

Editorial

# Burden of Comorbidities Predicts 30-Day Rehospitalizations in Young Adult Medicare Beneficiaries With Systemic Lupus Erythematosus

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Systemic lupus erythematosus (SLE) is a systemic autoimmune rheumatic disease associated with premature mortality and multimorbidity.<sup>1,2</sup> It predominately affects young adult females and disproportionately affects racial/ethnic minority groups and individuals with lower socioeconomic status.<sup>3,4</sup> Hospitalizations are frequent for people living with SLE, with an incidence rate of 0.3 hospitalizations per year, and carry an associated 2% risk of mortality.<sup>5-7</sup> People with SLE are also known to be at an increased risk of hospital readmissions within 30 days—an important metric related to healthcare quality.<sup>8-10</sup>

In the United States, hospital readmissions are frequent, occurring in nearly 20% of all Medicare hospitalizations, and are associated with significant healthcare costs.<sup>11</sup> Reducing preventable rehospitalizations is, therefore, a major target for quality improvement and cost-reduction initiatives.<sup>12</sup> According to the 2010 Healthcare Cost and Utilization Project,<sup>13</sup> SLE has the 6th highest readmission rate for all medical conditions, highlighting the extent of this problem for people with SLE. A prior study of State Inpatient Databases from 2008 and 2009 found an overall 16.5% readmission rate within 30 days of SLE hospitalizations. They found younger patients, Black and Hispanic patients, those with Medicare and Medicaid vs private insurance or uninsured populations, and those with lupus nephritis (LN) were more likely to be readmitted than other subsets of people with SLE.<sup>8</sup> Another population-based study used the nationally representative Nationwide Readmissions Database in 2016-2017 to investigate causes of 30-day readmissions in patients with SLE and also identified Medicare or Medicaid insurance and younger age

(18-30 years) to be predictors of this outcome, as well as comorbidities including autoimmune hemolytic anemia, glomerular disease, pericarditis, and heart failure.<sup>10</sup> A single-center academic medical center study of SLE readmissions within 30 days reported a 36% readmission rate, also higher among those with Medicare or Medicaid insurance.<sup>9</sup> In a Medicaid study of recurrent acute care use among people with SLE, LN and comorbidities including cardiovascular disease, chronic pain, and depression were also associated with a pattern of recurrent hospitalizations and emergency room visits.<sup>14</sup> Within the Medicare population, in a prior study using a 20% sample of US Medicare hospitalizations in 2014, Bartels et al found a 24% readmission rate for Medicare beneficiaries hospitalized for SLE, identical to that of Medicare beneficiaries hospitalized for heart failure, another condition for which readmissions are a recognized problem and that is currently a target of Medicare payment penalties for early readmissions.<sup>15</sup> The rates of SLE rehospitalization were highest for younger adults, Black individuals, and those with endstage renal disease (ESRD). These prior studies indicated the potential need for tailored strategies to reduce readmissions among people with SLE.

In this issue of *The Journal of Rheumatology*, Schletzbaum and colleagues report the findings of a cohort study of Medicare beneficiaries with SLE where they assessed age-stratified rehospitalization and mortality rates and identified predictors of 30-day rehospitalization among young adults (age 18-25 years), middle-aged adults (36-64 years), and older adults (65+ years) with SLE.<sup>16</sup> Study participants were identified from a geographic-linked 20% random sample of Medicare beneficiaries who were hospitalized between January and November 2014 and had at least a year of continuous Medicare coverage before the index hospitalization in this period as well as at least 30-days postdischarge Medicare enrollment or death within 30 days of discharge to ensure capture of early readmissions. All hospitalizations with an International Classification of Diseases, 9th revision, code for SLE (in any position) were classified as SLE hospitalizations (n = 10,868). Outcomes included all-cause 30-day readmissions and all-cause 30-day mortality per the National Death Index.

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Consistent with prior studies, they found higher rates of 30-day rehospitalization among younger adults with SLE vs older adults with SLE, with a 36% 30-day rehospitalization rate among young adults vs 20% among older adults. Young adults with SLE also had higher 30-day rehospitalization rates than non-SLE Medicare beneficiaries of the same age group (26%). Thirty-day mortality rates did not follow this pattern; SLE and non-SLE beneficiaries in the young adult age group had similar observed mortality risks (under 1%), which were lower than in older adults with SLE-related and non-SLE hospitalizations. Younger adults with SLE hospitalizations had higher illness burden, were very likely to have dual enrollment in Medicaid (91%), and were more likely to live in disadvantaged neighborhoods than older adults with SLE. These findings suggest young adults with SLE are a higher-risk group that could be targeted specifically for efforts to reduce rehospitalizations.

Building upon prior literature of rehospitalizations in SLE, a novel feature of this study was their approach to assessing predictors of 30-day readmissions for Medicare beneficiaries with SLE overall and within the age-stratified groups.<sup>16</sup> They used a combination of a priori variable selection and supervised machine-learning with least absolute shrinkage and selection operator (LASSO) regression to select additional predictor variables. LASSO is a technique that identifies influential variables while accounting for collinearity and overfitting to enhance accuracy of a predictive model while minimizing the number of variables included in that model.<sup>17</sup> The a priori variables included in this study were previously identified predictors of SLE rehospitalizations including age, sex, race, ethnicity, dual enrollment with Medicaid, disability, renal failure, and hospital length of stay. They took advantage of geographic linkage at the zip code level to additionally assess neighborhood-level socioeconomic disadvantage from the Area Deprivation Index (ADI). They also assessed the Center for Medicare & Medicaid Services hierarchical condition category (HCC) community risk score, which incorporates demographics and specific comorbidities that affect anticipated healthcare costs, as an a priori predictor of rehospitalization.<sup>18</sup> Additional candidate variables included rural vs urban geographical context, specific comorbidities, and hospital characteristics including medical school affiliation, discharge volume, and status as a critical access hospital.

The authors used generalized estimating equation models to assess predictors of SLE rehospitalizations with 2 approaches: first, using a combined prediction model that was applied separately to the 3 different age groups; and second, using separate prediction models that were generated for each individual age group. When considering all SLE hospitalizations together, several specific comorbidities were selected by the LASSO procedure for inclusion in prediction models, including coagulopathy, heart failure, drug use disorder, fluid and electrolyte disorders, and paralysis. Across all age groups, longer hospital length of stay and higher HCC community risk scores were predictive of 30-day readmissions—not surprisingly, as these are known to be predictive of 30-day readmissions generally.<sup>11,18</sup> The model performance was greatest for the overall model applied to the young adult subset, with a moderately good C statistic of 0.77.

When considering age-specific models of early rehospitalizations, some differences in variables selected by the LASSO procedure were noted between the age groups, including the particular comorbidities that were included in the models. This may reflect age-related differences in the prevalence or severity of these comorbidities among the Medicare population with SLE. Notably, drug use disorder was found to be predictive of 30-day readmissions following SLE hospitalizations in young adults and middle-aged individuals but not older adults. The prevalence of drug use disorder was highest among young adults (27%) and lowest among older adults (2%) with SLE. Congestive heart failure was associated with rehospitalizations among young adults and older adults with SLE, whereas liver disease was associated with rehospitalizations among middle-aged individuals. Interestingly, renal failure was not significantly predictive of rehospitalization in any of the models. This comorbidity was prevalent in 66% of young adults with SLE in this Medicare population, reflecting the role of ESRD as a qualifying condition for Medicare enrollment among younger individuals. As the authors note, “fluid and electrolyte disorders” was a separate category of comorbidities included in the predictive models and was a leading predictor of 30-day readmissions among young adults and middle-aged adults with SLE,<sup>16</sup> and this category likely captures morbidities related to underlying kidney disease.

Beyond the observed effect of comorbidities on rehospitalizations among people with SLE, index hospitalization at a medical school-affiliated hospital was protective of rehospitalization among young adults, as was index hospitalization at a critical access hospital among middle-aged individuals with SLE.<sup>16</sup> From this study, it is not clear whether this reflects improved quality care and/or successful processes to reduce readmissions at these types of hospitals or whether other factors are contributing to the observed findings, and further studies are warranted. Also of note, sex, race/ethnicity, ADI rank, and disability status were included in all models in this study but were not found to be significant predictors within the multivariable models, other than an observed protective association of Asian race on rehospitalization among young adults in the age-stratified model. Of note, these demographic variables did not undergo LASSO selection, so potential collinearity between these variables may not be accounted for in the models, and the HCC community risk scores do include demographic information. For young adults, the age-stratified model had a moderately good C statistic of 0.78 in predicting 30-day readmissions. As the authors note, this model performance is superior to other risk prediction models of US population-based readmission risks for other health conditions<sup>19</sup>; it also performed better than SLE-specific rehospitalization models in a study using US electronic health records data, with similar variables other than lacking the ADI, and using the deep learning method of long short-term memory (LSTM), a type of recurrent neural network.<sup>20</sup>

Another noteworthy finding of this study was their sensitivity analysis of 30-day readmissions following obstetric hospitalizations.<sup>16</sup> As females of reproductive age make up a substantial proportion of individuals with SLE overall and around 10% of this Medicare beneficiary cohort (which skews older than

the general population with SLE), and SLE is associated with pregnancy and postpartum complications,<sup>21</sup> obstetric-related hospitalizations could represent a unique source of rehospitalizations for people with SLE. This study assessed the rates of obstetric-related rehospitalizations among hospitalizations classified as related to SLE and compared this with non-SLE obstetric-related hospitalizations. They found a 31.7% rate of obstetric rehospitalization for young adults with SLE, which was similar to the overall rate of SLE rehospitalizations for young adults and 3 times higher than obstetric-related hospitalizations not related to SLE. Therefore, the problem of rehospitalizations among young adults with SLE clearly extends to that of obstetric-related care.

This study highlights the problem of frequent early rehospitalizations among young adults with SLE in the US Medicare population.<sup>16</sup> It demonstrates the impact of specific comorbid conditions and of overall comorbidity burden as key predictors of rehospitalizations in this high-risk population. Further work is needed to better understand to what extent these readmissions are potentially preventable and to develop targeted interventions to address preventable rehospitalizations for these individuals. Prior work on reducing 30-day rehospitalization beyond SLE-related hospitalizations has included pre-discharge interventions (eg, appointment scheduling and patient education), post-discharge intervention (eg, timely follow-up visits and/or telephone calls), and care transition bridging interventions (eg, provider continuity from the inpatient to outpatient setting).<sup>22</sup> An important future direction will be to consider strategies for potential interventions that may be most applicable to young adults with SLE.

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