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Palliative Care and Healthcare Utilization for Patients with End-Stage Liver Disease at the End of Life

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Abstract

Background & Aims—There has been increased attention on ways to improve the quality of end of life care for patients with end-stage liver disease, yet there have been few reports of care experiences for patients during terminal hospitalizations. We analyzed data from a large national database to increase our understanding of palliative care for and healthcare utilization by patients with end-stage liver disease.

Methods—We performed a cross-sectional, observational study to examine terminal hospitalizations of adults with decompensated cirrhosis using data from the National Inpatient Sample, from 2009 through 2013. We collected data on palliative care consultation and total hospital costs, and performed multivariate regression analyses to identify factors associated with palliative care consultation. We also investigated whether consultation was associated with lower costs.

Results—Of 59,687 hospitalized adults with terminal decompensated cirrhosis; 29.1% received palliative care; the mean cost per hospitalization was $49,167±$1169. Palliative care consultation increased annually, provided to 17.8% of patients in 2009 and 35.4% of patients in 2013 ($P<.05$).

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The mean cost for the terminal hospitalization also increased each year, from $47,766 in 2009 to $51,435 in 2013 ($P$<.05). African Americans, Hispanics, Asians, and liver transplant candidates were less likely to receive palliative care, whereas care in large, urban, teaching hospitals was associated with higher odds of receiving consultation. Palliative care was associated with lower procedure burden—after adjusting for other factors, palliative care was associated with cost reduction of $8892.

Conclusion—Palliative care consultation and cost of end of life care for patients with end-stage liver disease increased from 2009 through 2013. Palliative care consultation during terminal hospitalizations is associated with lower costs and procedure burden. Future research should evaluate timing and effects of palliative care on quality of end of life care in this population.

Keywords

NIS; death; HCC; palliation

INTRODUCTION

Cirrhosis of the liver affects 633,000 Americans, or 0.27% of the U.S. population[1] and is often characterized by an unpredictable and rapid clinical deterioration leading to death[2]. Liver transplantation is the only effective cure for decompensated cirrhosis. However, organ shortages restrict availability to only 5,500 patients receiving this procedure annually for all forms of liver disease, compared to the 36,400 deaths from decompensated cirrhosis each year[3, 4]. As a result, patients with cirrhosis and an estimated six-month life expectancy experience significant suffering and generate greater caregiver burden at the end-of-life compared to patients dying of other chronic conditions[5].

Despite increased attention paid to improving end-of-life care for patients with liver disease[6, 7], little is known about the current quality of care, resources, and costs associated with treating these patients. A study using the Health and Retirement Survey found that patients with cirrhosis report worse health status and require more caregiver support compared to age-matched patients without cirrhosis, but the sample was limited to Medicare recipients and hospital illness experiences and costs were not detailed[8].

For hospitalized patients, palliative care consultation has been shown to be associated with improved patient satisfaction, increased provider satisfaction, and lower intensive care unit (ICU) utilization, making it a marker for better inpatient end-of-life care quality[9, 10]. In 2014, an observational study from an academic medical center in Canada demonstrated that non-transplant candidates with cirrhosis had a mean survival of 52 days after being removed from the liver transplant list. For those hospitalized, receipt of inpatient palliative care consultation was as low as 11%, while 48% experienced ICU admission and 17% initiated hemodialysis[11]. Use of treatments and costs during terminal hospitalizations for patients with decompensated cirrhosis have not been characterized in the United States (U.S.) We used national data to describe palliative care consultation and resource utilization for patients with decompensated cirrhosis during terminal hospitalizations. Our hypothesis is that the overall rate of palliative care consultation in our population would be low while utilization in the form of procedures and total costs would be high.

METHODS

Dataset

The National Inpatient Sample (NIS) is a large, national database that contains annual clinical and resource utilization information from hospitalizations across the U.S. It is a product of the Healthcare Cost and Utilization Project (HCUP) and Agency for Healthcare Research and Quality[12]. National data are obtained from a total of 44 states, and each state database contains random samples of hospitalizations from HCUP member hospitals, stratified by census division, hospital ownership, setting, teaching status, and bed size as classified by the American Hospital Association Annual Survey of Hospitals. Starting from 2012, the database excludes hospitalizations from rehabilitation centers and long-term acute care hospitals.

Patient Cohort

Our population of interest was patients 18 years and older who died during their hospitalization and stayed in the hospital for at least 3 days[13]. Patients were identified as having end-stage liver disease by using validated International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes for end-stage liver disease (Supplementary Table 1). These codes were associated with an 85.7% positive predictive value for detecting end stage liver disease in a previous study[14].

Variables of Interest

The main outcomes of interest in our study were the proportion of patients with decompensated liver disease receiving palliative care consultation during the terminal hospitalization and the total cost of the terminal hospitalization. Receipt of palliative care consultation was identified by the presence of ICD-9-CM code V66.7, among listed subject diagnosis codes, consistent with previous studies[15, 16]. We calculated the total hospital cost of each hospitalization by applying hospital-specific and group average all-payer inpatient cost-to-charge ratios from the Center for Medicare and Medicaid Services provided by HCUP to the reported hospital charges. Costs were then adjusted for inflation using the Consumer Price Index (CPI) and expressed as 2013 dollars[17]. In addition, we We included several patient-level and hospital-level factors using a pre-specified conceptual model. Patient-level data included year of hospitalization, demographics, Charlson comorbidity index[18], reason for admission, length of stay, presence of hepatocellular carcinoma (HCC), transplant status (defined as those listed for or receiving transplant during hospitalization) and frequency of invasive procedures. Hospital-level variables were hospital bed size, hospital location/teaching status, hospital ownership, and hospital region. The ICD-9 CM codes used for analysis are described in Supplementary Table 1.

Statistical Analysis

We applied survey weights and adjustments from the NIS to provide national population estimates and to account for the changes in sampling in 2012. Bivariate analyses were performed examining differences in patient characteristics, cost, length of stay, and procedure burden based on receipt of palliative care using simple linear and logistic regressions. Then, multivariate regression analyses were performed to determine factors associated with palliative care and factors associated with total cost. To minimize bias from missing values, we used multiple imputation by chained equations[19] for race (8.3% missing), insurance status (0.3% missing), average household income (3.4%) and all hospital factors (1.2% missing). Of the final sample, 654 patients lacked cost data and were excluded from the multivariate analysis involving predictors of cost but were included in the analysis involving predictors of palliative care. Sensitivity analyses were conducted examining the relationship between palliative care consult and costs in two alternative settings: 1) excluding transplant candidates and recipients and 2) adjusting for treatment selection using doubly robust inverse probability of treatment weighting (IPTW) analysis[20]. Differences with *p*-values less than 0.05 were considered statistically significant. All analyses were performed with STATA 14.0 software (STATA Corp, College Station, TX).

RESULTS

Descriptive Statistics

From 2009 to 2013, the NIS contained 7,751,486 hospital discharges representing 38,051,324 discharges nationally. Among the 468,082 terminal hospitalizations over the five-year period for adults with a length of stay of at least 3 days, 12,162 (2.6%) hospitalizations were for patients with end-stage liver disease. Weighted, our total sample size was 59,687 patients. Since these hospitalizations were terminal, each discharge represented a unique patient.

Among the nationally weighted sample of 59,687 patients dying in the hospital with decompensated liver disease from 2009 to 2013, 18,027 (29.1%) received a palliative care consultation during the hospitalization. Palliative care consultation increased annually (17.8% to 35.4% from 2009 to 2013, $p<0.05$). The inpatient decedent population with decompensated liver disease was mostly male (62.7%), Caucasian (66.1%), and hospitalized at large (69.4%), urban/teaching (61.2%), private non-profit hospitals (71.8%). Forty-three percent were covered by Medicare. Septicemia was the most common identified reason for admission in 22.2% of patients. Out of decedents, 7.5% carried a diagnosis of HCC, 1.4% were listed for liver transplant and 0.7% received the operation (Table 1).

Mean cost for the terminal hospitalization was $49,167 (standard error = $1,116), which increased each year ($47,766 to $51,435 from 2009 to 2013, $p<0.05$). The mean length of stay was 14 days (SE = 0.2 days). Twenty-five percent of patients received an endoscopy while 40% of patients received a paracentesis. Fifty-six percent of patients received mechanical ventilation and 45% received a blood transfusion. Dialysis was initiated for 15.5% of patients and parenteral nutrition was used 13.2% of the time. Cardiopulmonary resuscitation was attempted in 6.2% of these patients before death (Table 2).

Factors Associated with Palliative Care Consultation

Bivariate analyses showed significant differences between decedents receiving and not receiving palliative care with respect to annual household income, hospital factors, presence of HCC and Charlson comorbidity index. Reasons for admission were not significant different between these groups (Table 1). Mean total costs, length of stay, and procedure burden were all significantly lower for patients who received palliative care consultation (Table 2).

Controlling for all other factors, patients with end-stage liver disease were increasingly likely to receive a palliative care consult during their terminal hospitalization from 2010 to 2013 as compared to 2009. Hospital factors, particularly large hospital bed size (OR: 1.48, 95% CI: 1.17-1.88), urban location and teaching status (OR: 1.37, 95% CI: 1.07-1.77), and West Coast region (OR: 2.40, 95% CI: 1.84-3.12) were associated with higher odds ratios of receiving palliative care consultation compared to their reference groups. Higher Charlson comorbidity index (OR: 1.02, 95% CI: 1.00-1.03) and presence of HCC (OR: 1.45, 95% CI: 1.24-1.70) were also associated with higher odds of receiving a palliative care consult. African American (OR: 0.74, 95% CI: 0.62-0.88), Hispanic (OR: 0.79, 95% CI: 0.68-0.93), and Asian (OR: 0.73, 95% CI: 0.54-0.99) patients had lower odds of receiving a palliative care consultation when compared to Caucasians. Decedents who were listed or received liver transplantation during admission were also less likely to receive palliative care (OR: 0.66, 95% CI: 0.48-0.92) than those who were not listed for liver transplant (Table 3). Palliative care receipt was also stratified by hospital bed size and hospital teaching status. Palliative care rates are highest at large, urban teaching hospitals (32.5%) and lower at small, rural (18.1%) and small, urban non-teaching hospitals (18.3%). However, rates of palliative care appear to be increasing at nearly every type and size of hospital over time. At large hospitals, patients with HCC appear to receive more palliative care consultation than patients without HCC. At urban/teaching hospitals, African Americans have lower odds of receiving palliative care while Native American have higher odds compared to Caucasians (Supplemental Table 2).

Factors Associated with Hospital Cost

In the model predicting total cost of the terminal hospitalization, palliative care consultation was associated with lower overall costs when adjusting for all other covariates (−$8,892, 95% CI: −$11,595, −$6,189). Having been listed or receiving liver transplant during the hospitalization was associated with higher overall costs compared to unlisted status ($105,906, 95% CI: 77,921, 133,892). Patients receiving hospital charity care or receiving other forms of government assistance were associated with lower costs compared to Medicare recipients. Increasing age, comorbidity, and diagnosis of HCC were associated with lower costs, while higher household income status was associated with higher costs. Hospital factors also significantly contributed to cost variation. Patients hospitalized at facilities with more beds, government ownership, urban location with teaching status, and Midwest and West coast regions tended to incur higher costs. Lastly, adjusting for all these predictors, year of hospitalization was not significantly associated with cost (Table 4).

Sensitivity Analysis

In a sample excluding transplant candidates and recipients, palliative care was still associated with lower costs (−$7,111, 95% CI: −10,242, 5,179). Doubly robust IPTW analysis also showed that mean average treatment effect of palliative care consultation on cost was −$9,733, adjusting for confounding related to treatment selection from observed variables (Supplementary Table 3).

DISCUSSION

Among decedents with end-stage liver disease, we found that utilization of palliative care consultation during terminal hospitalizations was low but increased from 2009 to 2013. Total costs of hospitalization for end-stage liver disease patients also steadily increased over this time period. Adjusting for patient and hospital factors, this national observational study shows that palliative care consultation is associated with lower costs of terminal hospitalization.

Recognizing that this is a decedent population, the proportion of patients receiving palliative care consultation -- 29% -- was low. Yet this estimate was higher than 11%, which was reported from the single-center Canadian study investigating mortality in non-transplant candidates[11]. The small proportion of these decedents receiving palliative care is particularly important given the high level of treatment intensity received prior to death. Comparing our decompensated liver disease decedents from 2009-2013 to an in-hospital decedent group previously analyzed by HCUP in 2007, length of stay (14 days vs. 8.8 days) and utilization of aggressive treatment is considerably higher in our end-stage liver disease sample, including mechanical ventilation (55.7% vs. 24.8%), hemodialysis (15.5% vs. 1.2%), and blood transfusion (43.6% vs. 3.8%)[21]. Our bivariate analyses demonstrated that palliative care consultation was associated with a reduced hospital length of stay and reduction in nearly all procedures.

Oncology guidelines have long recommended involvement of palliative care at the time of diagnosis of advanced disease in patients with malignancies[22], and while palliative care and hospice referral rates in non-cancer conditions still remain low[23-25], specialty societies treating heart failure, chronic kidney disease, and respiratory disorders have recently published guidelines that endorse involvement of palliative care in management of these chronic conditions[26-28]. A few small studies have explored methods for integrating palliative care earlier in the care of patients with end-stage liver disease[29-31]; however, guidelines regarding when to consider palliative care are needed. Our finding that transplantation listing or receipt is associated with lower odds of receiving inpatient palliative care mirrors findings from a previous study demonstrating an association between liver transplantation status and poorer end-of-life care quality[32]. Evaluating palliative care needs at the time of liver transplant referral may be needed to facilitate access to high quality end-of-life care for patients who may not survive before, during, or immediately following surgery. We also observed that racial and ethnic minorities tend to receive less palliative care consultation than Whites, which is consistent with previous literature[33]. Racial and ethnic disparities in access to palliative care in liver disease presents an important area for future research. Lastly, our finding that patients at larger hospitals tend to receive more palliative care is consistent with a study that found that 97% of hospitals with greater than 300 beds have palliative care consultation services compared to only 67% of hospitals with greater than 50 beds[34]. Our stratified analysis, however, demonstrated that rates of palliative care consultation for these patients have been increasing at nearly all types and sizes of hospitals over time.

The overall cost of end-of-life care for patients with end-stage liver disease is high, with an estimated cost per terminal hospitalization of $49,167 over the 5 years studied. The adjusted cost per hospitalization has been increasing by year from $47,766 in 2009 to $51,435 in 2013. This compares with a mean cost of terminal hospitalization estimated at $23,017 using HCUP data from 2007[21].

Our study has several strengths. First, though several papers have called for greater involvement of palliative care in the management of end-stage liver disease, this is the first study to highlight low palliative care rates as well as high utilization in the form of costs, length of stay, and procedure burden during terminal hospitalizations for these patients. Second, NIS is a large and comprehensive dataset that accurately reflects the diverse patient population and hospital settings in the U.S. The gender and racial composition seen in our data, for instance, is similar to 2014 Vital Statistics data from the Centers for Disease Control and Prevention[4]. Lastly, our study demonstrated that palliative care consultation was associated with lower overall costs when controlling for demographics and hospital characteristics. A multicenter, randomized control study found that inpatient palliative care consultation was associated with $4,855 cost savings over 6 months for patients with life-limiting illnesses[9]. Our study found an average $8,892 reduction in total costs per patient associated with palliative care consultation in decedents. This value did not change significantly when excluding transplant patients and may, in fact, be an underestimation of its true effect based on our sensitivity analysis. This supports that integration of palliative care in this population has the potential for cost savings.

Despite these strengths, there are some notable limitations. As mentioned, metrics for palliative care consultation and liver transplantation using ICD-9 CM codes have not been validated. Also, while palliative care is associated with lower overall hospital costs in this study, given the observational nature of the study, there likely are unmeasured variables not captured in the dataset which may confound this relationship. Next, while palliative care and lower costs have both been associated with improved end-of-life quality[35,36,37], specific outcome measures, including timely symptom management and provision of psychosocial and caregiver support were not captured. The presence of palliative care consultation and lower costs do not guarantee high quality end-of-life care, and similarly, the absence of palliative care consultation or higher costs do not mean that end-of-life care quality metrics are not achieved. For instance, patients who died shortly after admission may have received appropriate end-of-life care without consultation and patients experiencing long hospitalizations with high total costs may still receive high quality end-of-life care. The NIS is also limited in its ability to measure other key variables, including timing of palliative care consultation, availability of inpatient palliative care services at HCUP member hospitals, and prior healthcare encounters. Lastly, while all hospitalizations were terminal, it is not fully clear whether causes of death were liver-related or due to other external factors leading to death such as motor vehicle accident, suicide or homicide. Given the advanced stage of liver disease, however, we believe other causes are likely rare.

CONCLUSION

Our study corroborates previous data suggesting that rates of palliative care consultation in patients with end-stage liver disease are low, while also demonstrating that costs are exceedingly high for these terminally-ill patients. Our findings of racial and ethnic disparities in palliative care access and variations in palliative care access and cost based on hospital factors and transplant status present unique opportunities for research and quality improvement for this population. The association of palliative consultation with lower costs and procedure burden at the end-of-life suggests that improved palliative care in this population may be an opportunity for improved quality, efficiency and value for patients with end-stage liver disease.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

HCUP	Healthcare Cost and Utilization Project
HCC	Hepatocellular carcinoma
ICD-9 CM	International Classification of Diseases, 9th Revision, Clinical Management
NIS	National Inpatient Sample
U.S.	United States

References

1. Scaglione S, Kliethermes S, Cao G, et al. The Epidemiology of Cirrhosis in the United States: A Population-based Study. J Clin Gastroenterol. 2015; 49(8):690–6. [PubMed: 25291348]
2. D'Amico G, Garcia-Tsao G, Pagliaro L. Natural history and prognostic indicators of survival in cirrhosis: a systematic review of 118 studies. J Hepatol. 2006; 44(1):217–31. [PubMed: 16298014]
3. [March 28] 2012 Annual Report. Scientific Registry of Transplant Recipients. http://srtr.transplant.hrsa.gov/annual_reports/2012/.
4. Centers for Disease Control and Prevention. [March 27] National Center for Health Statistics.. VitalStats. http://www.cdc.gov/nchs/vitalstats.htm.
5. Roth K, Lynn J, Zhong Z, et al. Dying with end stage liver disease with cirrhosis: insights from SUPPORT. Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatment. J Am Geriatr Soc. 2000; 48(5 Suppl):S122–30. [PubMed: 10809465]
6. Walling AM, Wenger NS. Palliative care and end-stage liver disease. Clin Gastroenterol Hepatol. 2014; 12(4):699–700. [PubMed: 24246765]

7. Larson AM. Palliative care for patients with end-stage liver disease. Curr Gastroenterol Rep. 2015; 17(5):440. [PubMed: 25855211]

8. Rakoski MO, McCammon RJ, Piette JD, et al. Burden of cirrhosis on older Americans and their families: analysis of the health and retirement study. Hepatology. 2012; 55(1):184–91. [PubMed: 21858847]

9. Gade G, Venohr I, Conner D, et al. Impact of an inpatient palliative care team: a randomized control trial. J Palliat Med. 2008; 11(2):180–90. [PubMed: 18333732]

10. Casarett D, Pickard A, Bailey FA, et al. Do palliative consultations improve patient outcomes? J Am Geriatr Soc. 2008; 56(4):593–9. [PubMed: 18205757]

11. Poonja Z, Brisebois A, van Zanten SV, et al. Patients with cirrhosis and denied liver transplants rarely receive adequate palliative care or appropriate management. Clin Gastroenterol Hepatol. 2014; 12(4):692–8. [PubMed: 23978345]

12. HCUP National Inpatient Sample (NIS). Healthcare Cost and Utilization Project (HCUP). Agency for Healthcare Research and Quality R, MD.; 2012.

13. Penrod JD, Deb P, Luhrs C, et al. Cost and utilization outcomes of patients receiving hospital-based palliative care consultation. J Palliat Med. 2006; 9(4):855–60. [PubMed: 16910799]

14. Goldberg D, Lewis J, Halpern S, et al. Validation of three coding algorithms to identify patients with end-stage liver disease in an administrative database. Pharmacoepidemiol Drug Saf. 2012; 21(7):765–9. [PubMed: 22674685]

15. Okafor PN, Stobaugh DJ, Nnadi AK, et al. Determinants of Palliative Care Utilization Among Patients Hospitalized With Metastatic Gastrointestinal Malignancies. Am J Hosp Palliat Care. 2015

16. Murthy SB, Moradiya Y, Hanley DF, et al. Palliative Care Utilization in Nontraumatic Intracerebral Hemorrhage in the United States. Crit Care Med. 2016; 44(3):575–82. [PubMed: 26496450]

17. United States Department of Labor. [August 24] Bureau of Labor Statistics. Available at: http://www.bls.gov/data/inflation_calculator.htm.

18. Jepsen P, Vilstrup H, Andersen PK, et al. Comorbidity and survival of Danish cirrhosis patients: a nationwide population-based cohort study. Hepatology. 2008; 48(1):214–20. [PubMed: 18537190]

19. White IR, Royston P, Wood AM. Multiple imputation using chained equations: Issues and guidance for practice. Stat Med. 2011; 30(4):377–99. [PubMed: 21225900]

20. Austin PC, Stuart EA. Moving towards best practice when using inverse probability of treatment weighting (IPTW) using the propensity score to estimate causal treatment effects in observational studies. Stat Med. 2015; 34(28):3661–79. [PubMed: 26238958]

21. Zhao, Y., Encinosa, W. Healthcare Cost and Utilization Project (HCUP) Statistical Briefs. Rockville (MD): 2006. The Costs of End-of-Life Hospitalizations, 2007: Statistical Brief #81..

22. Smith TJ, Temin S, Alesi ER, et al. American Society of Clinical Oncology provisional clinical opinion: the integration of palliative care into standard oncology care. J Clin Oncol. 2012; 30(8): 880–7. [PubMed: 22312101]

23. Murray AM, Arko C, Chen SC, et al. Use of hospice in the United States dialysis population. Clin J Am Soc Nephrol. 2006; 1(6):1248–55. [PubMed: 17699355]

24. Lindell KO, Liang Z, Hoffman LA, et al. Palliative care and location of death in decedents with idiopathic pulmonary fibrosis. Chest. 2015; 147(2):423–9. [PubMed: 25187973]

25. Setoguchi S, Glynn RJ, Stedman M, et al. Hospice, opiates, and acute care service use among the elderly before death from heart failure or cancer. Am Heart J. 2010; 160(1):139–44. [PubMed: 20598984]

26. Hunt SA, Abraham WT, Chin MH, et al. ACC/AHA 2005 Guideline Update for the Diagnosis and Management of Chronic Heart Failure in the Adult: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2001 Guidelines for the Evaluation and Management of Heart Failure): developed in collaboration with the American College of Chest Physicians and the International Society for Heart and Lung Transplantation: endorsed by the Heart Rhythm Society. Circulation. 2005; 112(12):e154–235. [PubMed: 16160202]

27. Lanken PN, Terry PB, Delisser HM, et al. An official American Thoracic Society clinical policy statement: palliative care for patients with respiratory diseases and critical illnesses. Am J Respir Crit Care Med. 2008; 177(8):912–27. [PubMed: 18390964]

28. Galla JH. Clinical practice guideline on shared decision-making in the appropriate initiation of and withdrawal from dialysis. The Renal Physicians Association and the American Society of Nephrology. J Am Soc Nephrol. 2000; 11(7):1340–2. [PubMed: 10864592]

29. Walling AM, Schreibeis-Baum H, Pimstone N, et al. Proactive case finding to improve concurrently curative and palliative care in patients with end-stage liver disease. J Palliat Med. 2015; 18(4):378–81. [PubMed: 25493552]

30. Medici V, Rossaro L, Wegelin JA, et al. The utility of the model for end-stage liver disease score: a reliable guide for liver transplant candidacy and, for select patients, simultaneous hospice referral. Liver Transpl. 2008; 14(8):1100–6. [PubMed: 18668666]

31. Baumann AJ, Wheeler DS, James M, et al. Benefit of Early Palliative Care Intervention in End-Stage Liver Disease Patients Awaiting Liver Transplantation. J Pain Symptom Manage. 2015; 50(6):882–6. e2. [PubMed: 26303186]

32. Walling AM, Asch SM, Lorenz KA, et al. Impact of consideration of transplantation on end-of-life care for patients during a terminal hospitalization. Transplantation. 2013; 95(4):641–6. [PubMed: 23197177]

33. Borum ML, Lynn J, Zhong Z. The effects of patient race on outcomes in seriously ill patients in SUPPORT: an overview of economic impact, medical intervention, and end-of-life decisions. Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatments. J Am Geriatr Soc. 2000; 48(5 Suppl):S194–8. [PubMed: 10809475]

34. Dumanovsky T, Augustin R, Rogers M, et al. The Growth of Palliative Care in U.S. Hospitals: A Status Report. J Palliat Med. 2016; 19(1):8–15. [PubMed: 26417923]

35. Higginson IJ, Finlay I, Goodwin DM, et al. Do hospital-based palliative teams improve care for patients or families at the end of life? J Pain Symptom Manage. 2002; 23(2):96–106. [PubMed: 11844629]

36. Zhang B, Wright AA, Huskamp HA, et al. Health care costs in the last week of life: associations with end-of-life conversations. Arch Intern Med. 2009; 169(5):480–8. [PubMed: 19273778]

37. Wachterman MW, Pilver C, Smith D, et al. Quality of End-of-Life Care Provided to Patients With Different Serious Illnesses. JAMA Intern Med. 2016; 176(8):1095–1102. [PubMed: 27367547]

Table 1

Characteristics of patients terminally hospitalized for advanced liver disease from 2009 to 2013

Variable	**Total Sample, N (%) or Mean (SD)**	**Receiving Palliative Care, N (%) or Mean (SD)**	**Not Receiving Palliative Care, N (%) or Mean (SD)**
	59,687	17,358	42,328
Year[*]			
2009	10,894	1,936	8,958
2010	10,746	2,789	7,957
2011	12,281	3,743	8,538
2012	12,525	4,205	8,320
2013	13,239	4,684	8,555
Age	59.6 (0.15)	59.8 (0.255)	59.6 (0.182)
Gender			
Female	22,280 (37.3%)	6,506 (37.5%)	15,773 (37.3%)
Male	37,407 (62.7%)	10,851 (63.5%)	26,556 (62.7%)
Race			
Caucasian	39,453 (66.1%)	11,962 (68.9%)	27,653 (65.3%)
African American	6,446 (10.8%)	1,578 (9.1%)	4,923 (11.6%)
Hispanic	9,431 (15.8%)	2,495 (14.4%)	6,857 (16.2%)
Asian	1,313 (2.2%)	396 (2.3%)	937 (2.2%)
Native American	752 (1.3%)	335 (1.9%)	408 (1.0%)
Other	2,149 (3.6%)	592 (3.4%)	1,550 (3.7%)
Insurance Status			
Medicare	25,349 (42.5%)	7,246 (41.7%)	18,152 (42.9%)
Medicaid	12,593 (21.1%)	3,591 (20.7%)	8,918 (21.1%)
Private	14,616 (23.5%)	4,254 (24.5%)	9,803 (23.2%)
Self-pay	4,656 (7.8%)	1,307 (7.5%)	3,336 (7.9%)
No charge	513 (0.8%)	179 (1.0%)	325 (0.8%)
Other (%)	2,554 (4.3%)	780 (4.5%)	1,794 (4.2%)
Annual Household Income[*]			
0-25th Percentile	18,921 (31.7%)	5,148 (29.7%)	13,805 (32.6%)
25th-50th Percentile	15,399 (25.8%)	4,418 (25.5%)	11,019 (26.0%)
50-75th Percentile	13,728 (23.0%)	4,150 (23.9%)	9,574 (22.6%)
75th-100th Percentile	11,639 (19.5%)	3,635 (20.9%)	7,937 (18.8%)
Charlson Index[*]	2.11 (0.03)	2.26 (0.051)	2.06 (0.034)
Reason for Admission			
Septicemia	13,251 (22.2%)	3,836 (22.1%)	9,415 (22.2%)
Complications of Cirrhosis	10,206 (17.1%)	3,072 (17.7%)	7,134 (16.9%)
Substance Abuse	6,924 (11.6%)	2,013 (11.6%)	4,911 (11.6%)

Variable	**Total Sample, N (%) or Mean (SD)**	**Receiving Palliative Care, N (%) or Mean (SD)**	**Not Receiving Palliative Care, N (%) or Mean (SD)**
Hepatitis	3,545 (5.9%)	1,100 (6.3%)	2,445 (5.8%)
Gastrointestinal Hemorrhage	2,584 (4.3%)	703 (4.1%)	1,881 (4.4%)
Respiratory Failure	1,582 (2.7%)	359 (2.1%)	1,223 (2.9%)
Renal Failure	1,403 (2.4%)	394 (2.3%)	1,009 (2.4%)
Other	20,192 (33.8%)	5,881 (33.9%)	14,311 (33.8%)
Presence of Hepatocellular Carcinoma[*]	4,438 (7.4%)	1,663 (9.6%)	2,774 (6.6%)
Awaiting or Received Liver Transplant	1,255 (2.1%)	331 (1.9%)	923 (2.2%)
Hospital bed size[*]			
Small	5,193 (8.7%)	1,154 (6.6%)	5,300 (12.5%)
Medium	13,131 (21.9%)	3,512 (20.2%)	9,464 (22.4%)
Large	41,184 (69.4%)	12,692 (73.1%)	28,565 (67.5%)
Hospital ownership[*]			
Government	9,190 (15.4%)	2,851 (16.4%)	6,319 (14.9%)
Private, non-profit	42,849 (71.8%)	13,431 (77.4%)	29,232 (69.1%)
Private, for-profit	7,639 (12.8%)	1,076 (6.2%)	6,778 (16.0%)
Hospital teaching status[*]			
Rural	3,402 (5.7%)	824 (4.7%)	2,573 (6.1%)
Urban, non-teaching	19,753 (33.1%)	5,131 (29.6%)	14,836 (35.1%)
Urban, teaching	36,523 (61.2%)	11,403 (65.7%)	24,920 (58.9%)
Hospital region[*]			
Northeast	11,816 (19.8%)	2,762 (15.9%)	8,856 (20.9%)
Midwest	11,398 (19.1%)	3,509 (20.2%)	8,055 (19.0%)
South	21,545 (36.1%)	5,535 (31.9%)	16,079 (38.0%)
West	14,920 (25.0%)	5,551 (32.0%)	9,340 (22.1%)

[*] denotes result is significant for $\boldsymbol{\alpha} < \mathbf{0.05}$ for bivariate analysis.

Table 2

Patient total costs, length of stay, and treatments received while terminally hospitalized for advanced liver disease from 2009 to 2013

Variable	Total Sample, N (%) or Mean, (SD)	Receiving Palliative Care, N (%) or Mean (SD)	Not Receiving Palliative Care, N (%) or Mean (SD)
Total Cost[*]	$49,167 (1,169)	$45,710 (1,588)	$50,622 (1,379)
2009	$47,766 (2,838)	$45,864 (4,618)	$48,176 (2,954)
2010	$48,089 (2,429)	$48,547 (3,880)	$47,925 (2,476)
2011	$47,847 (3,256)	$43,365 (3,336)	$49,979 (4,128)
2012	$50,009 (2,346)	$43,751 (2,731)	$53,210 (2,975)
2013	$51,435 (2,335)	$47,574 (2,832)	$53,560 (2,710)
Length of Stay[*]	14.0 (0.21)	12.6 (0.29)	14.6 (0.26)
Treatments Received			
Mechanical Ventilation[*]	33,246 (55.7%)	8,443 (48.6%)	24,798 (58.6%)
Hemodialysis[*]	9,251 (15.5%)	2,437 (14.0%)	6,820 (16.1%)
Blood Transfusion[*]	26,019 (43.6%)	7,065 (40.7%)	18,963 (44.8%)
Parenteral Nutrition	7,877 (13.2%)	2,378 (13.7%)	5,502 (13.0%)
Cardiopulmonary Resuscitation[*]	3,689 (6.2%)	469 (2.7%)	3,217 (7.6%)
Endoscopy[*]	14,623 (24.5%)	3,777 (21.7%)	10,836 (25.6%)
Paracentesis[*]	23,910 (40.1%)	7,429 (42.8%)	16,466 (38.9%)
Transjugular Intrahepatic Portosystemic Shunt	1,890 (3.2%)	472 (2.7%)	1,418 (3.4%)
Blakemore Tube	255 (0.4%)	74 (0.4%)	181 (0.4%)
Radiofrequency Ablation	69 (0.1%)	15 (0.1%)	54 (0.1%)
Trans-arterial Chemoembolization	318 (0.5%)	93 (0.5%)	225 (0.5)
Liver Transplant[*]	444 (0.7%)	55 (0.3%)	389 (0.9%)

[*] denotes result is significant for $\alpha < \mathbf{0.05}$ for bivariate analysis.

Table 3

Factors Associated with Palliative Care Receipt for Patients with Advanced Liver Disease During a Terminal Hospitalization

Independent Variable	**Odds Ratio (OR) of Palliative Care Consultation, (95% CI)**
Female	1.00 (0.92-1.08)
Race	
Caucasian	Reference
African American	0.74 (0.62-0.88) *
Hispanic	0.79 (0.68-0.93) *
Asian	0.73 (0.54-0.99) *
Native American	1.44 (0.93-2.22)
Other	0.89 (0.68-1.16)
Insurance Status	
Medicare (%)	Reference
Medicaid (%)	1.02 (0.90-1.16)
Private (%)	1.07 (0.95-1.21)
Self-pay (%)	1.04 (0.87-1.25)
No charge (%)	1.39 (0.76-2.55)
Other (%)	1.15 (0.92-1.44)
Age	1.00 (1.00-1.01)
Annual Household Income	
0-25th Percentile	Reference
25th-50th Percentile	1.00 (0.88-1.14)
50-75th Percentile	1.06 (0.93-1.22)
75th-100th Percentile	1.08 (0.92-1.27)
Charlson comorbidity index	1.02 (1.00-1.03) *
Hepatocellular Carcinoma (%)	1.45 (1.24-1.70) *
Awaiting or Received Liver Transplant (%)	0.66 (0.48-0.92) *
Hospital bed size	
Small	Reference
Medium	1.30 (1.00-1.68) *
Large	1.48 (1.17-1.88) *
Hospital ownership	
Government	Reference
Private, non-profit	1.11 (0.89-1.37)
Private, for-profit	0.42 (0.31-0.56) *
Hospital teaching status	

Independent Variable	**Odds Ratio (OR) of Palliative Care Consultation, (95% CI)**
Urban, non-teaching	Reference
Rural	0.90 (0.70-1.17)
Urban, teaching	1.37 (1.07-1.77)[*]
Hospital region	
Northeast	Reference
Midwest	1.53 (1.14-2.03)[*]
South	1.40 (1.09-1.81)[*]
West	2.40 (1.84-3.12)[*]
Year	
2009	Reference
2010	1.64 (1.28-2.10)[*]
2011	2.15 (1.64-2.83)[*]
2012	2.39 (1.89-3.02)[*]
2013	2.60 (2.07-3.28)[*]

[*] denotes result is significant for **α<0.05.**

Table 4

Factors Associated with Hospital Cost for Patients with Advanced Liver Disease During a Terminal Hospitalization

Independent Variable	Cost Associated with Each Predictor ($), (CI)
Palliative Care Consultation	−8,892 (−11,595, −6,189) *
Female	1,703 (−539, 3,944)
Race	
Caucasian	Reference
African American	3,683 (−167, 7,532)
Hispanic	3,870 (−347, 8,088)
Asian	5,954 (−3,037, 14,946)
Native American	−6,381 (−14,042, 1,280)
Other	53 (5,288, 5,335)
Insurance Status	
Medicare (%)	Reference
Medicaid (%)	−2,179 (−5,485, 1,128)
Private (%)	108 (−3,255, 3,471)
Self-pay (%)	−11,775 (−15,717, −7,833) *
No charge (%)	−19,234 (−26,780, −11,688) *
Other (%)	−9,169 (−14,515, −3,825) *
Age	−433 (−547, −319) *
Annual Household Income	
0-25th Percentile	Reference
25th-50th Percentile	2,369 (−217, 4,956)
50-75th Percentile	4,868 (1,691, 8,045) *
75th-100th Percentile	12,440 (8,454, 16,427) *
Charlson comorbidity index	−803 (−1,214, −392) *
Hepatocellular Carcinoma (%)	−11,374 (−15,634, −7,113) *
Awaiting or Received Liver Transplant (%)	105,906 (77,921, 133,892) *
Hospital bed size	
Small	Reference
Medium	4,775 (−227, 9,777)
Large	11,250 (6,738, 15,762) *
Hospital ownership	
Government	Reference
Private, non-profit	−6,819 (−12,450, −1,188) *

Independent Variable	**Cost Associated with Each Predictor ($), (CI)**
Private, for-profit	−11,253 (−16,640, −5,865) *
Hospital teaching status	
Urban, non-teaching	Reference
Rural	−5,776 (,−9,331, −2,219) *
Urban, teaching	16,808 (13,422, 20,194) *
Hospital region	
Northeast	Reference
Midwest	7,994 (2,263, 13,724) *
South	2,203 (−2,605, 7,012)
West	21,442 (15,239, 27,645) *
Year	
2009	Reference
2010	1,375 (−3,082, 5,831)
2011	3,075 (−2,472, 8,622)
2012	3,243 (−1,417, 7,903)

*denotes result is significant for **α<0.05.**