Impact of State Medicaid Coverage on Utilization of Inpatient Rehabilitation Facilities Among Patients With Stroke

Lesli E. Skolarus, MD; James F. Burke, MD; Lewis B. Morgenstern, MD; William J. Meurer, MD; Eric E. Adelman, MD; Kevin A. Kerber, MD; Brian C. Callaghan, MD; Lynda D. Lisabeth, PhD

Background and Purpose—Poststroke rehabilitation is associated with improved outcomes. Medicaid coverage of inpatient rehabilitation facility (IRF) admissions varies by state. We explored the role of state Medicaid IRF coverage on IRF utilization among patients with stroke.

Methods—Working age ischemic stroke patients with Medicaid were identified from the 2010 Nationwide Inpatient Sample. Medicaid coverage of IRFs (yes versus no) was ascertained. Primary outcome was discharge to IRF (versus other discharge destinations). We fit a logistic regression model that included patient demographics, Medicaid coverage, comorbidities, length of stay, tissue-type plasminogen activator use, state Medicaid IRF coverage, and the interaction between patient Medicaid status and state Medicaid IRF coverage while accounting for hospital clustering.

Results—Medicaid did not cover IRFs in 4 (TN, TX, SC, WV) of 42 states. The impact of State Medicaid IRF coverage was limited to Medicaid stroke patients (P for interaction <0.01). Compared with Medicaid stroke patients in states with Medicaid IRF coverage, Medicaid stroke patients hospitalized in states without Medicaid IRF coverage were less likely to be discharged to an IRF of 11.6% (95% confidence interval, 8.5%–14.7%) versus 19.5% (95% confidence interval, 18.3%–20.8%), P<0.01 after full adjustment.

Conclusions—State Medicaid coverage of IRFs is associated with IRF utilization among stroke patients with Medicaid. Given the increasing stroke incidence among the working age and Medicaid expansion under the Affordable Care Act, careful attention to state Medicaid policy for poststroke rehabilitation and analysis of its effects on stroke outcome disparities are warranted. (Stroke. 2014;45:2472-2474.)

Key Words: Medicaid ■ rehabilitation ■ stroke
private insurance was identified. Visits with Medicare as a primary or secondary insurance were excluded.

**Covariates**

The primary outcome was discharge to an IRF (versus all other discharge destinations) using the UB-04 claims form (DISPUB04 62) in NIS. Data from 3 states were excluded because of absent documentation to identify IRF discharges. The primary exposure was a state policy variable representing whether a state’s Medicaid covers IRFs (yes versus no). These data were obtained by review of state Medicaid Web sites and was primarily available in Medicaid provider manuals. Models were adjusted for patient characteristics which may affect the probability of discharge to an IRF including age, sex, Charlson comorbidity index (continuous),

\begin{align*}
\text{length of stay (continuous), and receipt of thrombolysis (ICD-9-CM 99.10 or diagnosis-related group (MS-DRG) 61–63). We also explored whether state Medicaid IRF coverage is a marker of overall IRF utilization or is specific to the Medicaid population by including an interaction of patient Medicaid coverage–state Medicaid policy.}
\end{align*}

**Statistical Analysis**

Patient and hospital characteristics were calculated by state Medicaid IRF coverage using descriptive statistics. We fit a logistic regression model that included patient demographics, Charlson comorbidity index, length of stay, receipt of thrombolysis, patient Medicaid coverage, state Medicaid IRF coverage, and a patient Medicaid coverage–state Medicaid policy interaction term adjusting for clustering at the hospital level (online-only Data Supplement). Based on this model, we estimated the average marginal effect of discharge to an IRF in states with Medicaid IRF coverage compared with states without Medicaid IRF coverage in patients with and without Medicaid. NIS survey weights were applied to all primary analyses. Three secondary analyses were performed to ensure that our primary analysis was robust to modeling assumptions. First, given that state is not an element of the NIS stratification scheme and the sampling scheme is not designed to collect a representative sample within states, we ran the model without applying the survey weights. Second, we ran the model as a multilevel model to confirm model specification. Finally, the primary analysis was repeated by parameterizing the Charlson comorbidity index as a categorical variable (0, 1, 2, 3+). Analyses were performed using Stata 12 (StataCorp LP, College Station, TX).

**Results**

The study population included 20,392 ischemic stroke hospitalizations in working age stroke survivors, including 4482 in patients with Medicaid. Medicaid did not cover IRFs in 4 (TN, TX, SC, WV) of 42 states. Small differences in insurance, comorbidities, and thrombolysis were identified between states with and without Medicaid IRF coverage (Table).

Patient Medicaid coverage modified the association of state Medicaid IRF coverage and IRF utilization (P<0.01, online-only Data Supplement). Compared with Medicaid stroke patients residing in states with Medicaid IRF coverage, Medicaid stroke patients hospitalized in states without Medicaid IRF coverage were 41% less likely to be discharged to an IRF (11.6% [95% confidence interval, 8.5%–14.7%] versus 19.5% [95% confidence interval, 18.3%–20.8%], P<0.01) in the fully adjusted model. There was no difference in the probability of discharge to IRF for non-Medicaid patients in states without IRF coverage compared with states with IRF coverage (17.2% versus 18.8%; P=0.06). Results were not substantively altered in secondary analyses that did not apply survey weights (online-only Data Supplement), used a multilevel framework, or parameterized the Charlson comorbidity index as a categorical variable.

**Discussion**

State Medicaid IRF coverage varies, with 10% of the 42 states in this sample not providing IRF coverage. Working age stroke patients with Medicaid who reside in states without Medicaid IRF coverage have less utilization of IRFs than working age stroke patients with Medicaid residing in states with Medicaid IRF coverage after accounting for demographics, comorbidities, length of stay, and thrombolysis. There was no difference in IRF utilization among stroke patients with insurance other than Medicaid between states that cover and do not cover IRFs. More research is needed to determine whether changes in Medicaid coverage will increase IRF utilization.

Our results have implications for the millions of Americans who will purchase insurance through the Affordable Care Act (ACA)-established health insurance exchange. To ensure comprehensive benefits, the Institute of Medicine established 10 essential health benefit categories, one of which is rehabilitative and habilitative services and devices. Each state individually decides which rehabilitative services are essential, specifically IRF coverage, outpatient therapies, and durations. Our results suggest that states that elect not to cover IRFs in their essential benefit packages may have lower IRF admission for patients with stroke than if coverage was provided. Furthermore, given that Medicaid recipients and those purchasing insurance via the exchanges are disproportionately minorities,1 these policies have the potential to perpetuate and exacerbate stroke outcome disparities.

This study has several limitations. State Medicaid policy was taken from each state’s Web site, and we cannot ensure
the accuracy. Patients with stroke were assigned the state Medicaid of the hospital they were admitted, and the accuracy of the discharge destination field and stroke ICD-9 codes have not been determined in NIS. Unknown factors and factors that have been shown to influence utilization of IRFs including race–ethnicity, National Institutes of Health Stroke Scale, proximity/availability of IRFs, and preferences were not available. We do not expect that these would be different between states that do and do not cover IRFs.

In conclusion, states that cover IRFs have more IRF utilization among working age ischemic stroke patients with Medicaid than states without IRF coverage. As the number of working age stroke patients increases, careful attention to state Medicaid policy and essential health benefits coverage of IRFs and the effect on stroke outcome disparities is warranted.

Sources of Funding
This work was supported by grants National Institutes of Health (NIH)/National Institute of Neurological Disorders and Stroke (NINDS) K23 NS073685 (Dr. Skolarus), NIH/NINDS K08 NS082597 (Dr. Burke), NIH/NINDS K23NS079417 (Dr. Callaghan), NIH/ National Institute of Deafness and Other Communication Disorders (NIDCD) R01 DC012760 (Dr. Kerber), Agency for Healthcare Research and Quality (AHRQ) R18 HS017690 (Dr. Kerber), and NIH/NINDS R25NS088248 (Dr. Meurer).

Disclosures
None.

References
Impact of State Medicaid Coverage on Utilization of Inpatient Rehabilitation Facilities Among Patients With Stroke

*Stroke*. 2014;45:2472-2474; originally published online July 8, 2014;
doi: 10.1161/STROKEAHA.114.005882

*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2014 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/45/8/2472

Data Supplement (unedited) at:
http://stroke.ahajournals.org/content/suppl/2014/07/08/STROKEAHA.114.005882.DC1
http://stroke.ahajournals.org/content/suppl/2014/07/08/STROKEAHA.114.005882.DC2

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Stroke* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to *Stroke* is online at:
http://stroke.ahajournals.org/subscriptions/
NIS is a stratified sample of hospitals, with stratum defined by geographic region, location, teaching status, ownership and bed size categories, designed to be a nationally representative sample of all hospitalizations in the United States each year. A 20% sample of hospitals from each stratum is selected and all discharges from that hospital are included.

To select a functional form for the comparison of age and Charlson comorbidity index to discharge location, we compared plots of the predicted probability of discharge to each of the covariates. For both age and Charlson comorbidity index, we selected a continuous functional form.

Clustering was accounted for by estimating the variance-covariance matrix using a robust sandwich estimator that accounted for intragroup correlation. This approach is known to generate accurate standard errors in the context of clustered data and was selected instead of using a multi-level model because hospital-level intercepts assigned in such a model may reflect both hospital-level effects as well as the effect of state Medicaid policy and thus lead to mis-estimation due collinearity. So that collinearity could be explicitly tested for, we included a hospital-level IRF utilization variable reflecting the proportion of all stroke patients discharged to an IRF. No collinearity was detected, using this approach. (Variance inflation factors for all model covariates < 1.5).

The average marginal effect represents the probability, based on our model, that an individual would be discharged to IRF while holding all covariates in the sample at their actual values. We opted to use average marginal effects to simplify interpretation of the main effects due to the presence of an interaction effect.
**Results of Sensitivity Analysis without Survey Weights:**

Similar to the primary model, when survey weights were not applied, Medicaid stroke patients hospitalized in states without Medicaid IRF coverage were less likely to be discharged to an IRF than Medicaid stroke patients residing in states with Medicaid IRF coverage, 10.6% (95% CI, 6.7-14.6%) versus 18.3% (95% CI, 16.8-19.8%), p<0.01 in the fully adjusted model, p<0.01 in the fully adjusted model. Also similar to the primary model, there was no difference in the probability of discharge to IRF for non-Medicaid patients in states without IRF coverage compared to states with IRF coverage (16.2% vs. 17.6%, p=0.15).
Supplemental Table I: Results of logistic regression model exploring predictors of admission to an inpatient rehabilitation facility.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Unadjusted Odds Ratio</th>
<th>95% CI</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (continuous)</td>
<td>1.008</td>
<td>1.003-1.012</td>
<td>1.007</td>
<td>1.002-1.011</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Female (Male reference)</td>
<td>1.09</td>
<td>1.02-1.18</td>
<td>1.07</td>
<td>0.99-1.16</td>
<td>0.07</td>
</tr>
<tr>
<td>Length of stay (continuous)</td>
<td>1.03</td>
<td>1.03-1.04</td>
<td>1.02</td>
<td>1.017-1.03</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>tpa (reference: no tpa)</td>
<td>1.76</td>
<td>1.54-2.01</td>
<td>1.47</td>
<td>1.28-1.70</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Charlson comorbidity index (continuous)</td>
<td>1.31</td>
<td>1.28-1.34</td>
<td>1.30</td>
<td>1.27-1.33</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Patient Medicaid (ref: patient not Medicaid)</td>
<td>1.23</td>
<td>1.03-1.34</td>
<td>0.60</td>
<td>0.43-0.85</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>State Medicaid covers IRF (reference: State does not cover IRF)</td>
<td>1.03</td>
<td>0.95-1.19</td>
<td>1.13</td>
<td>0.99-1.28</td>
<td>0.07</td>
</tr>
<tr>
<td>Patient Medicaid-State Medicaid IRF coverage interaction</td>
<td>1.76</td>
<td>1.22-2.52</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

References:

SUPPLEMENTAL MATERIAL:

Supplemental Methodological Details:

NIS is a stratified sample of hospitals, with stratum defined by geographic region, location, teaching status, ownership and bed size categories, designed to be a nationally representative sample of all hospitalizations in the United States each year. A 20% sample of hospitals from each stratum is selected and all discharges from that hospital are included.

To select a functional form for the comparison of age and Charlson comorbidity index to discharge location, we compared plots of the predicted probability of discharge to each of the covariates. For both age and Charlson comorbidity index, we selected a continuous functional form.

Clustering was accounted for by estimating the variance-covariance matrix using a robust sandwich estimator that accounted for intragroup correlation. This approach is known to generate accurate standard errors in the context of clustered data and was selected instead of using a multi-level model because hospital-level intercepts assigned in such a model may reflect both hospital-level effects as well as the effect of state Medicaid policy and thus lead to mis-estimation due collinearity. So that collinearity could be explicitly tested for, we included a hospital-level IRF utilization variable reflecting the proportion of all stroke patients discharged to an IRF. No collinearity was detected, using this approach. (Variance inflation factors for all model covariates < 1.5).

The average marginal effect represents the probability, based on our model, that an individual would be discharged to IRF while holding all covariates in the sample at their actual values. We opted to use average marginal effects to simplify interpretation of the main effects due to the presence of an interaction effect.
Results of Sensitivity Analysis without Survey Weights:

Similar to the primary model, when survey weights were not applied, Medicaid stroke patients hospitalized in states without Medicaid IRF coverage were less likely to be discharged to an IRF than Medicaid stroke patients residing in states with Medicaid IRF coverage, 10.6% (95% CI, 6.7-14.6%) versus 18.3% (95% CI, 16.8-19.8%), p<0.01 in the fully adjusted model, p<0.01 in the fully adjusted model. Also similar to the primary model, there was no difference in the probability of discharge to IRF for non-Medicaid patients in states without IRF coverage compared to states with IRF coverage (16.2% vs. 17.6%, p=0.15).
Supplemental Table I: Results of logistic regression model exploring predictors of admission to an inpatient rehabilitation facility.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Unadjusted Odds Ratio</th>
<th>95% CI</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (continuous)</td>
<td>1.008</td>
<td>1.003-1.012</td>
<td>1.007</td>
<td>1.002-1.011</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Female (Male reference)</td>
<td>1.09</td>
<td>1.02-1.18</td>
<td>1.07</td>
<td>0.99-1.16</td>
<td>0.07</td>
</tr>
<tr>
<td>Length of stay (continuous)</td>
<td>1.03</td>
<td>1.03-1.04</td>
<td>1.02</td>
<td>1.017-1.03</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>tpa (reference: no tpa)</td>
<td>1.76</td>
<td>1.54-2.01</td>
<td>1.47</td>
<td>1.28-1.70</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Charlson comorbidity index (continuous)</td>
<td>1.31</td>
<td>1.28-1.34</td>
<td>1.30</td>
<td>1.27-1.33</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Patient Medicaid (ref: patient not Medicaid)</td>
<td>1.23</td>
<td>1.03-1.34</td>
<td>0.60</td>
<td>0.43-0.85</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>State Medicaid covers IRF (reference: State does not cover IRF)</td>
<td>1.03</td>
<td>0.95-1.19</td>
<td>1.13</td>
<td>0.99-1.28</td>
<td>0.07</td>
</tr>
<tr>
<td>Patient Medicaid-State Medicaid IRF coverage interaction</td>
<td>1.76</td>
<td></td>
<td>1.22-2.52</td>
<td></td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

References:
