Resource Use in Treating Alcohol- and Drug-related Diagnoses

Does Teaching Status and Experience Matter?

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OBJECTIVE: This study examined the variations in hospital resource use in the treatment of alcohol and drug diagnoses. Specifically, the study tested 2 hypotheses: 1) patients treated in teaching hospitals will have shorter lengths of stay and lower hospital charges than patients treated in nonteaching hospitals; and 2) patients treated in hospitals with more experience treating these conditions will have shorter lengths of stay and lower hospital charges.

DESIGN: A retrospective cross-sectional study design used data from the 1996 Health Care Utilization Project to test the proposed hypotheses.

PATIENTS/PARTICIPANTS: The population for this study consisted of patients over 18 years old with an acute alcohol- or drug-related discharge diagnostic related group code.

MEASUREMENT AND MAIN RESULTS: The variables of interest were teaching hospital status, as defined by the Council of Teaching Hospitals, and hospital experience, defined as the ratio of alcohol- and drug-related diagnoses to the hospital's total admissions. Measures of hospital resource use included the patient's length of stay and total hospital charges. Patients treated at hospitals with relatively more experience in treating alcohol- and drug-related diagnoses had 10.3% (\$321) lower total charges ($P = .017$).

CONCLUSIONS: Similar to research for high-volume surgical hospitals, these findings confirm that hospitals that have greater experience with complex medical conditions such as alcohol and drug intoxication and withdrawal may be more efficient. This important finding provides a rationale for further exploration of the key factors associated with higher quality and more efficient care for complex medical conditions.

KEY WORDS: hospital charges; length of stay; resource use; teaching hospitals.

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The inpatient treatment of alcohol and drug abuse represents significant costs to U.S. hospitals. Medical complications arising from the abuse of alcohol or illicit drugs include not only toxicities, overdose, and withdrawal, but also complications arising from continued abuse of these toxins. In 1991, 1 of every 5 Medicaid patient days, or 4 million days, were the result of substance abuse-related diagnoses, accounting for almost \$8 billion in Medicaid expenditures.¹ A large percentage of the health care cost devoted to alcohol- and drug-related diagnoses occurs in a hospital setting. Hospitals account for 31% of the \$22.5 billion spent on alcohol abuse and 6% of the \$11.9 billion spent on drug abuse.²

The rising cost to society for the care of these patients has sparked interest among hospital administrators, government leaders, and third-party payers to identify more appropriate ways to effectively and efficiently care for patients admitted with alcohol and drug abuse complications. This problem is of particular importance for many teaching hospitals, due to their urban location and the patient population they serve.

Although teaching hospitals tend to be more expensive than other hospitals, they have been shown to have lower lengths of stay for certain conditions.³ It is thus plausible that these hospitals may also experience additional efficiencies in the provision of care in other yet unexplored areas.

Previous studies exploring the association between provider experience and patient outcomes have focused on procedures such as coronary artery bypass graft, hip fractures, angioplasty procedures, surgical oncology, and other cancer treatments.^{4–8} These studies suggest that care delivered in centers with relatively more experience achieve optimal outcomes and greater efficiencies. The argument follows that higher patient volumes with specific diagnoses or conditions provide physicians with an opportunity for more experience, which translates into more efficient and higher quality care. Although alcohol- and drug-related diagnoses do not rely on the development of specific manual or technical skills, as do surgical diagnoses, the experience gained by caring for more patients may be just as valuable. This experience leads to perfecting the ability to quickly formulate accurate differential diagnoses,⁹ choose appropriate tests,¹⁰ make appropriate referrals, and recognize and treat complications in a timely manner.

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In this study, we examined how hospital length of stay and charges for patients with drug- and alcohol-associated problems related to hospital teaching status and experience in caring for such patients. We hypothesized that 1) patients admitted to teaching hospitals would have shorter lengths of stay and lower charges compared to patients admitted to nonteaching hospitals, and 2) patients treated in hospitals that have more experience in treating alcohol- and drug-related conditions will also have shorter lengths of stay and lower charges compared to patients treated in hospitals with less experience.

METHODS

Data Sources

This study brought together large administrative databases, explained briefly below, to create a unique dataset that allowed for the testing of the proposed hypotheses.

Nationwide Inpatient Sample. The 1996 Nationwide Inpatient Sample (NIS) is part of the Healthcare Cost and Utilization Project (HCUP) sponsored by the Agency for Healthcare Research and Quality (AHRQ). The HCUP is a partnership between federal and state government agencies, as well as private industry. The NIS represents a 20% sample of all U.S. community hospitals stratified to include a proportionate number of hospitals for each stratum. In 1996, 19 states and over 900 hospitals participated, with over 6.5 million discharges. States participating during this time included Arizona, California, Colorado, Connecticut, Florida, Illinois, Iowa, Kansas, Maryland, Massachusetts, Montana, New Jersey, New York, Oregon, Pennsylvania, South Carolina, Tennessee, Washington, and Wisconsin. We extracted patient level data on diagnosis, demographics, hospital charges, and payer source.

American Hospital Association Annual Survey of Hospitals Data. The American Hospital Association's (AHA) hospital survey represents data on hospitals across the country. Data gathered through AHA's Annual Hospital Survey includes information on the hospital's utilization and organizational structure. We extracted hospital characteristics that included number of hospital beds set up and staffed, hospital ownership, occupancy rate, state locale, and teaching status. We linked hospital characteristics to patient data from the NIS using the AHA hospital identification number.

Area Resource File. The Area Resource File (ARF) is a comprehensive database of various market level variables designed for use by planners, policy makers, and researchers.¹¹ The file measures county level demographic data on health care professionals, facilities, utilization, and expenditures, as well as data on the county's population for multiple years. Using the metropolitan statistical area (MSA) code, we linked the population data to the

previous sources allowing us to control for various market level effects. These variables included the MSA's population, per capita income, percent elderly, and percent primary care physician.

InterStudy. This database provided key information on health maintenance organizations (HMOs). InterStudy data tracks the evolving trends of the HMO industry including the entrance, or exit, of HMOs in markets across the country as well as changes in enrollment. We extracted data on the number of HMOs and HMO penetration in each market and linked these data to the working database through MSA codes.

Centers for Medicare and Medicaid Services. We extracted the wage index and the case mix index from databases maintained by the Centers for Medicare and Medicaid Services (CMS). The case mix index measures the costliness of the cases treated by hospitals relative to the national average costs.¹² Similarly, the wage index measures differences in hospital wage structures relative to the national average. Data were linked using the provider number found in both the CMS and AHA databases.

Sample Population

We used the following selection criteria to derive the sample population. At the state level, states had to provide the appropriate AHA identifier that allowed NIS data to be merged with the AHA annual survey, thus allowing the appropriate hospital characteristics to be included in the analyses. Also, states had to provide the appropriate patient characteristic data (i.e., ethnicity, age, etc.). We excluded 6 states that did not meet these criteria: Kansas, South Carolina, and Tennessee did not provide the AHA identifier, while Illinois, Oregon, and Washington were missing patient characteristics critical to this study.

Criteria at the hospital level included 1) hospitals defined as nonfederal acute care facilities,¹³ and 2) hospitals located within urban areas. The lack of managed care penetration data for rural areas necessitated their exclusion.

Finally, we applied patient level criteria. First, patients were at least 18 years of age. Second, patients had a minimum length of stay of 1 day. Last, patients must have had an alcohol- or drug-related diagnosis based on diagnostic related group (DRG) codes. General internal medicine physicians identified 6 DRG codes representing alcohol and drug abuse or dependence. After sampling patients meeting these criteria, we used International Classification of Disease 9th Revision (ICD-9) principal diagnosis codes to verify that sampled patients represented those treated for abuse and withdrawal rather than rehabilitation. Table 1 shows the DRGs, along with the ICD-9 codes of the sampled patients. After applying the sampling criteria and merging the databases, 8,184 discharges, or 85.9% of alcohol- and drug-related discharges in the HCUP sample, were available for analysis.

Table 1. Alcohol- and Drug-Related Diagnostic Related Groups (DRGs)

DRG	Description and ICD-9 Breakdown	N
433	Alcohol & drug abuse or dependence with a disposition left against medical advice.	971
291	Alcohol psychoses	217
292	Drug psychoses	27
303	Alcohol Dependence Syndrome	244
304	Drug dependence	447
305	Nondependent abuse of drugs	36
434	Alcohol & drug abuse or dependence detoxification or other symptomatic treatment with a comorbidity or complication.	1,794
291	Alcohol psychoses	722
292	Drug psychoses	192
303	Alcohol Dependence Syndrome	466
304	Drug dependence	325
305	Nondependent abuse of drugs	89
435	Alcohol & drug abuse or dependence detoxification or other symptomatic treatment	3,991
291	Alcohol psychoses	813
292	Drug psychoses	251
303	Alcohol Dependence Syndrome	1,139
304	Drug dependence	1,539
305	Nondependent abuse of drugs	249
436	Alcohol & drug dependence with rehabilitation therapy	479
291	Alcohol psychoses	14
292	Drug psychoses	0
303	Alcohol Dependence Syndrome	327
304	Drug dependence	136
305	Nondependent abuse of drugs	2
437	Alcohol & drug dependence with combined rehabilitation and detoxification therapy	949
291	Alcohol psychoses	173
292	Drug psychoses	2
303	Alcohol Dependence Syndrome	434
304	Drug dependence	338
305	Nondependent abuse of drugs	2

ICD-9, International Disease Classification 9th Revision.

Variables

The 2 independent variables of interest, the hospital's teaching status and the hospital's relative experience, were analyzed in separate regression equations to estimate their effect on length of stay and total charges. We defined and measured the hospital's relative experience as the percentage of total admissions with an alcohol- and drug-related diagnosis. We measured teaching status as a binary variable defined as membership in the Council of Teaching Hospital and Health Systems (COTH) or not. A member of COTH must, at a minimum, sponsor 4 approved residency programs. Two of these must include medicine, surgery, pediatrics, family practice, obstetrics/gynecology, or psychiatry. They must also have a documented affiliation agreement with a medical school.¹⁴ Many hospitals demonstrate a commitment to the 3 missions of teaching

hospitals; namely, medical education, clinical research, and patient care, especially care of the poor and indigent;¹⁵ but they differ in the degree to which they are involved in each of these missions. Using the COTH definition allowed us to distinguish between major teaching and nonteaching hospitals and identify teaching hospitals according to their degree of commitment to academic medicine. Such distinctions have proven useful in identifying teaching and nonteaching hospitals over several decades.¹⁶

The dependent variable was hospital resource use per patient. We measured resource use using 2 variables: 1) the patient's length of stay and 2) total charges per patient. Logarithmic transformations corrected for the skewed distribution of both of these variables.^{17,18} Total charges and the patient's length of stay were obtained from the NIS database.

Both patient length of stay and hospital charges could be confounded by many environmental variables independent of the patient's condition, diagnosis, or cost of care.^{19,20} Thus, we considered a number of control variables to adjust for hospital, market, and patient characteristics shown to affect variation in resource use per admitted patient.²¹

Hospital characteristic variables included hospital size, occupancy rate, ownership, and the hospital's case mix. Previous research has shown the need to control for the mix of patients when examining hospital resource utilization.²² The Medicare case mix index is a hospital level measure that captures the severity of illness of admitted patients based on the hospital's average DRG relative weight.¹² Hospitals that admit more severely ill patients have a higher case mix index. Thus, we accounted for hospitals with higher charges due to a more costly patient population.

Market characteristic variables included: the penetration of managed care, the number of managed care organizations, the Herfindahl Index, per capita income, the percent of elderly, and wage index. The Herfindahl Index measures the concentration of an industry within a specific market. For example, when a small number of hospitals control the majority of patients, the market is considered concentrated. Alternatively, markets characterized by an even distribution of patients across hospitals are less concentrated. Previous research indicates that market concentration affects hospital charges.²³ Thus, we included a Herfindahl Index based on admissions to control any market concentration effect. We used the wage index to control for variations in wages across markets and HMO measures to control for their influence on length of stay and charges.

Patient characteristics used to adjust for the variation of hospital charges associated with a patient stay included the patient's age, gender, race, diagnosis, number of secondary diagnoses, and payer source.

Table 2 is a comprehensive list of all variables included in the analyses. As previously mentioned, we merged data from various sources to create the working database used to test the study's hypotheses. Table 2 indicates the measurement and source of each variable used in the study.

Statistical Analysis

With the individual patient as the unit of analysis, we analyzed these variables using a three-level hierarchical linear model that accounts for the data's hierarchical nature.²⁴ In this study, patients (level 1) were clustered within hospitals (level 2) that were subsequently clustered within markets (level 3). We analyzed the variables of interest and control variables that were derived from theoretical considerations with the following model:

Resource use per admitted patient = f (teaching status, patient characteristics, hospital characteristics, and market characters)

Empirical considerations for the final model included the examination of any collinearity in the data and the existence of an interaction between teaching hospitals and experience. The data were analyzed using SAS (SAS Institute, Inc., Cary, NC) for Windows version 8.

We analyzed 4 regression models that included: 1) the association of teaching status and length of stay; 2) the association of teaching status and total charges; 3) the association of relative experience and length of stay; and 4) the association of relative experience and total charges.

All 4 models included the same control variables while the relative experience models also controlled for teaching status.

RESULTS

Patient, Hospital, and Market Characteristics

Table 3 provides descriptive statistics for patients identified as admitted with an alcohol- or drug-related DRG code, length of stay of at least one day, and having valid data for the study variables. For comparison, we categorized the descriptive data by teaching (i.e., COTH) and nonteaching hospitals. In all cases, except for the age and gender of the patient, the unadjusted differences between teaching and nonteaching hospitals were significant. The average patient age at both teaching and nonteaching hospitals was approximately 39 years, with both hospitals having a preponderance of male patients. In regard to race, teaching hospitals had a higher percentage of African-American patients as compared to nonteaching. Approximately 50% of all patients with an alcohol- or drug-related diagnosis used some government program to pay for their inpatient care, with the majority paid through the Medicaid program. Patients in teaching hospitals also had slightly

Table 2. Variable Names, Definitions, and Source

Variables	Definitions	Source
Dependent Variables		
Length of stay (LOS)	Log transformation of patient LOS	HCUP
Costs	Log transformation of total hospital charges per admitted patient	HCUP
Independent Variables of Interest		
Teaching status	1 = COTH member; 0 = nonteaching	AHA
Relative experience	(Alcohol and drug-related admissions / total admissions) × 100	HCUP
Control Variables		
Hospital Characteristics		
Bed size	Number of beds set up and staffed	AHA
Ownership	1 = For-profit; 2 = Not-for-profit; 3 = Church	AHA
Member of a multihospital system	0 = not a member; 1 = member	AHA
Occupancy rate	Number of admission / (staffed beds * 365)	AHA
Case Mix Index	A continuous index of the patient mix	HCFA
Patient Characteristics		
Age	Age at time of admission	HCUP
Gender	1 = Male; 2 = Female	HCUP
Ethnicity	1 = White; 2 = African-American; 3 = Other	HCUP
Payer type	1 = Medicare; 2 = Medicaid; 3 = Self-pay; 4 = Other	HCUP
DX2	Number of secondary diagnoses	HCUP
DRG	Diagnostic related group	HCUP
Market Characteristics		
Population	Number of people within the MSA	ARF
Number of HMOs	Number of managed care firms in the MSA	InterStudy
HMO penetration, %	Percent of population enrolled in HMOs	InterStudy
Herfindahl Index (HHI)	Measure of concentration in the market	
Income	Per capita income in the MSA	ARF
Elderly, %	Percent of MSA population 65+	ARF
Wage index	An index of wages across all MSA markets	HCFA

COTH, Council of Teaching Hospitals; MSA, Metropolitan Statistical Area; HCUP, Healthcare Costs and Utilization Project, National Inpatient Sample; AHA, American Hospital Association Annual Hospital Survey; InterStudy, The Interstudy Competitive Edge HMO Industry report; ARF, Area Resource File; HCFA, HealthCare Financing Administration.

more secondary diagnoses on average than patients in nonteaching hospitals.

With regard to the hospital characteristics displayed in Table 3, teaching hospitals were approximately twice as large on average as nonteaching hospitals. Teaching hospitals also had higher occupancy rates and case mix index than their nonteaching counterparts. Data on the case mix index suggested that on average, teaching hospitals treated a sicker inpatient population than did nonteaching hospitals.

Many markets had both COTH and non-COTH facilities where both hospital types shared common market

characteristics. However, many markets did not have a COTH hospital; thus the differences in Table 3. Table 3 indicates that markets with teaching hospitals had fewer HMOs than markets without a teaching hospital. However, despite having fewer HMOs, HMO penetration in those markets with teaching hospitals was slightly higher than nonteaching hospital markets. Also, teaching hospitals were located in markets with a slightly higher percentage of elderly patients.

Each of the 4 regression models used the same explanatory variables shown in Table 3. Table 4 reports only the results for the independent variables of interest,

Table 3. Descriptive Statistics: Mean (Standard Deviation) and Frequency of Continuous and Categorical Variables

Variables	Teaching Hospitals (N = 55 hospitals; 1,546 patients)	Nonteaching Hospitals (N = 390 hospitals; 5,266 patients)
Dependent Variables		
Length of stay per patient, d	5.02 (5.37)	5.41 (12.29)
Charges per patient, [‡] \$	4,891.13 (5,433.67)	4,326.88 (4,468.82)
Control Variables		
Hospital Characteristics		
Number of beds [‡]	527.8 (231.4)	251.1 (158.7)
Ownership [‡]		
Investor owned, %	11.6	6.2
Not-for-profit, %	80.9	88.2
Government, %	17.9	5.5
Occupancy rate, % [‡]	70.1 (9.2)	61.9 (15.4)
Case mix index [‡]	1.81 (0.24)	1.67 (0.31)
Patient Characteristics		
Age, y	39.4 (12.5)	39.5 (12.7)
Gender		
Male, %	68.8	67.7
Female, %	31.1	32.3
Ethnicity*		
White, %	45.1	49.9
African-American, %	35.4	12.3
Other, %	19.5	37.8
Payer type [‡]		
Medicare, %	14.7	15.5
Medicaid, %	34.9	34.0
Self-pay, %	24.8	26.7
Other, %	25.6	23.7
Number of secondary diagnoses [†]	4.0 (2.2)	3.8 (2.2)
Market Characteristics		
Number of HMOs [‡]	12.8 (6.2)	15.6 (7.6)
HMO penetration [‡]	28.3 (11.6)	24.5 (13.6)
Elderly, % [‡]	13.9 (2.4)	12.8 (2.9)
Income, [‡] \$	2,7100.60 (8,954.4)	2,4813.60 (5,124.6)

* P < .05; † P < .01; ‡ P < .001.

Table 4. Results of Hierarchical Linear Model for Teaching Status and Relative Experience

Variable	β Estimate	P Value
Teaching Status		
Length of stay	-0.1238	.163
Total charges	0.03	.716
Relative Experience		
Length of stay	0.08964	.052
Total charges	-0.1031	.017

To calculate the percentage effect of a 1% change in a log-transformed continuous variable (such as log length of stay or log charges), the β estimate is multiplied by 100.^{29*}

specifically, length of stay and total charges for teaching status and length of stay and total charges for relative hospital experience.

The results in terms of teaching status were not significant. For both the length of stay and total charges, the analyses failed to confirm our hypotheses that a significant, negative relationship exists. However, the results for relative experience were mixed in terms of supporting our hypotheses. While the results were not significant with regard to length of stay, the results did indicate that patients admitted with an alcohol- or drug-related DRG code who received care in a hospital with greater experience treating those conditions were more likely to have lower total charges ($P = .017$).

As stated earlier, the specification of relative experience was the proportion of drug- and alcohol-related DRG admitted compared to total admissions; thus, we measured relative experience as a continuous variable. Applying the β estimates shown in Table 4 and the observed median total charges of \$3,112, we found that a 1% increase in "relative experience" (i.e., proportion of total admissions with an alcohol- and drug-related admission) was associated with a reduction of total charges per patient of \$321 (10.3%).

DISCUSSION

Our analysis supported one of our hypotheses; specifically, an association between experience and total charges. Thus, after adjusting for teaching status, patients with an

alcohol- or drug-related diagnosis had significantly lower hospital charges when treated in those hospitals with a higher percentage of alcohol- or drug-related admissions. This finding supports claims that experience does matter. While most of the evidence concerning the influence of physician volume on outcomes of care deals with surgical procedures, this study shows that a volume or experience relationship also may exist for medical diagnoses. Thus, greater experience in caring for patients with alcohol- or drug-related problems might enable hospital staff and physicians to recognize earlier the needs of these patients, anticipate complications, and coordinate patient care more efficiently. Such institutional experience might also enable hospitals to identify efficient methods of caring for these patients and enact policies such as care pathways to provide efficient care.

We note that the association of length of stay and greater relative experience approached the acceptable level of significance ($P = .052$). Interpreting this coefficient (see Table 4) yields that a 1% increase in relative experience is associated with slightly less than an extra half day. Taken in conjunction with the finding that relative experience is also associated with lower charges, we hypothesize that physicians in hospitals with relatively more experience in treating these patients may be less dependent on expensive diagnostic testing and may care for them in a less expensive setting (i.e., general medical floor vs intensive care unit). Thus, it is plausible that charges associated with an extra half day are mitigated by avoiding unnecessary testing and providing more appropriate levels of care at hospitals with more relative experience.

Although the hypotheses with regard to teaching status were not supported, the data may suggest teaching hospitals were not significantly different than their community counterparts. This finding contradicts, to some degree, the perceived view that teaching hospitals generally have longer lengths of stay and higher costs.^{21,25} Though our hypotheses were not supported, it is reassuring that in treating this patient population, teaching hospitals did not have longer lengths of stay and higher charges than community hospitals. The efficacy of a large multispecialty teaching hospital better equipped to treat this type of patient may allow teaching facilities to buck the trend of having longer lengths of stay and higher costs.^{21,25}

Our study only looked at resource use; therefore, we cannot comment on whether this apparently more "efficient" care was indeed of comparable or higher quality. Because of the structure of the NIS, we were not able to track patients over time to determine whether this lower resource use per admission came at the expense of earlier and/or more frequent readmissions. Furthermore, these data did not provide us the information necessary to investigate inpatient quality of care measures to determine whether teaching hospital status or hospital experience were associated with differences in patient outcomes. Mortality rates were too small (8 total) to serve as a reliable patient outcome measure, and other outcome measures were not available

* Two regression models, 1 for length of stay and 1 for charges, were analyzed for both teaching status and relative experience. The full regression models are given below:

1. Teaching Status

Length of Stay or Total Charges = COTH Member + Age + Gender + Payer Source + Race + Income + Case Mix + DRG + % Elderly + HHI + HMO Penetration + No. of HMOs + Multihospital System + No. Secondary Diagnoses + Occupancy Rate + Ownership + Staffed Beds + Wage Index + State

2. Relative Experience

Length of Stay or Total Charges = Relative Experience + Age + Gender + Payer Source + Race + Income + Case Mix + DRG + % Elderly + HHI + HMO Penetration + No. of HMOs + Multihospital System + No. Secondary Diagnoses + Occupancy Rate + Ownership + Staffed Beds + COTH Member + Wage Index + State

from our data sources. Further research involving quality of care indicators will be necessary to determine whether the hospital characteristics associated with differences in resource use are also associated with variations in care outcomes.

We also note that the use of the 2 outcome measures that capture the resource utilization of a hospital are not without limitations. We recognize that though historically used as a proxy for resource use,²⁶ the changing environment has reduced the utility of length of stay as a measure of resource use. The introduction of DRGs, the growth of managed care, and other programs have compressed lengths of stay¹⁹ and may have reduced the variability in length of stay for certain diagnoses. Likewise, total hospital charges, as a proxy for hospital costs,²⁰ are confounded by many environmental variables not necessarily related to the cost of treatment. Some of these include the pricing structure of the hospital, the wage structure of the market, as well as the charge structure allowed by managed care. Given these concerns, we employed a number of control variables and although charges may not accurately reflect the actual cost of patient care, they do represent a valid estimate of the patient's relative expense for a hospital stay.²⁷ Future studies should attempt to improve upon measurement of resource utilization.

Another limitation of this study is its retrospective cross-sectional design. We only studied patients identified by DRG codes and it is likely this definition would not include all patients with comorbid drug and alcohol problems. However, under the regulations governing assignment of DRG codes, it is reasonable to assume that if alcohol- or drug-related problems represent the principle reason for the patient's acute hospital admission, the patient would be assigned to 1 of these DRG codes.²⁸ Despite these limitations, our study demonstrated that the amount of experience an institution has in caring for patients with drug- and alcohol-related illnesses was associated with lower resource use for these patients as measured by total charges. This is an important finding and should spur efforts to further identify the key factors for efficient and appropriate care of this patient population, as well as encouraging the exploration of additional volume outcome relationships relevant to medical inpatients.

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