or ARB ***	Within 1 year	102	82 (81.2)
8: Blood pressure target achieved	To reach target ≤140/90 in 1 year	102	79 (77.5)

*Based on ACR criteria for suspected LN prior to biopsy: Increasing serum creatinine without alternative causes, proteinuria more than 1gm/24 hours, or proteinuria more than 0.5gm/24 hours plus hematuria, or proteinuria more than 0.5gm/24 hours with cellular casts

**Immunosuppressant medications include mycophenolate, cyclophosphamide, azathioprine, cyclosporine, tacrolimus, rituximab

***Angiotensin-converting enzyme inhibitor (ACE); angiotensin II receptor blocker (ARB)

Notes on eligibility (by quality measure number from table):

4) Renal biopsy: 5 patients excluded from denominator because renal biopsy deemed too risky: 3 patients had APS on anticoagulation, 1 patient had ITP with intracerebral hemorrhage, 1 patient had prolonged coagulation studies.

6) Anti-malarial: 3 patients excluded from denominator because of allergy or intolerance to anti-malarial agent (ex. 1 patient with alopecia).

7) ACE inhibitor or ARB: 1 patient excluded from denominator because of renal failure presentation

Table 3:

Overall pass rates for the three screening quality measures in 148 CLUES patients without lupus nephritis

Characteristics	Unadjusted Pass Rates (95% CI)		Adjusted Pass Rates (95% CI)	
Overall pass rate	53.6 (48.9, 58.2)			
Demographics				
Age				
1st quartile (37 years)	57.0 (49.4, 64.7)		53.9 (46.9, 61.0)	
Median (50 years)	52.9 (47.2, 58.6)		53.5 (48.5, 58.6)	
3rd quartile (58 years)	50.3 (43.7, 57.0)		53.3 (46.2, 60.3)	
Gender		*		*
Male	30.0 (12.8, 47.2)		29.4 (12.5, 46.2)	
Female	55.3 (49.4, 61.3)		55.5 (50.3, 60.7)	
Race/Ethnicity				
Non-Hispanic White**	50.0 (41.1, 58.9)		55.5 (47.3, 63.8)	
Hispanic	65.3 (51.7, 78.9)		61.0 (48.5, 73.5)	
Non-Hispanic African American	46.3 (30.7, 61.9)		48.8 (35.0, 62.6)	
Asian/Pacific Islander	54.6 (44.1, 65.1)		49.0 (39.6, 58.4)	
Education				
≤High school graduate	56.6 (44.8, 68.3)		52.4 (40.1, 64.7)	
>High school	52.8 (46.2, 59.4)		53.9 (48.0, 59.9)	
Insurance				*
public	47.9 (39.4, 56.5)		44.4 (36.5, 52.4)	
non-public	57.9 (50.3, 65.6)		60.3 (53.4, 67.1)	
Clinical and Practice Characteristics				
Disease duration				
1st quartile (8.5 years)	56.5 (48.7, 64.3)		51.3 (44.6, 58.0)	
Median (17 years)	53.7 (47.9, 59.5)		53.5 (48.7, 58.4)	
3rd quartile (23.5 years)	51.6 (45.5, 57.6)		55.2 (49.7, 60.8)	
Lupus severity index		*		
1st quartile (score=4.9)	49.7 (43.1, 56.2)		49.8 (43.6, 56.0)	
Median (score=5.5)	52.9 (47.2, 58.7)		52.9 (48.0, 57.9)	
3rd quartile (score=6.3)	57.1 (50.1, 64.1)		56.9 (50.5, 63.2)	
Provider Practice Setting		*		*
University clinic	66.1 (57.1, 75.2)		63.4 (54.4, 72.4)	
County hospital clinic	65.0 (50.0, 80.0)		73.0 (57.5, 88.4)	
Community, staff model HMO	40.0 (26.4, 53.6)		38.4 (24.0, 52.9)	
Community, other providers	37.7 (29.5, 45.9)		37.9 (29.7, 46.0)	
Number of years with current provider		*		*
< 1 year	59.3 (48.9, 69.8)		58.9 (48.4, 69.5)	
1–5 years	53.2 (43.0, 63.4)		55.0 (46.3, 63.7)	
>5 years	51.2 (41.4, 61.0)		50.3 (41.9, 58.7)	

Based on generalized estimating equations (GEE) with an observation for each patient for each eligible quality measure. Total observations = 444.

Age, disease duration, and LSI entered into models as continuous variables. Pass rates shown are calculated at the 1st quartile, median, and 3rd quartile.

Models adjusted for all variables shown.

* p<0.05

** Mixed/other race included with whites, n=4

Table 4:

Overall pass rates for the five quality measures in 102 CLUES patients with lupus nephritis.

Characteristics	Unadjusted Pass Rates (95% CI)	Adjusted Pass Rates (95% CI)
Overall pass rate	79.6 (75.9, 82.9)	
Demographics		
Age		
1st quartile (28 years)	78.3 (72.6,83.9)	78.0 (72.5,83.5)
Median (35 years)	79.2 (74.7,83.6)	79.1 (75.2,82.9)
3rd quartile (47 years)	80.6 (76.6,84.7)	80.8 (76.9,84.8)
Gender		
Male	78.1 (69.4,86.9)	71.3 (59.8,82.8)
Female	79.9 (75.3,84.5)	81.0 (77.4,84.6)
Race/Ethnicity		
Non-Hispanic White **	77.9 (66.0,89.7)	82.8 (74.5,91.1)
Hispanic	82.6 (75.3,90.0)	80.8 (73.9,87.7)
Non-Hispanic African American	81.1 (73.9,88.3)	82.9 (74.8,90.9)
Asian/Pacific Islander	77.4 (71.2,83.6)	76.8 (70.5,83.2)
Education	*	
≤High school graduate	86.7 (80.4,92.9)	85.2 (77.9,92.5)
>High school	76.6 (71.6,81.6)	77.4 (72.7,82.2)
Insurance	*	
public	83.6 (78.8,88.4)	79.5 (74.2,84.9)
non-public	74.6 (67.9,81.2)	79.7 (74.4,84.9)
Clinical and Practice Characteristics		
Disease duration		
1st quartile (5 years)	79.8 (74.7,84.9)	80.0 (75.6,84.5)
Median (11 years)	79.6 (75.6,83.7)	79.6 (76.2,83.1)
3rd quartile (16 years)	79.5 (74.6,84.3)	79.3 (75.4,83.3)
Lupus severity index		
1st quartile (score=8.2)	79.5 (75.2,83.8)	79.1 (75.3,82.9)
Median (score=8.5)	79.6 (75.5,83.7)	79.8 (76.4,83.2)
3rd quartile (score=8.8)	79.7 (75.1,84.3)	80.5 (76.6,84.4)
Provider Practice Setting	*	*
University clinic	83.1 (78.2,88.0)	84.1 (79.3,89.0)
County hospital clinic	86.4 (80.4,92.4)	85.2 (77.7,92.6)
Community, staff model HMO	55.2 (38.2,72.3)	60.2 (42.5,78.0)
Community, other providers	61.8 (50.0,73.6)	54.8 (41.6,67.9)
Number of years with current provider		
< 1 year	77.2 (68.3,86.1)	74.7 (66.8,82.7)
1–5 years	80.5 (73.9,87.1)	78.3 (72.1,84.4)
>5 years	80.3 (73.5,87.1)	83.6 (78.4,88.9)

Based on generalized estimating equations (GEE) with an observation for each patient for each eligible quality measure. Total observations = 502.

Age, disease duration, and LSI entered into models as continuous variables. Pass rates shown are calculated at the 1st quartile, median, and 3rd quartile.

Models adjusted for all variables shown.

* p<0.05

** Mixed/other race included with whites, n=1