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Thirty-Day Hospital Readmissions in Systemic Lupus Erythematosus

Predictors and Hospital- and State-Level Variation

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Objective. Systemic lupus erythematosus (SLE) has one of the highest hospital readmission rates among chronic conditions. This study was undertaken to identify patient-level, hospital-level, and geographic predictors of 30-day hospital readmissions associated with SLE.

Methods. Using hospital discharge databases from 5 geographically dispersed states, we studied all-cause readmission of SLE patients between 2008 and 2009. We evaluated each hospitalization as a possible index event leading up to a readmission, our primary outcome. We accounted for clustering of hospitalizations within patients and within hospitals and adjusted for hospital case mix. Using multilevel mixed-effects logistic regression, we examined factors associated with 30-day readmission and calculated risk-standardized hospital-level and state-level readmission rates.

Results. We examined 55,936 hospitalizations among 31,903 patients with SLE. Of these hospitalizations, 9,244 (16.5%) resulted in readmission within 30 days. In adjusted analyses, age was inversely related to risk of readmission. African American and Hispanic patients were more likely to be readmitted than white patients, as were those with Medicare or Medicaid insurance (versus private insurance). Several clinical characteristics of lupus, including nephritis, serositis, and thrombocytopenia, were associated with readmission. Readmission rates varied significantly between hospitals after accounting for patient-level clustering and hospital case mix. We also found geographic variation, with risk-adjusted readmission rates lower in New York and higher in Florida as compared to California.

Conclusion. We found that ~1 in 6 hospitalized patients with SLE were readmitted within 30 days of discharge, with higher rates among historically underserved populations. Significant geographic and hospital-level variation in risk-adjusted readmission rates suggests potential for quality improvement.

Between 20% and 25% of individuals with systematic lupus erythematosus (SLE) are hospitalized each year, accounting for >140,000 hospitalizations in the US (1–3). Health care for patients with SLE is complex, and low overall quality of care and disparities in care have been reported for many care processes (4–8). Hospital readmissions are a potentially important outcome measure, given that SLE has the sixth highest readmission rate among all medical conditions in the US

(3). The prevalence of early readmission following hospitalization, a measure increasingly used to understand quality of care, cost of care, and care transitions (9), has not been studied in SLE.

Most hospitalizations related to SLE are for the treatment of disease manifestations, infections, or associated medical comorbidities (10). Previous studies of hospital utilization among SLE patients have focused on patient characteristics associated with initial hospitalization or factors associated with mortality (10–13). Identifying both risk factors associated with early readmission and variation in readmission rates among SLE patients could potentially inform efforts to improve the quality of care during initial hospitalizations as well as during ambulatory care transitions.

In this study, we investigated the 30-day all-cause hospital readmission rate for adults with SLE in a multistate sample that included a large proportion of all hospitalizations for SLE in the US. We sought to identify factors associated with readmission of SLE patients and to examine variation in risk-adjusted readmission rates at the hospital and state levels. Additionally, we compared hospital variation in readmission rates for SLE to rates for other common chronic conditions.

METHODS

Data source and population. We used data from the Healthcare Cost and Utilization Project (HCUP) 2008 and 2009 State Inpatient Databases, which are maintained by the Agency for Healthcare Research and Quality. The State Inpatient Databases include administrative data on all inpatient discharges from nonfederal acute care facilities, covering ~85% of US hospitals. These data include information on patient demographic characteristics, International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) principal and secondary diagnosis codes, expected payer, date of hospital admission, length of stay, and disposition upon discharge. Several states also provide unique patient identifiers, allowing linkage of hospitalizations for a single patient whether at the index institution or a different institution, which made it possible to calculate hospital- and state-level readmission rates in those states.

We aggregated state databases from 5 geographically dispersed states (New York, Florida, Utah, California, and Washington) that included all of the variables of interest. Our study population comprised individuals ages 18 years or older with hospitalizations that included an ICD-9-CM code for SLE (710.0). Because our primary focus was hospital readmission, we excluded hospitalizations 1) that were hospital transfers, 2) that did not result in a discharge to home (i.e., individuals discharged to other hospitals or to skilled nursing or rehabilitation facilities), 3) that included maternity-related

diagnoses, and 4) for which the patient died during the index hospitalization. Finally, we excluded patients whose discharge file did not include a unique identifier, since readmissions could not be accurately determined for these patients (3,654 encount-

ers were missing this identifier). The study protocol was submitted and determined to be exempt from review by the Committee on Human Research at the University of California, San Francisco.

Measures. *Outcome measure.* The primary outcome measure was all-cause readmission to any acute care hospital within 30 days of initial hospital discharge. Some readmissions may have been planned or unavoidable—we did not attempt to remove these hospitalizations from our analysis. In order to ensure complete 30-day followup, we excluded discharges from the final month of available data, leaving us with a data set covering January 2008 to November 2009. For discharges from hospitals in Florida and Washington, we included index admissions from the first quarter of 2008 to the third quarter of 2009 because only the quarter of discharge (rather than the month of discharge) was available for these states (but the linkage files still permitted determination that readmission occurred within 30 days). For individuals who were readmitted multiple times during the year, additional hospitalizations after the initial 30-day readmission were analyzed as new index hospitalizations. Multiple 30-day readmissions per patient were, therefore, eligible for inclusion, and within-patient repeated measures were accounted for in our analyses.

Independent variables. Individual demographic characteristics included age, sex, and race/ethnicity (white, African American, Asian/Pacific Islander, Hispanic/Latino, or other). Socioeconomic status was categorized into quartiles for each state based on the median income reported for each patient's ZIP code. The primary expected payer was categorized as Medicaid, Medicare, private, uninsured (defined as self-pay or no charge), or other. Because up to 2 expected payers can be coded for a hospital stay in HCUP, we selected the primary payer.

We used nonoverlapping variables from validated indexes to characterize disease status, including variables from the Charlson comorbidity index (calculated from discharge diagnoses of all available encounters) (14) and variables from a lupus-specific mortality index developed by one of the authors (MM), which consists of disease features associated with high hospital mortality rates in SLE. This index includes common manifestations of SLE, including glomerulonephritis, chronic renal failure, pericarditis, pleuritis, psychosis, seizures, hemolytic anemia, and thrombocytopenia (15). Because of the high rate of infection related to both immunosuppression and underlying disease among SLE patients, we also used a validated measure of infection, including both bacterial and opportunistic infections, in our analysis (16). The length of stay was calculated for the index admission preceding the readmission as an additional proxy of disease severity. For descriptive purposes, we also characterized causes of readmission using the Clinical Classifications Software tool for ICD-9-CM. We included information from the American Hospital Association's annual survey to determine each hospital's size, teaching status, and location (urban versus rural).

Table 1. Characteristics of adults hospitalized for systemic lupus erythematosus in California, Florida, New York, Utah, and Washington, 2008–2009*

	No readmission	Readmission	P
Demographic characteristics of unique patients†			
Age at first hospitalization			<0.001‡
18–30 years	2,560 (9.5)	802 (16.3)	
31–45 years	6,392 (23.7)	1,406 (28.6)	
46–64 years	11,466 (42.5)	1,855 (37.7)	
≥65 years	6,569 (24.3)	853 (17.4)	
Sex, female	24,129 (89.4)	4,385 (89.2)	0.677
Race			<0.001‡
White	15,533 (57.6)	2,215 (45.1)	
African American	5,361 (19.9)	1,347 (27.4)	
Asian	957 (3.5)	238 (4.8)	
Hispanic	4,271 (15.8)	947 (19.3)	
Other	865 (3.2)	169 (3.4)	
Income quartile			<0.001‡
Fourth	5,839 (21.6)	893 (18.2)	
Third	6,695 (24.8)	1,204 (24.5)	
Second	6,793 (25.2)	1,228 (25.0)	
First (lowest)	7,660 (28.4)	1,591 (32.4)	
Primary payer			<0.001‡
Public	15,012 (58.3)	3,114 (63.4)	
Private	10,025 (37.1)	1,456 (29.6)	
Uninsured	1,090 (4.0)	197 (4.0)	
Other/unknown	860 (3.2)	149 (3.0)	
Clinical characteristics at hospitalization§			
Charlson comorbidity index, mean ± SD	3.59 ± 2.97	4.53 ± 3.22	<0.001
Ward index, mean ± SD	2.89 ± 3.82	3.83 ± 4.04	<0.001
Clinical conditions¶			
Nephritis	8,822 (18.9)	2,817 (30.5)	<0.001
Chronic renal failure	8,899 (19.1)	3,174 (34.3)	<0.001
Autoimmune hemolytic anemia	446 (1.0)	111 (1.2)	0.034
Thrombocytopenia	2,281 (4.9)	665 (7.2)	<0.001
Pericarditis	761 (1.6)	208 (2.3)	<0.001
Pleuritis	1,822 (3.9)	475 (5.1)	<0.001
Seizure	3,811 (8.2)	1,095 (11.8)	<0.001
Psychosis	3,787 (8.1)	776 (8.4)	0.373
Cancer	1,872 (4.0)	411 (4.4)	0.056
Congestive heart failure	5,594 (12.0)	1,586 (17.2)	<0.001
Myocardial infarction	1,243 (2.7)	226 (2.4)	0.247
Cerebrovascular accident	960 (2.1)	126 (1.4)	<0.001
Diabetes	8,348 (17.9)	1,713 (18.5)	0.140
Peripheral vascular disease	4,151 (8.9)	931 (10.1)	<0.001
Liver disease	1,445 (3.1)	297 (3.2)	0.572
Infection	6,454 (13.8)	1,551 (16.8)	<0.001
Length of stay, median (IQR) days	3 (2–6)	4 (2–7)	<0.001
Community and hospital characteristics			
Patient geographic location			<0.001‡
Urban	41,748 (89.4)	8,438 (91.3)	
Rural	4,944 (10.6)	806 (8.7)	
Hospital teaching status			<0.001‡
Non-teaching	33,878 (72.6)	6,405 (69.3)	
Teaching	12,814 (27.4)	2,839 (30.7)	
State			<0.001‡
California	17,774 (38.1)	3,624 (39.2)	
Florida	15,183 (32.5)	3,536 (38.3)	
New York	11,589 (24.8)	1,786 (19.3)	
Utah	753 (1.6)	85 (0.9)	
Washington state	1,393 (3.0)	213 (2.3)	

* Except where indicated otherwise, values are the number (%). IQR = interquartile range.
† Of 31,903 unique patients, 26,987 were not readmitted to a hospital and 4,916 were readmitted.
‡ P for distribution.
§ Of 55,936 total hospitalizations, 46,692 (83.5%) were unique visits and 9,244 (16.5%) were readmissions occurring within 30 days of the initial hospitalization.
¶ Specific conditions listed are components of the Charlson comorbidity index and/or the Ward index. Infection is based on a validated measure (16).

Statistical analysis. *Characteristics associated with re-admission within 30 days of discharge.* We examined the characteristics of initial hospitalizations among those who were and those who were not subsequently readmitted, using Student's *t*-tests for continuous measures and chi-square tests for categorical measures.

Factors associated with readmission within 30 days of discharge. We used a multilevel mixed-effects logistic model to examine factors associated with readmission of SLE patients within 30 days. We chose the generalized linear mixed model over a marginal model, such as generalized estimating equations (GEE), because we specifically wanted to obtain subject-specific estimates of the covariates, as opposed to the population averages produced by a GEE model.

We counted each hospitalization as a possible index event leading up to a readmission. Data on admissions were nested within individual patient data, and individual patient data, in turn, were nested within hospital data. To account for repeated observations for patients, a random intercept was estimated for each patient's series of admissions, which represents that patient's effect on risk of readmission. A random intercept was also estimated for each hospital, controlling for its case mix. All other covariates were treated as fixed in order to obtain global (i.e., across all patients) estimates for the effects of these covariates on readmission risk. In our model, the fixed effects quantify the global effects of socioeconomic and demographic status, disease severity, and comorbidity burden, among other covariates. The model parameter estimates were approximated by Gauss-Hermite quadrature, with 15 quadrature points.

Risk-standardized readmission rates (RSRRs). In order to calculate risk-standardized hospital-level readmission rates, we used a multilevel mixed-effects logistic regression model to obtain the best linear unbiased predictions of the risk-standardized odds ratio (OR) of readmission to each hospital. The risk-standardized readmission rate for each hospital (RSRR$_i$, with "i" representing the individual hospital) was obtained by scaling the crude grand mean (p$_0$), by the best linear unbiased prediction of the hospital's OR, as follows:

$$\text{RSRR}_i = p_0 \times \text{OR}_i / (1 + p_0 \times [\text{OR}_i - 1])$$

where OR$_i$ = log σ_i and σ_i denotes the estimated random effect for hospital "i."

To compare readmission rates among hospitals, we constructed a sample of hospitals (n = 486) that admitted ≥25 individuals with SLE over the study period. This minimum number of admissions aligns with the Centers for Medicare and Medicaid Services' requirement of at least 25 cases for a specific condition over a 3-year period to report a hospital's excess readmission ratio. Outlier hospitals were those whose 95% confidence intervals (95% CIs) for the RSRRs excluded the benchmark rate among these hospitals. All variables were checked for nonlinearity, and we tested for interactions between age, race/ethnicity, and primary payer.

These methods are analogous to those used by the Centers for Medicare and Medicaid Services to calculate per-hospital RSRRs for a variety of conditions (17). This has the advantage of shrinking rate estimates for individual hospitals toward the grand mean, depending on sample size.

Hospitals with fewer cases experienced greater shrinkage of their RSRRs toward the grand mean compared to those with more cases. This produced more reliable estimates of RSRRs, particularly for hospitals with smaller numbers of admissions.

In additional analysis, we compared the RSRR for SLE with those for other common chronic conditions to see if hospitals with higher readmission rates for SLE also had higher rates of readmission for these conditions. We obtained 2009 (the first year for which these data were available) per-hospital 30-day RSRR data from Medicare (through hospitalcompare.gov) for pneumonia, acute myocardial infarction, and chronic heart failure, and combined these with our data, resulting in 3 sets of pairs of RSRRs for SLE and each of the 3 conditions for each hospital. We then estimated correlation coefficients and performed linear regression analyses for each pair of RSRRs across all 3 conditions.

Data were analyzed using Stata/SE 12.0 (StataCorp) and R version 2.14.2 (R Foundation for Statistical Computing).

RESULTS

In 2008 and 2009, there were 55,936 hospitalizations among 31,903 individuals with SLE in the 5 states examined. Data from 810 hospitals were included in the analysis. Readmission within 30 days occurred following 9,244 hospitalizations (16.5%). These readmissions occurred among 4,916 unique patients. Characteristics of SLE hospitalizations with and without record linkages are provided in Supplementary Table 1 (available on the *Arthritis & Rheumatology* web site at http://onlinelibrary.wiley.com/doi/10.1002/art.38768/abstract).

Characteristics of patients who were initially hospitalized and those who were readmitted within 30 days are listed in Table 1. Readmission occurred among predominantly young (82.6% age <65 years), female (89.2%), and racially/ethnically diverse (54.9%) patients. A majority had Medicare or Medicaid as the primary payer (63.4%). Readmitted patients had a high prevalence of severe lupus manifestations. The mean Charlson comorbidity index for readmitted patients was higher than that for those who were not readmitted (mean ± SD 4.53 ± 3.22 compared to 3.59 ± 2.97). Similarly, the mean Ward index was also higher for readmitted patients (3.83 ± 4.04 compared to 2.89 ± 3.82). A detailed list of the primary diagnoses associated with readmission within 30 days, determined using the Clinical Classifications Software tool for ICD-9-CM, can be found in Supplementary Table 2 (available on the *Arthritis & Rheumatology* web site at http://online library.wiley.com/doi/10.1002/art.38768/abstract).

The adjusted odds of 30-day readmission are presented in Table 2; all variables listed were entered in the multilevel mixed-effects logistic model. Age (per

Table 2. Odds of 30-day readmission among adults with systemic lupus erythematosus in California, Florida, New York, Utah, and Washington, 2008–2009*

	OR (95% CI)	P for 95% CI
Demographic characteristics		
Age, per year	0.98 (0.98–0.98)	<0.001
Sex		
Female	Referent	–
Male	0.93 (0.85–1.03)	0.160
Race		
White	Referent	–
African American	1.18 (1.09–1.28)	<0.001
Hispanic	1.12 (1.02–1.22)	0.009
Asian	1.13 (0.97–1.31)	0.110
Other	1.14 (1.01–1.39)	0.042
Income quartile		
Fourth	Referent	–
Third	1.08 (0.99–1.18)	0.097
Second	1.01 (0.92–1.11)	0.872
First (lowest)	1.06 (0.97–1.16)	0.230
Primary payer		
Private insurance	Referent	–
Medicare	1.57 (1.45–1.69)	<0.001
Medicaid	1.53 (1.40–1.67)	<0.001
Uninsured	1.20 (1.01–1.42)	0.040
Other/unknown	1.18 (1.01–1.38)	0.036
Clinical characteristics at hospitalization		
Clinical conditions†		
Nephritis	1.25 (1.16–1.34)	<0.001
Chronic renal failure	1.61 (1.50–1.73)	<0.001
Autoimmune hemolytic anemia	1.06 (0.82–1.37)	0.661
Thrombocytopenia	1.17 (1.04–1.30)	0.006
Pericarditis	1.08 (0.89–1.30)	0.428
Pleuritis	1.13 (0.99–1.27)	0.064
Seizure	1.17 (1.07–1.28)	<0.001
Psychosis	1.11 (1.01–1.23)	0.027
Cancer	1.64 (1.43–1.88)	<0.001
Congestive heart failure	1.40 (1.29–1.52)	<0.001
Myocardial infarction	1.07 (0.90–1.27)	0.439
Cerebrovascular accident	0.78 (0.63–0.96)	0.019
Diabetes	1.10 (1.02–1.18)	0.011
Peripheral vascular disease	1.19 (1.09–1.30)	<0.001
Liver disease	0.96 (0.82–1.12)	0.538
Infection	0.99 (0.92–1.07)	0.847
Length of stay, per day	1.01 (1.00–1.01)	<0.001
Community and hospital characteristics at index visit		
Patient geographic location		
Urban	Referent	–
Rural	0.86 (0.77–0.95)	0.005
Hospital teaching status		
Non-teaching	Referent	–
Teaching	0.94 (0.85–1.03)	0.185
State		
California	Referent	–
Florida	1.20 (1.11–1.32)	<0.001
New York	0.77 (0.70–0.85)	<0.001
Utah	0.76 (0.57–1.02)	0.065
Washington	0.91 (0.75–1.12)	0.339

* Data are adjusted results from a multilevel mixed-effects logistic model in which all of the listed variables were entered. OR = odds ratio; 95% CI = 95% confidence interval.
† Specific conditions listed are components of the Charlson comorbidity index and/or the Ward index. Infection is based on a validated measure (16).

year) had a striking inverse relationship with the risk of 30-day readmission (OR 0.98 [95% CI 0.98–0.98]) (Figure 1 and Table 2). African American and Hispanic patients were significantly more likely to be readmitted (OR 1.18 [95% CI 1.09–1.28] and OR 1.12 [95% CI 1.02–1.22], respectively). Similarly, compared to those with private insurance, individuals with Medicare or Medicaid as the primary payer were substantially more likely to be readmitted (OR 1.57 [95% CI 1.45–1.69] and OR 1.53 [95% CI 1.40–1.67], respectively). Those living in rural locations were less likely to be readmitted (OR 0.86 [95% CI 0.77–0.95]).

Clinical variables associated with readmission are listed in Table 2. Severe manifestations of SLE, including renal, hematologic, and neurologic diagnoses, were associated with a higher rate of 30-day readmission, as were comorbid conditions known to have higher prevalence in SLE, including cardiovascular disease, diabetes, and cancer.

Risk-adjusted readmission rates varied between states. We found significantly lower 30-day readmission rates in New York (OR 0.77 [95% CI 0.70–0.85]) and significantly higher rates in Florida (OR 1.20 [95% CI 1.11–1.32]) compared to California in our adjusted analysis.

Figure 2 presents the point estimates of risk-standardized 30-day hospital readmission rates for hospitals (n = 486) with moderate or high volumes of SLE admissions per year. To classify outlier hospitals, we identified those whose 95% CIs for the RSRRs excluded the benchmark rate, which was the average readmission rate (16.8%) for this subset of hospitals having extant identifiers. At the 95% CIs depicted in Figure 2 (corresponding to 2 standard deviations around the mean), we identified 19 outlier hospitals compared to the benchmark, all of which had higher-than-expected readmission rates.

When we compared the RSRRs for SLE with those of 3 common chronic conditions to see if hospitals with higher readmission rates for SLE also had higher rates of readmission for these other conditions, we did not find statistically significant correlations ($\rho = 0.038$ and $P = 0.330$ for heart failure, $\rho = 0.001$ and $P = 0.892$ for anterior myocardial infarction, and $\rho = 0.047$ and $P = 0.229$ for pneumonia). Our linear regression analyses for the per-hospital RSRRs across all 3 conditions also did not reveal a statistically significant relationship. We did not find any interactions between age, race/ethnicity, and primary payer.
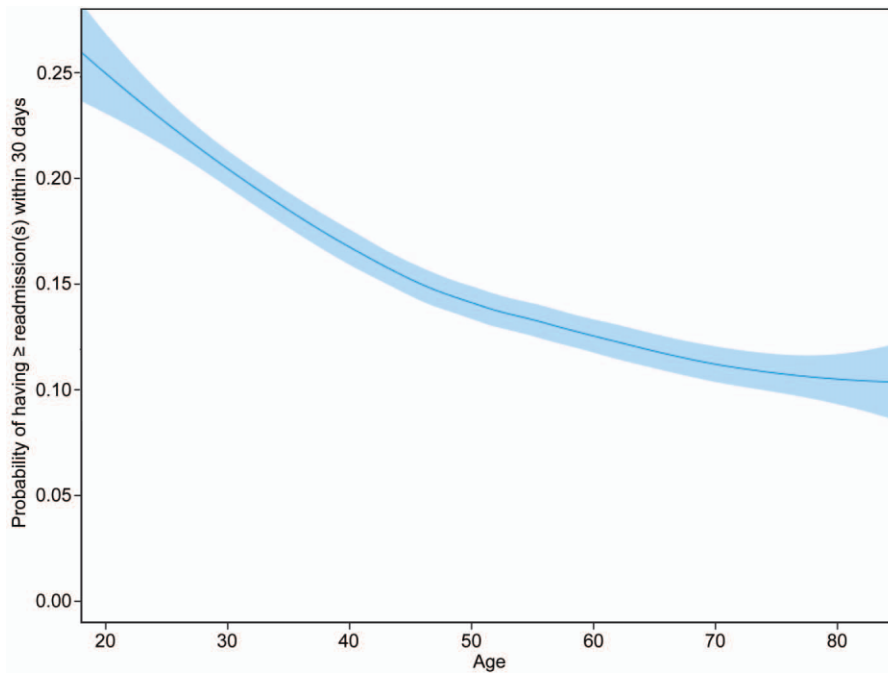
Figure 1. Relationship between age and probability of being readmitted 1 or more times within 30 days of an initial hospital discharge among systemic lupus erythematosus patients during 2008 and 2009. Smoothing methods were used to depict probability of readmission for each age point. The 95% confidence intervals for these estimates are represented by the shaded region.

DISCUSSION

In this population-based study of 55,936 hospitalizations for SLE, we found that ~1 in 6 patients were readmitted to the hospital within 30 days. Because we used a multistate, multipayer sample, our results provide the first large-scale depiction of readmission among SLE patients. We found that readmission occurred most frequently among young patients, those who were members of racial/ethnic minorities, those with publicly funded health insurance, and those with specific SLE manifestations, such as renal disease, neurologic disease, and thrombocytopenia. After adjusting for differential case mix based on these characteristics as well as clustering of hospitalizations within patients, we identified statistically significant variation in readmission rates of SLE patients, both among hospitals and among the 5 states examined. In addition, we found that hospitals with higher readmission rates of SLE patients did not
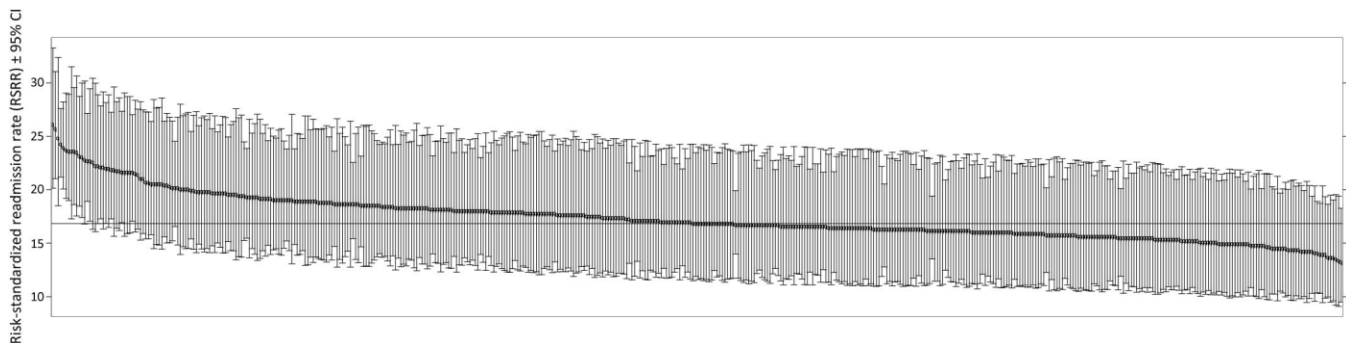

Figure 2. Risk-standardized 30-day hospital readmission rates and 95% confidence intervals (95% CIs) for 486 hospitals in California, Florida, New York, Utah, and Washington from 2008 and 2009. Hospitals with ≥25 readmitted systemic lupus erythematosus patients are depicted. Each point represents a hospital's risk-adjusted readmission rate, and the error bars represent 95% CIs. Low-performing outliers (n = 19) are hospitals with 95% CIs that fall above the mean rate of 16.8% (horizontal line).

have higher readmission rates of patients with other common chronic conditions (heart failure, myocardial infarction, or pneumonia), justifying the importance of examining condition-specific readmissions for SLE.

Although 30-day hospital readmissions are increasingly tied to financial quality programs in the US health care system, the purpose of our study was not to examine readmission as a performance measure. Instead, we were interested in understanding the utility of SLE-related readmission data in making inferences about utilization and quality, particularly in identifying groups at risk of readmission and investigating variations across the population. This distinction is important since it may be impractical to subject hospitals to performance measures for each chronic condition separately. However, for the purposes of population health management or quality improvement, examining readmission rates for individual chronic conditions might inform local or regional efforts to organize and improve chronic disease care, particularly for severe conditions such as SLE.

As with other chronic conditions, we found that patient sociodemographic characteristics were an important predictor of SLE-associated readmission. Historically underserved populations were at highest risk of 30-day readmissions, including African American and Hispanic patients and those with publicly funded insurance, even after adjustment for a variety of patient, disease, and health care system factors. This adds to a growing body of literature that reveals striking disparities in SLE; racial/ethnic minorities and those with low socioeconomic status have a higher prevalence of the disease (18), significantly greater disease-related organ damage, and higher mortality rates (19–22). The finding that age was inversely related to the risk of readmission is also noteworthy. SLE differs from most chronic conditions examined to date, in which the risk of hospital readmission has been found to increase with age (9,23). This difference may at least in part reflect the greater severity of SLE in younger individuals who are more likely to have life-threatening organ manifestations (24,25). More research is needed, but the paradoxical relationship between age and readmission illustrates that investigating condition-specific factors in SLE may be important in appropriately identifying patients at risk of readmission. Further research is needed to understand whether intervention to improve care transitions for at-risk populations can reduce readmission rates and ultimately improve health outcomes.

We found that severe manifestations of SLE, such as renal disease, thrombocytopenia, serositis, and seizures, were associated with higher readmission rates. SLE-related comorbidities, including cardiovascular disease, diabetes, and malignancy (26,27), were also associated with higher readmission rates. While more severe cases of many chronic illnesses have higher readmission rates, these findings suggest that SLE patients with these clinical characteristics also warrant more careful attention, especially when coordinating health care transitions and specialty care followup.

After adjusting for differential case mix based on these demographic and clinical characteristics, we found variation in readmission rates between the hospitals examined. In other chronic conditions, variation in hospital readmission rates has signaled opportunities for quality improvement, particularly in discharge planning, post-hospitalization followup, adherence, or coordination of care with providers in the ambulatory setting (28–30). Patients with SLE may be particularly vulnerable to problems in these areas given the counterintuitive severity of symptoms among younger patients, the complexity of the disease, and the limited experience of many care coordinators and clinicians with its management.

Finally, we found further evidence of significant variation in readmission rates when we aggregated data at the state level, which allowed us to include the hospitals in our sample (40%) that had relatively low volumes of SLE admissions. Both high-performing and low-performing states were identified. Our study does not address the reasons underlying this state-level variation. However, it is interesting to note that the state with significantly lower risk-adjusted readmission rates for SLE (New York), also has facilities with significant clinical expertise in SLE, with a high concentration of dedicated SLE centers (31). The impact of how SLE care is organized and its influence on outcomes such as readmissions will require further study.

Taken together, our findings regarding both risk factors and variability in 30-day readmissions suggest that readmission rates may be an important outcome measure in SLE. First, our data suggest that it is possible to identify both demographic and clinical risk factors for readmission among SLE patients. For clinicians caring for patients with SLE in both the hospital and ambulatory settings, information on these risk factors can help identify patients who need particularly careful attention with regard to care transitions and specialty care followup. Second, although there is much interest in reducing the striking racial/ethnic and socioeconomic disparities in SLE, there are currently few tools available for

this purpose. The relatively low prevalence and complexity of the disease have posed challenges in developing broadly applicable outcome measures to track potential health disparities and investigate their causes or design interventions. Since up to a quarter of all patients with SLE are hospitalized each year, hospitalizations might serve as a critical opportunity for study and intervention. Finally, although our study does not address the reasons for variation in readmission rates between hospitals and states, the presence of unexplained variation after careful risk-adjustment suggests that there is room for quality improvement. Further work to identify care processes that can reduce readmission rates for this complex disease is needed.

Our study has limitations. Findings based on the 5 states examined may not be nationally representative. However, our study covers a substantial number of admissions among individuals with SLE in the US. Although administrative definitions of SLE used in our study have moderate or good sensitivity and specificity (32), some medical records may have been miscoded (erroneously identifying a patient as having SLE), potentially decreasing the precision of our estimates. Several states in our study did not provide information on whether admissions were planned or unplanned/urgent, and therefore some planned re-hospitalizations may have been misclassified as unplanned readmissions. Finally, because we used administrative data, clinical information on hospitalizations was limited, and we could not assess the preventability of readmissions.

In conclusion, we found that nearly 1 in 6 hospitalized patients with SLE were readmitted within 30 days. Significant geographic and hospital-level variation in risk-adjusted readmission rates suggests potential for quality improvement.

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

Study conception and design. Yazdany, Marafino, Dean, Dudley.
Acquisition of data. Marafino, Dean.
Analysis and interpretation of data. Yazdany, Marafino, Dean, Bardach, Duseja, Ward, Dudley.

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