Factors Associated with Lengths-of-Stay for Inpatients with Substance Use Disorders

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This policy brief identifies factors associated with inpatient length-of-stay (LOS) for the treatment of substance use disorders (SUDs), and whether there are systematic differences in LOS for rural and urban residents. Inpatient LOS is an important factor in determining the costs associated with treatment of SUDs, a topic addressed in a companion brief by Rural Health Equity Research Center staff.

Background

It is estimated that over $118 billion in health care expenditures were attributed to SUDs in 2019 and that the total cost of SUDs – including societal costs such as lost work productivity, associated crime, death, and loss of quality-of-life – was $3.7 trillion.[1] Hospitals play important roles in inpatient and outpatient treatment for SUDs, and in referrals to other inpatient and outpatient sources of care. The Substance Abuse and Mental Health Services Administration (SAMHSA) distinguishes between general and specialty hospitals. In 2015, the share of direct spending to providers on treatment of SUDs: among general hospitals was 24 percent, and the all-hospital share was 34 percent.[2]

Although the prevalence of SUDs is a problem nationwide, evidence indicates that treatment availability and access varies by geography.[3,4] Owens et al., using hospital stay data from the Health Care Cost and Utilization Project (HCUP), found that rates of stays for mental health or substance use disorders were higher in urban areas than in rural areas (709 per 100,000 population in urban v. 683 in rural areas in 2016), but that rates for persons with secondary mental/SUD diagnoses in rural areas exceeded the rate for urban areas (2,938 per 100,000 v. 2,474 in urban areas).[5] In a separate analysis of inpatient stays for opioid use disorders, Owens et al. found that hospitals located in urban areas had a higher average rate of opioid-related inpatient stays than did hospitals located in rural areas.[6] In rural communities there are often fewer resources, such as hospital beds, emergency facilities, physicians with SUD training, and outpatient treatment programs, as compared

Key Takeaways

- Inpatient length of stays (LOS) for substance use disorder (SUD) treatment were longer for rural residents using urban hospitals than rural residents using rural hospitals.

- Length of stays (LOS) was longer for patients who resided in mental health professional shortage areas and in areas with fewer buprenorphine waivered physicians.

- Medicare patients had longer hospital stays than similar patients without Medicare, especially when also dealing with substance use disorder, mental health conditions, or chronic illnesses.

- Medicaid LOS differed between states, but more research is needed to understand how the federal-state cost-sharing structure affects the availability and effectiveness of outpatient and inpatient treatment for substance use disorder.

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to more densely populated areas. Owens et al. report that costs for stays nationwide with a principal mental or SUD-related disorder were over $15 billion in 2016, or $7,100 per stay; stays for a principal mental disorder were $6,700 per stay nationwide, compared to $7,900 for a principal-SUD stay. Urban and rural costs were not reported separately.[5]

LOS is an indicator of resource use during the stay, and thus an important correlate of cost. As the prevalence of SUDs continues to increase and involve multiple substances such as fentanyl, so will the inpatient costs of treating overdoses and drug-related injuries and conditions (at least until outpatient treatment widely substitutes and complements inpatient care). While LOS is an important indicator of cost of SUD care, research interest in LOS has often focused other areas, including relationships between LOS and the primary source of payment and regional practice patterns.[7] Beyond cost, an understanding of LOS may also be useful to hospital providers in documenting how facilities and professionals prioritize resource use[7] and how rural administrators plan for care delivery. Although cited research documents differences in rates of inpatient stays for SUDs in urban and rural residents, data have not been used to examine relationships between LOS for SUDs and hospital characteristics[7,8] and differences in inpatient resource use for rural residents using rural and urban hospitals – a distinction that may be important, given the relative lack of hospital and other SUD treatment resources in rural areas, resource constraints on rural facilities, and payment-related constraints on LOS for many rural hospitals from which rural residents may be transferred.

This Brief extends the analyses of Owens et al. in several dimensions. First, analysis of factors hypothesized to affect LOS (and cost) are not addressed by Owens et al., such as measures of patient health status, insurance, and characteristics such as the availability of health resources in the broader community where the patient resides. Second, this analysis differentiates between LOS of rural and urban residents, based on rurality of the hospital. Third, the definition of "rural" used by Owens et al. was derived from the county/standard metropolitan statistical areas (SMSA) based rural measure used by the National Center for Health Statistics. By contrast, this analysis assigns the Federal Office of Rural Health Policy's (FORHP) ZIP code-based definition of rurality both to patient residence and to the hospital where inpatient services were provided.[9]

Data and Methods

Data are from the Health Care Cost and Utilization Project (HCUP), based at the Agency for Healthcare Research and Quality (AHRQ). HCUP produces the largest longitudinal hospital care data set in the U.S., from all payor data submitted annually by participating states. HCUP's State Inpatient Data (SID) set includes inpatient stay data for all stays at inpatient community hospitals in the participating states. Data from seven states were acquired for study of inpatient SUD stays[i]; this analysis is based on SID data from four states: Kentucky; North Carolina; Vermont; and Washington. Data from these four states include patient residence ZIP codes and the ZIP codes of the hospital used by the patient. ZIP codes were matched to those that meet FORHP's preferred definition of rurality, both for patient residence and the hospital. Hospital identification for the study states enabled linkage of the stay data to hospital-level data

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[i] These states were selected based on their relatively large rural populations, high rates of SUDs, and data availability which varies state-to-state.

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from the 2018 American Hospital Association (AHA) Survey. A ZIP code-county crosswalk was employed to link patient residence with other county-level data, including data from the Health Resources and Services Administration's (HRSA) Area Health Resources File, data identifying Health Professional Shortage Areas (HPSAs) and availability of physicians licensed to provide buprenorphine.

The conceptual model underlying this analysis is the economics of demand for and supply of inpatient services as informed by Donabedian's structure-process-outcome model of quality[10] and prior research on factors associated with delivery of inpatient services. Underlying this framework, the demand for inpatient care (and other services) is a *derived* demand, derived from the individual's demand for health.[11] LOS is a measure of inpatient resource use. LOS reflects stay and hospital characteristics (structure and process measures); clinical need; patient preferences and information need as measured by various socio-demographic and economic factors including health insurance (price); and market factors, such as community income and the availability of complementary and substitute services such as outpatient care. Rurality is a hypothesized factor, to the extent that it is not measured by other factors such as availability of resources.

The focus of this analysis is LOS for SUD stays. SUD stays were defined as those with a primary diagnosis of SUD. Primary SUD diagnoses were identified using ICD-10-CM codes reported in the HCUP data. Disorders of interest are those used by Owens et al., including diagnoses related to alcohol, cannabis, opioid, sedative, stimulant, or miscellaneous substance abuse.[5,ii] Analysis is limited to stays of persons over the age of 5 years, and stays of more than 40 days have been deleted as outliers (fewer than 0.5 percent of the sample included in the analysis).

Univariate estimates of stays with a primary SUD diagnosis describe the four-state "sample" of inpatient stays, with a focus on comparing rural and urban stays. Poisson regression estimates of LOS show various associations with LOS, controlling for other factors.[iii] Transfer indicators (from another hospital, health facility, or not a transfer) were included in the model as indication that the admission may have required special resources or was expected to require treatment capabilities not available at the prior hospital or facility, e.g., a critical access hospital (CAH) may transfer a patient who is expected to require a stay of five or more days. Admission type distinguishes between emergency, urgent, and elective. Elective admissions are expected to be longer and with patient compliance ("tastes"), in contrast to emergency and urgent admissions. Hospital characteristics, available for all hospitals from the AHA linkage, include bed size and a CAH indicator. Shorter stays in CAHs are expected as CAHs are required by their Conditions of Participation to maintain an overall average LOS of 96 or fewer hours.

Clinical need variables are important as controls for severity and health status. Indicators have been defined from HCUP's diagnosis, chronic conditions, and present-on-admission data. An indicator for stays for which the patient had a secondary SUD diagnosis (in addition to a primary SUD diagnosis) is included in the model, as well as separate indicators for patient diagnoses of depression and psychoses; indicators

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[ii] Diagnosis data from HCUP were processed with software from AHRQ (Clinical Classifications Software Refined (CCSR) for ICD-10-CM Diagnoses (ahrq.gov)).

[iii] Poisson regression is often used on studies of LOS as it is viewed as more appropriate because the dependent variable is "count" data. The distribution of the regression error term, the Poisson distribution, is preferred to the normal distribution that underlies ordinary least squares regression.

that count the number of chronic conditions were developed by applying the Elixhauser software to the HCUP stay data. Owens et al. indicated the importance of secondary SUD, depression, and psychoses in empirical analyses of rates of stays and cost. The number of chronic conditions as an indicator of health status was to be directly related to LOS as chronic conditions may increase disease expected severity and the occurrence of complications.[iv]

Socio-demographic factors included in the model were patient sex, age, and race/ethnicity. The model included a variable indicating the expected primary payor of the stay, as insurance benefits are likely to affect out-of-pocket costs and the costs of complementary and substitute treatments. Payor indicators distinguish between Medicare, Medicaid, private insurance, self-pay, and "other".[5,7,v] As Medicaid benefits may vary among the states, the Medicaid indicators are state-specific.

Several factors included in the model measure demand and supply factors that may be associated with LOS. These include the median household income of the patient's county of residence and the number of physicians per capita waivered to provide buprenorphine. The latter factor is hypothesized to be negatively related to LOS, as it may be correlated with community attitudes affecting the availability of treatment alternatives for SUD.[12] Also included were indicators of whether the patient resided in a county that was in-whole or in-part designated as a Health Professional Shortage Area (HPSA) for mental health (data from HRSA's Area Health Resources File). This measure of relative lack of mental health resources was expected to be positively associated with LOS, as scarcity of resources increases travel costs and other non-monetary costs of stays.

Many data items from the AHA survey indicate whether certain services are available from the hospital or hospital's system that provides the inpatient care. Availability indicators are for telehealth psychiatric and addiction services, alcohol and chemical dependency services, alcohol and drug dependency outpatient services, and alcohol and chemical dependency partial hospitalization services. These process indicators may be important as indicators of resource usage within the facility and within the community-at-large. Unfortunately, these data are not available for a relatively large number of hospitals (and a disproportionately larger number of smaller facilities) because hospital respondents did not complete relevant AHA Survey questions. Therefore, separate regression estimates were obtained for stays in hospitals for which these process measures are available.

As noted, the FORHP definition of rural was applied to both patient residence and hospital location. These indicators of rurality were also interacted to determine whether LOS of rural (urban) patients differs by rurality of hospital. For purposes of discussion below, rural areas are those ZIP-code geographies recognized as rural by FORHP; other areas are referred to as urban, although there are geographic variations within each category.[9]

[iv] Psychoses and depression chronic condition indicators and counts of chronic conditions were created from HCUP data using Elixhauser software available through HCUP (Elixhauser Comorbidity Software, Version 3.7 (ahrq.gov)).
[v] HCUP data creates a uniformly defined *expected primary payor* from hospital-reported information, including patients who are dual-eligibles.

Results

Stays by Rural and Urban Residents

Analysis included inpatient stays with a primary diagnosis of an SUD(s), including over 14,000 stays in rural and 36,000 stays in urban areas of the study states in 2018 (**Exhibit 1**). Average LOS for rural and urban patients were similar – 5.2 days for rural residents, and 5.5 days for urban residents. However, there was considerable variation for both rural and urban stays – LOS ranged from one to 40 days, with standard deviations 5.5 and 5.6 days for rural and urban stays, respectively.

A majority of stays of rural residents were in rural facilities. While fewer than 5 percent of stays by urban residents were in rural facilities, about 41 percent of stays of rural residents were in urban hospitals (**Exhibit 1**). Fifty-nine percent of stays by rural patients were in rural facilities. The distributions of rural and urban stays by hospital size reveal that a disproportionate number of rural stays were in smaller hospitals, including CAHs. Over 23 percent of rural SUD stays were in facilities with fewer than 100 beds, versus about 8 percent of urban stays; over 6 percent of stays of rural residents were at a CAH, versus 2.5 percent for stays of urban residents.

Exhibit 1: Characteristics of Stays for a Primary SUD Diagnosis, by Rurality of Patient, Sample States, 2018

Stay Characteristics	Rural	Urban	Difference
Total SUD stays	14,140	36,291	--
Average length-of-stay, days	5.2	5.5	-0.3*
	Rural (%)	Urban (%)	Difference (%)
Hospital Location			
Rural	59.4	4.7	54.7*
Urban	40.6	95.3	-54.7*
Hospital Stay at a CAH	6.3	2.5	3.8*
Hospital Bed Size			
6-49	6.9	1.0	5.9*
50-99	16.6	6.8	9.8*
100-199	27.6	23.1	4.6*
200-299	16.5	18.6	-2.1*
300-399	16.0	9.8	6.2*
400-499	2.3	8.2	-5.5*
500 or more	14.1	32.4	-18.5*
Admission			
Emergency	58.8	63.1	-4.3*

Stay Characteristics	Rural	Urban	Difference
Urgent	29.3	25.8	3.5*
Elective	11.8	10.9	1.0*
Transfer			
From another hospital	10.1	6.4	3.8*
From another facility	7.3	1.7	5.6*
Not transferred in	82.6	92.0	-9.4*
Buprenorphine-waived Physicians per 10,000 County Population	2.5	2.2	0.3*
Mental Health Professional Shortage Area Designation			
None	8.2	6.5	1.8*
Partial County	34.8	78.6	-43.8*
Whole County	56.1	14.7	43.1*

Notes: Authors' estimates, HCUP data for sample states of Kentucky, North Carolina, Vermont, and Washington. Differences may reflect rounding; all rural-urban percent differences are statistically significant at better than the 5 percent level, indicated by an asterisk (*).

Urban stays were more likely to be categorized as "emergency" in origin (63 percent v. 59 percent of rural stays), and less likely to be regarded as "urgent." Stays of rural residents were more likely to be transfer stays. Over 17 percent of stays of rural patients were transfers from either another hospital or another type of facility, versus 8 percent of urban resident stays. Although the model controlled for measures of clinical need, such as presence of mental health diagnoses and chronic conditions (and community resources though the transfer and HPSA designation variables), unmeasured differences in severity of SUD conditions of rural patients who leave rural communities for urban stays may contribute to the differential.

Over half of stays for an SUD, by both rural and urban residents, were by patients with at least one additional (secondary) SUD diagnosis. Mental health diagnoses of depression and psychoses were common among both rural and urban residents (Appendix). These findings indicate that both rural and urban stays were of patients with similar numbers of chronic conditions. Thirty percent of stays of rural patients were by patients with no chronic conditions, versus 28 percent of stays by urban patients. As indicated in the Appendix, these differences are often of statistical significance, but not large in absolute terms (e.g., about 19 percent of rural stays were of patients with three or four chronic conditions, versus about 21 percent of urban patients).

Age and sex differences of stays of rural and urban patients are small, while some differences by race/ethnicity were noted. Relatively more stays of urban-residing patients were Black (14 percent vs. 7 percent of rural-residing patients, respectively), while Hispanic patients were similarly represented among urban and rural inpatients (2 percent versus 3 percent).

Household income in counties of rural patients was lower than in counties of urban patients. There were relatively large differences in payment sources between rural and urban stays. Private insurance coverage was a more common primary payment source for urban stays (26 percent v. 18 percent for rural stays), as was self-coverage (13 percent v. 9 percent of rural). Public insurance coverage was relatively more common for rural stays. Medicaid was a primary payor for over 46 percent of rural stays, compared with 37 percent of urban stays, and Medicare was a primary source for 22 percent of rural stays and 19 percent for urban stays.

Although rural stays were somewhat more likely to occur in counties with larger numbers of physicians who were authorized to use buprenorphine (**Exhibit 1**), the strength of the association between stays and mental health resource availability as measured by the mental health HPSA designation is apparent. Overall, more than 90 percent of inpatient stays occurred in HPSA-shortage counties; 56 percent of rural inpatient stays occurred in counties that had a whole-county designation versus 15 percent of urban inpatient stays.

Stay Resource Use, Measured by Length-of-Stay

Poisson regression estimates of LOS reveal important relationships concerning SUD LOS in general, and relationships involving LOS for rural compared to urban patients. Clinical need measures are related to LOS in expected ways. Stays of patients with a secondary SUD diagnosis are 10 percent longer than other stays, holding constant other factors in the model (**Exhibit 2**). LOS is positively related to the presence of chronic conditions in a predictable fashion—stays of patients having no chronic conditions are about 6 percent shorter than stays of patients with 1-2 conditions and stays of patients with 5 or more chronic conditions are associated with a 30 percent increase in the LOS of patients relative to stays of patients with 1-2 conditions.

LOS for Whites, Blacks, and Hispanics are similar, while LOS for females are 4 percent shorter than for males. Of note, stays of the youngest patients, ages 6-19, are about 60 percent longer, but are relatively uncommon (Appendix).

Exhibit 2: Poisson Regression Impacts of Selected Factors on LOS for a Primary SUD Diagnosis: Mental Diagnoses, Chronic Conditions, and Socio-Demographic Measures, Sample States, 2018

Selected Factors	Impact
Mental Health and Chronic Conditions	
With Secondary SUD Diagnosis (ref. – without secondary)	1.10*
Additional Mental Health Diagnosis (ref. – none)	
Depression	1.18*
Psychoses	1.21*
Count of Elixhauser Chronic Conditions (ref. 1-2)	
0	0.94*

Selected Factors	Impact
3-4	1.12*
5 or more	1.32*
Socio-Demographic	
Female (ref. Male)	0.96*
Age (ref. 20-44 years)	
5-19 years	1.61*
45-64 years	1.12*
65 years and older	1.08*
Race/Ethnicity (ref. White)	
Black	0.99
Hispanic	0.98
Other	0.92*
Stay Characteristics	
Admission (ref. Emergency)	
Urgent	1.47*
Elective	1.65*
Transfer (ref. Not transferred in)	
From another hospital	1.01
From another facility	1.05*
Hospital Characteristics	
Critical Access Hospital	0.96
Hospital Bed Size (ref. 100-199)	
6-49	0.92*
50-99	0.88*
200-299	0.68*
300-399	0.75*
400-499	0.68*
500 or more	0.77*

Notes: Authors' estimates, HCUP data for sample states of Kentucky, North Carolina, Vermont, and Washington. "Impacts" measure the percent increase (decrease) in LOS associated with a unit increase in the factor, holding other factors constant. Impacts are derived from Poisson

regression of LOS by the authors. Statistical significance, indicated by an asterisk (*), means that the corresponding regression coefficient differs from 0 (no effect) at better than the 5 percent level. Impacts of 1.00 are for reference categories of the indicator factors.

Elective admissions tend to be longer than stays of other admission types, controlling for mental health, chronic conditions, and payor. Elective stays are 65 percent longer than emergency stays, and transfer stays on average were 5 percent longer than non-transfers if transferred from a facility other than another hospital. Stays at CAHs are somewhat shorter than other stays, which is not surprising given institutional and payment limitations on CAHs. The average stay in the smallest hospital group (6-49 beds) is also less than in larger hospitals, an association that may be confounded by CAHs being included in that group. Otherwise, the relationship between hospital size and LOS appears to take on an "inverted-U" shape – the longest stays are in 100-199 bed hospitals.

Payor-type may have a substantial impact on LOS. Holding all other factors (including need, county household income, and other patient characteristics) constant, patients for whom the primary payor was Medicare have the longest stays – 26 percent longer than the privately insured (the reference group, **Exhibit 3**). The Medicaid impact for this sample is "bi-modal" – Medicaid stays in Vermont and Washington are about 15 percent longer than for the privately insured, whereas Medicaid stays in Kentucky and North Carolina tend to be shorter than for the privately insured (10 and 7 percent less, respectively).

Exhibit 3: Poisson Regression Impacts of Payor and Market Characteristics on LOS for a Primary SUD Diagnosis: Sample States, 2018

Payer and Market Characteristics	Impact
Primary Payor of the Stay (ref. Private insurance)	
Medicare	1.26
Medicaid*Kentucky	0.90
Medicaid*North Carolina	0.97
Medicaid*Vermont	1.15
Medicaid*Washington	1.16
Self	1.01
Other	1.08
Median household income, $0000s	1.03
Buprenorphine-waived physicians per 10,000 county population	0.98
Mental Health Professional Shortage Area Designation (ref. None)	
Partial County	1.09
Whole County	1.31
Rurality (ref. Non-rural Patient, Non-rural Hospital)	

Payer and Market Characteristics	Impact
Rural Patient, Rural Hospital	0.76
Rural Patient, Non-rural Hospital	1.03
Non-rural Patient, Rural Hospital	1.07
Abbreviated Model (ref. Non-rural Patient, Non-rural Hospital)	
Rural Patient, Rural Hospital	0.80
Rural Patient, Non-rural Hospital	1.09
Non-rural Patient, Rural Hospital	1.07
*Model for Stays with AHA Service Linkage***	
Service Availability	
Telehealth Psychiatric and Addiction	1.05
Alcohol and Chemical Dependency	0.93
Alcohol and Drug Dependency Outpatient	0.97
Alcohol and Chemical Dependency Partial Hospitalization	1.10

Notes: Authors' estimates, HCUP data for sample states of Kentucky, North Carolina, Vermont, and Washington. "Impacts" measure the percent increase (decrease) in LOS associated with a unit increase in the factor, holding other factors constant. Impacts are derived from Poisson regression of LOS by the authors, and all corresponding Poisson regression coefficients differ from 0 (no effect) at better than the 5 percent level. *Abbreviated Model estimates are derived from model estimates, less the CAH and HPSA-designation variables. **Impacts of these indicators are from a model based on a considerably smaller sample of stays, as not all hospitals provided responses to the service availability questions.

In addition to associations between LOS and Medicaid, geographic market factors are associated with LOS. The relationship between mental health HPSA designation and LOS is as hypothesized. LOS is less for patients residing in counties with no HPSA designation – generally counties with more mental health resources. By contrast, LOSs for patients who reside in counties wholly designated as HPSAs are 30 percent longer, other factors being held constant. For the patient who resides in a county with a partial designation (more often urban than rural inpatients), LOS is less than for whole-county HPSA residents, but 9 percent longer than for patients who reside in a county not designated. The density of buprenorphine-waived physicians is inversely related to LOS – in counties with a larger number of waived physicians, LOS is less. Albeit a small impact, it is in the expected direction.

Rurality of patient residence and the hospital's rurality are associated with LOS, and these dimensions of rurality interact. Compared to stays by urban residents in urban facilities, stays by rural residents in urban facilities are somewhat (3 percent) longer, and 24 percent shorter for rural residents in rural facilities (which are often CAHs and/or smaller than urban facilities). Note that these rural associations were estimated while controlling for other factors in the model, including whether the hospital is a CAH and whether the county is designated as a mental health HPSA. Estimates of the impacts of rurality are larger when the CAH and HPSA designation variables are deleted from the model (the Abbreviated Model results in **Exhibit 3**).

As previously noted, a strength of the HCUP data is that inpatient stay information can sometimes be linked with data from the AHA survey. Hospital survey data items of relevance to this analysis are indicators of whether certain services targeting SUDs were available from the hospital or the hospital's system, and hence are indicators of community resources that may be available as complements or substitutes for inpatient treatment. While the waivered physician factor refers to waivered physicians in the county of the patient's residence, the set of hospital indicators pertain to the community where the hospital is located and not the patient's community. Nevertheless, there is evidence that these resource availability measures may be related to LOS. Stays are somewhat shorter at facilities that targeted services to alcohol and chemical dependent inpatients and outpatients, and longer where these services are provided by way of partial hospitalization (**Exhibit 3**). But as noted, inclusion of these variables in the model significantly reduced the number of stays and hospitals represented in the model (reductions of 21 and 31 percent, respectively) and the lost stays were disproportionately from smaller hospitals. Thus, these results are not necessarily valid for the larger set of modeled stays.

Limitations

This analysis is limited to four states; the findings may not be representative of LOS for the national, rural, and urban inpatient populations as findings might be if data were from more participating HCUP states. Nevertheless, data limitations permit use of FORHP's definition of rural, employed as measures of rurality of both inpatients and the hospitals used, and this study's findings support other findings of prior research and raise hypotheses that call for additional study.

Another consideration pertains to the inability to fully control for local, community-based SUD outpatient treatment opportunities that may differentiate communities represented in the analysis. Although the buprenorphine waiver and HSPA designation variables help control for county-level variations in the availability SUD-related resources, data on specific treatment programs[13] that may affect LOS were not available for areas within the four states included in this analysis.

Discussion

Inpatient resources used in treatment, as measured by LOS, are associated with the rurality of patient residence and the hospital providing treatment. This study finds that LOS for inpatient SUD treatment was longer for rural residents using urban hospitals than for rural residents using rural hospitals (by as much as 35 percent, adjusted for other factors). Previous studies have not accounted for rurality of the hospital. By contrast, when facility rurality is not considered, unadjusted rural LOS is less than urban LOS. Use of urban hospitals by rural residents may be necessary, especially by residents of rural communities where mental health resources may be limited.

Rural residents are more likely to be transferred to another hospital and have longer unadjusted LOS; adjusted LOS of transfers from other health facilities, such as ambulatory surgery centers or distinct units of hospitals, are even longer. Although the model controls for measures of clinical patient need, such as presence of mental health diagnoses and chronic conditions (and community resources though the transfer and HPSA designation variables), unmeasured differences in severity of SUD conditions of rural patients who leave rural communities for urban stays may contribute to the differential.

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It is important to note that while LOS-rurality associations are direct and apparent, these associations diminish with the addition of factors to the model that are indirectly related to rural-urban differences, such as hospital characteristics, physicians providing buprenorphine, and HPSA designations. Additional research with data from a larger number of states should continue to explore the makeup and size of patient and hospital rurality effects.

This research strongly supports the importance of health care resources and outpatient treatment options in treating SUDs. Findings indicate that LOS is longer for patients who reside in mental health shortage areas, both in whole- and partial-county HPSA designated areas, and in rural and urban areas. A possible explanation of this association is that a stronger mental health infrastructure, including outpatient treatment options, reduces the severity of inpatient needs (as well as the prevalence of inpatient treatment). The model also indicates that LOS is lower in areas with a larger per capita number of physicians waivered to provide buprenorphine. Not all SUDs are directly impacted by buprenorphine treatment (e.g., alcohol abuse), but the presence of waivers in the community or county may be indicative of a treatment infrastructure that helps treat SUDs in general on an outpatient basis, thereby reducing the need for hospital resources among those admitted. Evidence from this and other studies suggest that hospital and hospital system characteristics may also be related to LOS. Such research would be facilitated if more states supported the HCUP-AHA data linkage so that supplemental data on hospital characteristics could be more readily employed in research studies.

Length of stay (LOS) is associated with the primary payor, but the nature of the associations illustrates the need for additional research. Medicare stays are the longest, holding other factors constant including patient age, and the presence of other SUD, mental, and chronic conditions. While older patients' needs may not be fully controlled for by the variables in the model, some analysts characterize Medicare as "discriminatory" in its treatment of Medicare patients by only covering early intervention and inpatient care, while not adequately covering intensive outpatient and residential treatment that constitute the "middle" stages of the SUD care continuum. A possible consequence is that "gaps in care continuity can destabilize a person's recovery, leading to escalation of symptoms and a need for more intensive and costly levels of care".[14]

The larger associations of Medicaid and LOS for Vermont and Washington than for Kentucky and North Carolina are notable and suggest that Medicaid-LOS relationships should be further explored. A review of SUD coverage using Kaiser Family Fund-compiled data reveals that these states are quite similar except there is a lack of some drug treatment coverage in Kentucky. However, a notable difference between the state pairings is the Federal Medical Assistance Percentage (FMAP), the programmatic, by-formula share of state Medicaid expenditures incurred by the Federal government.[15] [16] The 2018 FMAPs for Kentucky and North Carolina --71 percent and 68 percent, respectively -- were considerably larger than for Vermont and Washington -- 53 percent and 50 percent, respectively. An important part of the FMAP formula is the state's per capita income – per capita incomes in Vermont and Washington are greater than in Kentucky and North Carolina. Although the model controls for differences in income in the patient's county of residence, the Medicaid impact differential may reflect overall state financial health and ability to support Medicaid. Additional study of how the cost-sharing of FMAP incentives outpatient and inpatient SUD treatments is warranted.

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Although Owens et al. document the associations between socio-demographic characteristics and rates of admission for SUD disorders, results of this analysis suggest that these factors have smaller effects once patients become inpatients. These findings are consistent with others that suggest that patient socio-demographics may have little effect on LOS.[8]

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Appendix

Appendix Exhibit: Patient Need, Socio-Demographic, and Market Characteristics of Patient Stays for a Primary Diagnosis of Substance Use Disorder, by Rurality of Patient, Sample States, 2018

	Rural (%)	Urban (%)	Difference (%)
With Secondary SUD Diagnosis	54.8	56.2	-1.5*
Additional Mental Health Diagnosis			
Depression	29.7	31.2	-1.6*
Psychoses	14.6	16.3	-1.7*
Count of Elixhauser Chronic Conditions			
0	30.1	28.4	1.7*
1-2	45.4	44.8	1.6
3-4	18.6	20.6	-2.0*
5 or more	5.9	6.2	-0.3
Age			
5-19 years	1.9	1.7	0.2
20-44 years	50.0	47.9	2.2*
45-64 years	39.6	41.6	-2.1*
65 years and older	8.5	8.8	-0.4
Female	38.8	37.9	1.8
Race/Ethnicity			
White	86.2	80.0	6.1*
Black	7.2	13.6	-6.5*
Hispanic	2.2	3.0	-0.9*
Other	4.5	3.3	1.2*
Primary Payor			
Private Insurance	17.6	25.5	-7.9*
Medicare	21.9	19.0	2.9*
Medicaid	46.1	37.4	8.7*
Self	8.8	12.7	-3.9*
Other	5.7	5.4	0.2

	Rural (%)	Urban (%)	Difference (%)
Median Household Income, $0,000s	4.7	6.2	-1.5*
Buprenorphine-waived Physicians per 10,000 County Population	2.5	2.2	0.3*
Mental Health Professional Shortage Area Designation			
None	8.2	6.5	1.8*
Partial County	34.8	78.6	-43.8*
Whole County	56.1	14.7	43.1*

Notes: Authors' estimates, HCUP data for sample states of Kentucky, North Carolina, Vermont, and Washington. Differences may reflect rounding error. Statistical significance, indicated by an asterisk (*), means that the corresponding regression coefficient differs from 0 (no effect) at better than the 5 percent level.

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