ORIGINAL ARTICLE

Geographical differences exist in high-value care delivery for inpatient management of cirrhosis: Cost conscious care in cirrhosis

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Abstract

Background and Aims: The United States spends more money per person on health care than any other country in the world. Patients with cirrhosis are at an increased risk of health-care utilization. The aim of this study is to evaluate differences in health-care utilization based on the region of treatment during the inpatient management of patients with cirrhosis.

Method: A retrospective database analysis using the Nationwide Inpatient Sample was performed, including adult patients with a primary diagnosis of cirrhosis determined by ICD-9 codes. Univariate and multivariate analyses were performed to analyze liver decompensation, mortality, length of stay, and total charges in different regions across the United States.

Results: A total of 75 280 patients with cirrhosis who received treatment in nine different regions across the United States were included. Rates of liver decompensation were significantly decreased in the Pacific region compared to the New England region (OR: 0.69, 95% CI: 0.51–0.94). Length of stay was significantly different between regions; however, the means only varied by half a day and were of minimal clinical significance. Inpatient mortality rates were not significantly different between regions. Total charges for inpatient management between regions were significantly different, with the Pacific region having the highest total hospital charges with a mean of $82 731.

Conclusions: Health-care utilization during the inpatient management of cirrhosis varies based on the region. The charges for treatment were the highest in the West despite no impact on mortality, minimal improvement in length of stay, and fewer features of decompensation on admission.

Introduction

The 2015 Commonwealth Fund report highlighted the cost of health care across 13 of the highest income countries, including the United States. The United States spent significantly more money on health care than any other country included in the study, with 17% of the country's gross domestic product spent on health care. This is approximately 50% more than any other country included in the report. Unfortunately, increased spending did not correlate to improved care and life expectancy. Life expectancy in the United States is 78 years of age, which is significantly lower than other countries included in this study, all of which had a life expectancy greater than 80 years of age.[1,2]

Cirrhosis is a chronic liver disease marked by the presence of fibrosis in the liver. Approximately 600 000 patients in the United States are affected, and this number continues to increase

yearly.[3,4] Given the severity of illness and the complications associated with this disease, patients require frequent office visits, hospital admissions, and have high readmission rates despite interventions to improve the management of cirrhosis.[5] Patients with cirrhosis account for a large economic burden in the United States, with greater than $2.5 billion spent annually on their care and the cost of each readmission averaging $28 000.[6,7] Given the high economic burden, it is crucial and timely to evaluate physicians' ability to perform high-value, cost-effective care in different regions in the United States. Currently, there is no nationwide analysis that evaluates the cost differences for the inpatient management of cirrhosis based on the region where the patient receives care. The aim of this study is to use the Nationwide Inpatient Sample (NIS) to evaluate differences in health-care utilization during the inpatient management of cirrhosis between different regions across the United States. We

hypothesize that certain regions will have increased health-care expenditures during the inpatient management of cirrhosis with minimal to no improvement in mortality or length of stay.

Methods

Data source: A retrospective analysis was performed utilizing the NIS during the calendar year of 2013. The NIS is part of the Healthcare Cost and Utilization Project (HCUP) and is one of the largest publically available databases, consisting of information from over 7 million hospital discharges annually across the United States.[8] This database contains over 100 clinical and hospital variables. It utilizes the unit of observation as an admission, not the patient; therefore, if a patient was readmitted in the year, they would be included more than once. This database does not allow limiting data to only include a patient once. The information is deidentified in order to protect the privacy of the patients, the physician involved in care, and the hospital where care was received; therefore, this study is exempt from review from The Ohio State University Institutional Review Board (IRB).

Study sample: Patients with a primary diagnosis of cirrhosis determined by the International Classification of Disease code (ICD-9) of 571.2, 571.5, or 571.6 were included in this study. Patients were excluded if they were under the age of 18 years.

Outcomes of interest: We evaluated differences in hospital outcomes based on the geographic region in which patients with cirrhosis received care. Geographic regions included New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific. Our primary outcomes were inpatient mortality, length of stay, total adjusted charges, and features of liver decompensation, including ascites, hepatic encephalopathy, hepatocellular carcinoma, spontaneous bacterial peritonitis, edema, hepatorenal syndrome, varices, and portal hypertension.

Covariates: Other variables examined included age; gender; race; income bracket based on zip code; hospital size and type; primary insurance pay; etiology of cirrhosis; and treatment for hepatocellular carcinoma, including liver transplantation, liver resection, ablation, transarterial chemoembolization (TACE), and noninvasive, which was defined as the lack of coding of one of the previous procedures. If patients underwent more than one procedure, they were listed under the most invasive procedure. The presence of comorbidities was also evaluated using the Elixhauser comorbidity scale, which was modified to exclude liver disease and metastatic disease.[9]

Statistical analysis: Differences in each of the factors of interest between regions were evaluated with χ^2 and *t*-tests, as appropriate. Multivariate logistic and linear regression models were fit for specific outcomes, including liver decompensation, mortality, length of stay, and total charge. All patient demographics, hospital characteristics, causes of cirrhosis, features of liver decompensation, and treatment were included in each of the models. The models for mortality, length of stay, and total charge were additionally adjusted for features of liver decompensation. All analyses were performed using weighted data and appropriate survey procedures to produce national estimates. Data were analyzed using SAS software (version 9.4, SAS Institute Inc., Cary, NC, USA).

Results

Demographics: A total of 75 280 admissions of patients with cirrhosis were included in this study. The South Atlantic region had the largest number with 15 855(21%) admissions, followed by Pacific (*n* = 11 020, 15%), West South Central (*n* = 10 690, 14%), East North Central (*n* = 10 335, 14%), Middle Atlantic (*n* = 10 035, 13%), East South Central (*n* = 5620, 7%), Mountain (*n* = 5125, 7%), West North Central (*n* = 3385, 4%), and New England region (*n* = 3215, 4%) (Table 1).

Features of liver decompensation: The majority of patients (90%) had at least one feature of liver decompensation, with ascites being the most common complication. The presence of at least one feature of decompensation was significant between regions, with the New England region having the highest percentage (*P* value 0.002 (Table 1). On multivariate analysis, patients who received care in the East North Central regions were less likely to present with a feature of liver decompensation compared to New England patients (odds ratio [OR]: 0.69, 95% confidence interval [CI]: 0.40, 0.79). There were no significant differences between other regions (Table 2).

Length of stay: Length of stay was significantly different between the regions (*P* value 0.037), with West South Central having the shortest length of stay (5.4 days) and Middle Atlantic having the longest length of stay (6.4 days) (Table 1). After adjusting for confounders, length of stay remained significantly different between regions with the East North Central region having the shortest length of stay compared to New England. However, this difference is minimal and is likely of no clinical significance (−0.51 days, −0.97, −0.05). There was no statistically significant difference in length of stay between the other regions (Table 2).

Inpatient mortality: Inpatient mortality during admission ranged from 4.43% in the West North Central region to 6.08% in the Middle Atlantic Region. However, inpatient mortality was not significantly different between regions on the univariate (*P* value 0.65) or multivariate analysis (*P* value 0.34) (Tables 1 and 2).

Charge: The total charge for each admission was significantly different between regions (*P* value < 0.001). Average charge per admission was the highest in the Pacific region at $82 731 and was the lowest in the New England region at $41 662 (Table 1). In the multivariate analysis, the Pacific region had the highest charge compared to the New England region ($41 069, $25 138–$56 998). Other regions, including the South Atlantic, West South Central, Mountain, and Middle Atlantic, also had significantly higher charges than the New English region [($11 534, $567–$22 501), ($14 858, $4257–$25 485), ($25 808, $9148–$42 467), ($27 257, $15 989–$38 525), respectively] (Table 2).

Discussion

Despite recent emphasis to perform high-value, cost-conscious care, previous studies have proven that health-care expenditures in the United States are significantly higher than in other developed countries despite no improvement in life expectancy. This is the first nationwide study to recognize differences in hospital outcomes based on the region in the United States where

Table 1 Demographics and clinical parameters of patients with cirrhosis by region

	New England (n = 3215)	Middle Atlantic (n = 10 035)	East North Central (n = 10 335)	West North Central (n = 3385)	South Atlantic (n = 15 855)	East South Central (n = 5620)	West South Central (n = 10 690)	Mountain (n = 5125)	Pacific (n = 11 020)	P-value
Age (years)										<0.001
≤64	78.4%	72.1%	75.9%	73.4%	77.0%	76.3%	79.1%	79.3%	79.6%	
65–79	16.8%	21.9%	20.2%	20.7%	19.2%	19.6%	18.0%	15.8%	16.3%	
≥80	4.8%	6.0%	3.9%	5.9%	3.9%	4.2%	2.9%	4.9%	4.0%	
Gender										0.161
Male	65.9%	64.0%	62.7%	61.0%	64.0%	62.9%	65.0%	63.0%	66.5%	
Female	34.1%	36.0%	37.3%	39.0%	36.0%	37.1%	35.0%	37.0%	33.5%	
Race										<0.001
White	80.9%	64.3%	76.1%	87.5%	71.7%	88.6%	53.5%	59.9%	48.3%	
Black	4.6%	9.8%	11.0%	7.0%	13.8%	7.6%	6.8%	3.2%	3.2%	
Hispanic	11.3%	16.3%	9.2%	1.3%	11.1%	2.4%	32.8%	22.5%	41.1%	
Other	3.3%	9.7%	3.7%	4.2%	3.4%	1.4%	7.0%	14.4%	7.4%	
Income bracket										<0.001
Low	14.3%	21.9%	30.6%	27.0%	40.2%	60.8%	43.2%	39.5%	21.2%	
Moderate	15.0%	23.0%	32.9%	35.4%	27.9%	25.1%	24.3%	29.6%	24.8%	
High	31.1%	26.5%	23.3%	25.0%	19.4%	11.4%	21.8%	20.7%	31.7%	
Very high	39.6%	28.7%	13.3%	12.7%	12.6%	2.7%	10.7%	10.2%	22.3%	
Insurance										<0.001
Medicare	37.3%	37.8%	37.2%	38.4%	36.5%	41.8%	30.7%	33.3%	29.0%	
Medicaid	31.0%	28.4%	22.7%	23.8%	24.5%	21.1%	18.1%	23.0%	31.7%	
Private	21.6%	23.4%	23.1%	23.2%	19.7%	19.2%	22.4%	18.8%	20.3%	
Other	10.1%	10.4%	16.9%	14.6%	19.3%	17.9%	28.9%	25.0%	18.9%	
Hospital type										<0.001
Rural	6.4%	5.4%	7.0%	12.1%	9.5%	20.6%	7.0%	7.4%	3.3%	
Urban nonteaching	26.4%	25.8%	31.5%	22.9%	42.5%	23.6%	31.4%	49.7%	53.6%	
Urban teaching	67.2%	68.8%	61.5%	65.0%	48.0%	55.8%	61.6%	42.9%	43.2%	
Hospital bed size										<0.001
Small	26.1%	12.8%	10.6%	10.8%	8.6%	7.5%	15.3%	4.5%	8.8%	
Medium	31.9%	29.2%	22.9%	19.2%	24.9%	29.9%	35.6%	24.6%	22.6%	
Large	42.0%	58.1%	66.6%	70.0%	66.5%	62.6%	49.2%	70.9%	68.6%	
Elixhauser score										<0.001
<3	26.8%	27.1%	19.9%	23.8%	23.8%	24.6%	27.9%	24.9%	26.2%	
≥3	73.3%	72.9%	80.1%	76.2%	76.2%	75.4%	72.1%	75.1%	73.8%	
Causes of cirrhosis										
Hepatitis C	10.4%	11.7%	7.5%	6.8%	8.8%	8.6%	9.3%	8.3%	10.5%	0.008
Hepatitis B	1.2%	1.5%	1.0%	0.2%	1.0%	1.6%	0.7%	0.4%	1.0%	0.016
Alcohol	69.2%	59.5%	63.8%	61.9%	62.4%	54.0%	58.9%	70.2%	67.5%	<0.001
NASH	31.7%	39.7%	36.7%	39.1%	38.1%	46.6%	40.3%	29.9%	33.0%	<0.001
Primary sclerosing cholangitis	0.5%	0.7%	0.5%	0.00%	0.3%	0.8%	0.3%	0.5%	0.5%	–
Primary biliary cirrhosis	1.9%	1.9%	1.4%	1.6%	1.3%	1.8%	2.2%	2.0%	1.5%	0.521

Variable										P-value
Autoimmune	0.8%	1.0%	1.1%	0.6%	1.2%	0.8%	1.1%	0.6%	0.6%	0.540
Liver decompensation factors										
Any	93.5%	91.2%	88.5%	90.7%	91.0%	91.0%	91.9%	93.3%	91.7%	0.002
Ascites	69.2%	68.4%	64.4%	65.3%	68.5%	66.0%	64.6%	61.1%	63.6%	0.001
Coagulopathy	5.9%	7.5%	7.5%	8.7%	8.0%	10.1%	8.5%	12.2%	11.2%	<0.001
Esophageal varices	39.2%	36.6%	40.2%	41.1%	38.4%	39.6%	41.1%	46.8%	46.0%	<0.001
Portal hypertension	44.8%	44.7%	44.8%	47.3%	41.7%	41.4%	44.1%	50.4%	43.2%	0.082
Encephalopathy	1.9%	2.2%	2.0%	0.7%	2.3%	4.0%	2.1%	3.0%	1.9%	0.003
Edema	5.0%	3.0%	4.3%	5.6%	4.4%	5.9%	3.9%	6.5%	4.3%	0.002
Hepatorenal syndrome	8.4%	5.7%	6.1%	5.0%	4.5%	5.3%	4.9%	6.1%	5.7%	0.075
Spontaneous bacterial peritonitis	2.6%	3.1%	2.2%	2.8%	2.6%	2.4%	2.7%	2.5%	3.3%	0.585
Hepatocellular carcinoma	4.8%	4.0%	3.5%	3.7%	2.5%	2.6%	4.4%	2.4%	4.4%	0.010
Metastatic hepatocellular carcinoma	0.6%	0.8%	1.0%	0.4%	0.8%	0.2%	1.0%	0.2%	0.7%	0.055
Outcomes										
Length of stay (days)	6.0	6.4	5.6	5.9	5.7	5.7	5.4	5.5	5.7	0.037
Length of stay										<0.001
<3 days	38.6%	37.9%	42.3%	46.4%	42.6%	41.4%	45.3%	46.5%	47.8%	
3–7 days	38.3%	35.8%	37.5%	34.9%	36.1%	38.5%	36.9%	36.1%	32.2%	
>7 days	23.2%	26.3%	20.2%	18.8%	21.2%	20.1%	17.8%	17.4%	20.0%	
Treatment										
Transplant	2.3%	1.7%	2.4%	3.0%	2.5%	3.7%	2.7%	1.7%	2.4%	
Resection	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Ablation	0.2%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	
TACE	1.1%	1.3%	2.1%	1.5%	1.1%	2.1%	1.2%	1.7%	0.9%	
Noninvasive	96.3%	97.1%	95.5%	95.6%	96.4%	94.3%	96.1%	96.5%	96.7%	
In-hospital mortality	5.9%	6.1%	5.2%	4.4%	5.1%	5.9%	5.1%	4.6%	5.1%	0.655
Cost ($)	17 102	15 074	14 479	15 598	13 119	12 248	12 862	16 121	20 289	0.068
Charge ($)	41 662	65 306	47 858	49 020	49 232	44 824	54 346	61 663	82 731	<0.001

P-values are calculated using χ^2 tests (categorical variables) or *t*-tests (continuous variables). Percentages displayed are percentages of the regions (column percent).

treatment was received during the inpatient management of cirrhosis. Patients who received care in the Pacific region had a higher total charge of admission despite no improvement in inpatient mortality or length of stay. Patients in this region presented with fewer features of decompensated cirrhosis then other regions; however, this was not statistically significant. These geographical differences in high-value, cost-conscious care is likely influenced by multiple factors and ultimately has an effect on patient ability to access and afford future care.

Multiple regions in the United States have increased charge for care compared to New England, with the highest cost in patients with cirrhosis who receive care in the Pacific region. This trend has been noted in previous cost analysis studies in multiple aspects of medical care. Cost of surgery, specifically in limb amputation in diabetes patients; the cost of imaging with MRI; and the overall cost of care in the Medicaid population has been noted to be higher in California, which is part of the Pacific

region in this study.[10–13] Increased cost of care is likely influenced by the price inflation in the region, income of patients, availability of care and specialty resources, and many other factors.[11,14] The cost of increased medical services in a region is complex and is affected by many variables outside of the hospital, patient, or state factors according to recent studies.[11]

Despite the Pacific region having higher charges during the inpatient management of cirrhosis, there was no benefit in inpatient mortality or length of stay. Inflation in the charge for services would increase total charges compared to other regions without benefiting length of stay or inpatient mortality. Patients may also be undergoing routine outpatient testing and screening during their inpatient stay, which would unnecessarily increase the charge for hospital admissions with no improvement in inpatient mortality and could unnecessarily increase hospital length of stay.[15] High-value, cost-effective care has been proven to minimize costs and improve outcomes; however, if excessive tests or procedures are completed, the

Table 2 Multivariate logistic regression models for liver decompensation, mortality, length of stay, and cost

	Liver decompensation			Mortality		
	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Hospital region			0.001			0.330
New England	Reference			Reference		
Middle Atlantic	0.73	(0.52, 1.03)		1.03	(0.67, 1.58)	
East North Central	0.56	(0.40, 0.79)		0.77	(0.50, 1.19)	
West North Central	0.69	(0.44, 1.08)		0.60	(0.36, 1.03)	
South Atlantic	0.76	(0.55, 1.06)		0.80	(0.52, 1.22)	
East South Central	0.84	(0.55, 1.28)		0.83	(0.50, 1.37)	
West South Central	0.87	(0.62, 1.23)		0.81	(0.52, 1.26)	
Mountain	1.08	(0.71, 1.64)		0.65	(0.36, 1.17)	
Pacific	0.76	(0.53, 1.09)		0.86	(0.55, 1.33)	

	Days	95% CI	*P*-value	$	95% CI	*P*-value
Hospital region			0.008			<0.001
New England	Reference			Reference		
Middle Atlantic	0.46	(−0.02, 0.94)		-1079	(−3612, 1455)	
East North Central	−0.50	(−0.96, −0.04)		−2247	(−4740, 246)	
West North Central	−0.07	(1.00, 0.85)		−2178	(−5426, 1070)	
South Atlantic	−0.21	(−0.68, 0.26)		−2916	(−5321, −511)	
East South Central	−0.31	(−0.95, 0.34)		−5227	(−8240, −2215)	
West South Central	−0.34	(−0.86, 0.17)		−3483	(−5882, −1084)	
Mountain	−0.39	(−1.30, 0.52)		557	(−3444, 4557)	
Pacific	−0.17	(−0.83, 0.49)		3658	(−322, 7639)	

	$	95% CI				*P*-value
Hospital region						<0.001
New England	Reference					
Middle Atlantic	27 606	(16 188, 39 024)				
East North Central	6969	(−3524, 17 461)				
West North Central	10 584	(−3526, 24 695)				
South Atlantic	11 533	(407, 22 658)				
East South Central	2964	(−9224, 15 152)				
West South Central	14 857	(4089, 25 624)				
Mountain	25 429	(8616, 42 242)				
Pacific	40 591	(24 599, 56 582)				

cost of care would be increased with no improvement in mortality or length of stay, which is demonstrated in this study.[16]

Inability of physicians to perform high-value, cost-effective care can have a profound effect on patients in the United States. Patients who are subject to a higher cost of care could suffer from increased economic hardships given that their income is being spent on health care instead of other necessities.[17] Patients are likely to refuse medical care if the cost is too high, which would lead to increased disease severity, complications, and earlier-than-anticipated mortality.[18] Given the effect of health-care cost on patients and society, interventions to promote high-value, cost-conscious care have been instituted in the United States, such as the Centers for Medicare and Medicaid nonpayment policy for health care-acquired conditions.[19] The future of our medical systems is that physician reimbursement will be directly linked to quality physician performance in performing high-value, cost-effective care.[20,21]

There are multiple limitations in this study. First, the data were collected through the NIS where information can only be obtained from ICD-9 coding. These codes could not be verified by medical charts given privacy issues; however, they have been verified in other studies.[22] This database also does not include laboratory data; therefore, other important information, including Childs Pugh Score and MELD score, could not be calculated. In addition, although this is a nationwide study that was conducted through the NIS, some states do not report hospital statistics to the NIS and therefore would not have been included. In addition, other factors that could affect hospital outcomes and cost, such as scheduled outpatient follow up, intensity of outpatient care, procedures during admission, if patient was cared for by a hepatologist or hospitalist, if the patient was on the transplant waiting list, disposition after discharge, and if patients with chronic hepatitis C received antiviral therapy, are not evaluated in this study. Despite its limitations, this study has multiple strengths, the primary of which is a large patient sample with a diverse population across the United States.

This is the first nationwide study that evaluated differences in high-value, cost-effective care during the inpatient management of patients with cirrhosis in the United States. This study shows that the Pacific region of the United States, including the states of Washington, Oregon, California, and Alaska, averages a higher charge per admission compared to other regions in the United States. However, the increased cost of services does not correlate with decreased mortality rates or improved length of stay. Further research should be completed to determine interventions that promote high-value, cost-effective care in order to improve patient outcomes, decrease economic burden on the United States, and minimize unnecessary utilization of health-care dollars in patients with cirrhosis.

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