

The Clinical and Economic Toll Associated with Hepatorenal Syndrome From a Hospital Perspective in the United States: 2009-2015



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INTRODUCTION

- Hepatorenal Syndrome (HRS) is the development of functional renal failure in patients with chronic liver disease¹
- HRS is one of the leading causes of hospitalizations in patients with chronic liver disease (CLD) and can be classified as Type 1 or 2, depending on the severity of the condition¹
- Precipitating factors of HRS typically include bacterial infections, acute alcoholic hepatitis, and upper GI bleeding²
- The 90-day mortality rate for HRS exceeds 50%³
- Multiple prognostic factors can help predict the reversal of HRS, including serum creatinine, glomerular filtration rate (GFR), model for end-stage liver disease (MELD), and the Child-Turcotte-Pugh (CTP) system³
- Multiple clinical trials have demonstrated that HRS is associated with significant resource utilization and high costs due to medication costs, increased length of stay, intensive care unit stays, and emergency surgeries, but the real-world cost analyses of HRS in a non-trial setting have been limited⁴

AIM

To assess the real-world clinical outcomes, resource and cost burdens, and cost drivers of HRS from a US hospital perspective

MATERIAL & METHODS

- Patient Selection**
- A retrospective, longitudinal analysis of the CERNER HealthFacts[®] electronic health record (EHR) database was performed
 - HealthFacts[®] contains de-identified EHRs from over 600 US hospitals
 - Inclusion criteria included adult patients hospitalized with a diagnosis of HRS based on ICD-9 code (572.4) between 2009 and 2015
 - Exclusion criteria included incomplete encounter data, absence of Serum Creatinine laboratory values (SCr), missing primary procedure code, under 18 years of age, length of stay (LOS) <2 days, visits prior to January 1, 2009, indeterminate MELD scores, and the absence of an inpatient designation

- Clinical Measures**
- Clinical staging and laboratory data were used to assess the health impact of these patients, including the Child-Turcotte -Pugh (CTP) system of classification and Acute on Chronic Liver Failure (ACLF) grade

- Analysis of Costs and Cost Drivers**
- Only patients with complete institution information related to charge were included; therefore, the cost analysis included a subset of 25.1% of the study population
 - Charges and LOS were log-transformed to decrease skewing
 - All analyses were performed using SAS 9.4 (SAS Institute, Inc.)
 - When data fields were missing for analysis of charges, length of stay, mortality, and readmissions, these patients were excluded. Patients who received transplant were also excluded

RESULTS

Table 1: Patient Demographics
 • Selection began with 6,118 patients with HRS ICD-9 coding; 3,576 patients were excluded and 2,542 patients were included

Age Group	N (%)
18 – 35 years	103 (4.1)
36 – 50 years	563 (22.1)
51 – 64 years	1,154 (45.4)
>65 years	722 (28.4)
Gender	
Male	1,571 (61.8)
Female	971 (38.2)
Race	
Caucasian	1,887 (74.2)
Black	351 (13.8)
Unspecified/Other	201 (7.9)
Hispanic	58 (2.3)
Asian	45 (1.8)
Admission Type	
Emergency	1,130 (44.5)
Elective	519 (20.4)
Urgent	349 (13.7)
Other/unspecified	544 (21.4)
Discharge destination	
Transfer to Inpatient Setting	107 (4.2)
Nursing Facility or similar	313 (12.3)
Home	796 (30.9)
Hospice	225 (8.9)
Death	937 (36.9)
No Data Available	167 (6.5)

Table 2: Hospital Characteristics, Mean Length of Stay (LOS), and Mean Costs
 • The majority of HRS patients were treated at large teaching hospitals
 • The mean length of stay for all patients was 29 days
 • For patients with reliable cost information (637/2542; 25.1%), the total average cost per patient was \$91,504

Primary Payer	N (%)
Medicare	760 (29.9)
Commercial	768 (30.2)
Medicaid	420 (16.5)
Self-pay / Indigent	164 (6.5)
Any other payer	170 (6.7)
Unknown	260 (10.2)
Institution Type	
Teaching	1,989 (78.2)
Non-teaching	549 (21.6)
Unknown	4 (0.2)
Number of Beds	
<100	172 (6.8)
100-199	218 (8.6)
200-299	476 (18.7)
300-499	741 (29.2)
>500	935 (36.8)
Mean Cost and LOS	
Cost (N = 637)	\$91,504
LOS (N = 2,542)	29 Days

Figure 1: Average Hospitalization Cost and LOS by CTP Classification for Severity of Cirrhosis

- Excluding the CTP class A (n=2), the highest mean costs were observed with more severe cirrhosis (CTP Class B \$65,122, CTP Class C = \$103,763)
- Sample sizes: A = 2; B = 97, C = 420, and U = 118
- The highest median length of stay was observed for CTP class C (12.3 days); CTP class B patients had a median length of stay of 9.2 days
- Sample sizes: A = 22; B = 397, C = 1562, and U = 561

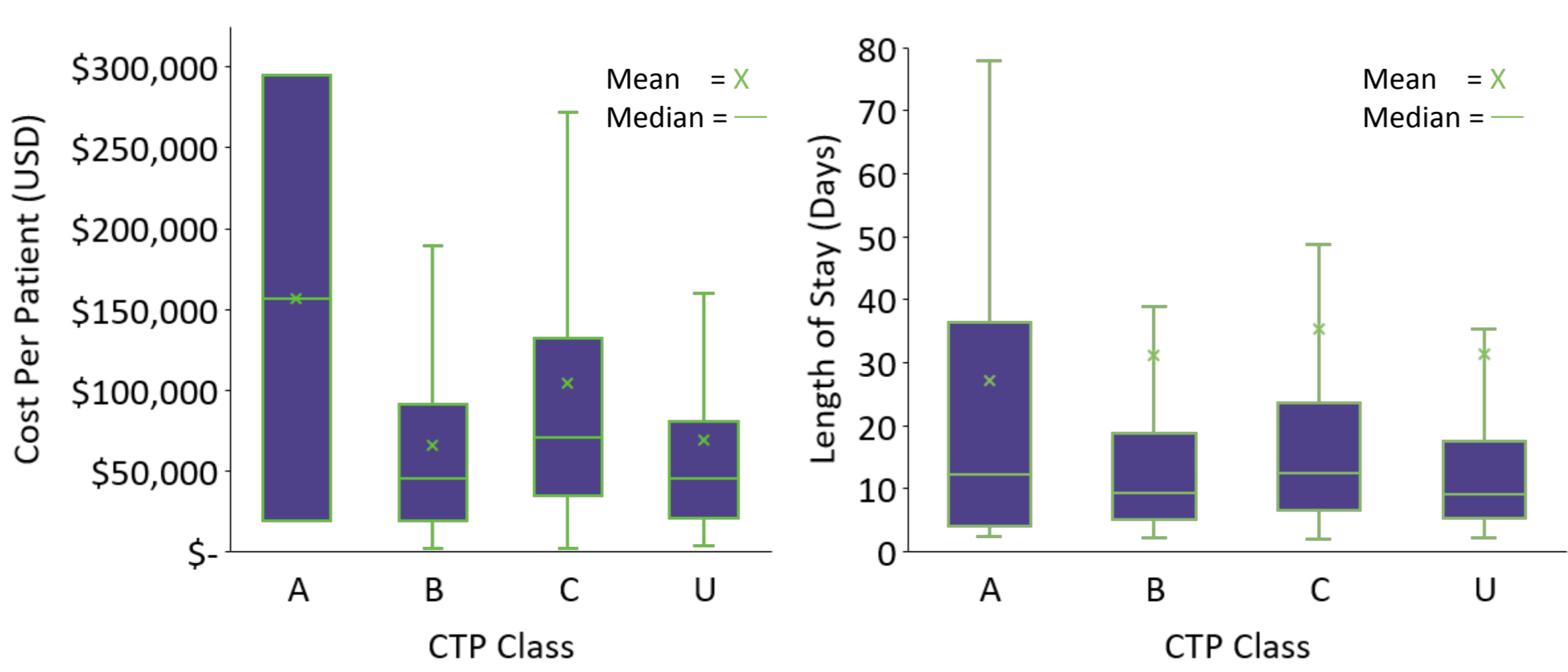


Figure 2: Stratification of Costs and LOS by ACLF Grade

- Patients with ACLF Grade 0 (\$102,297) or 3 (\$112,191) had high mean costs compared with patients with an ACLF Grade of 1 (\$70,676) or 2 (\$79,121)
- Sample sizes: Grade 0 = 31; Grade 1 = 144, Grade 2 = 211, and Grade 3 = 249
- Costs correlated with length of stay, with ACLF Grades 2 and 3 having the longest length of stay (medians of 11.0 and 12.8, respectively)
- Sample sizes: Grade 0 = 153; Grade 1 = 594, Grade 2 = 869, and Grade 3 = 919

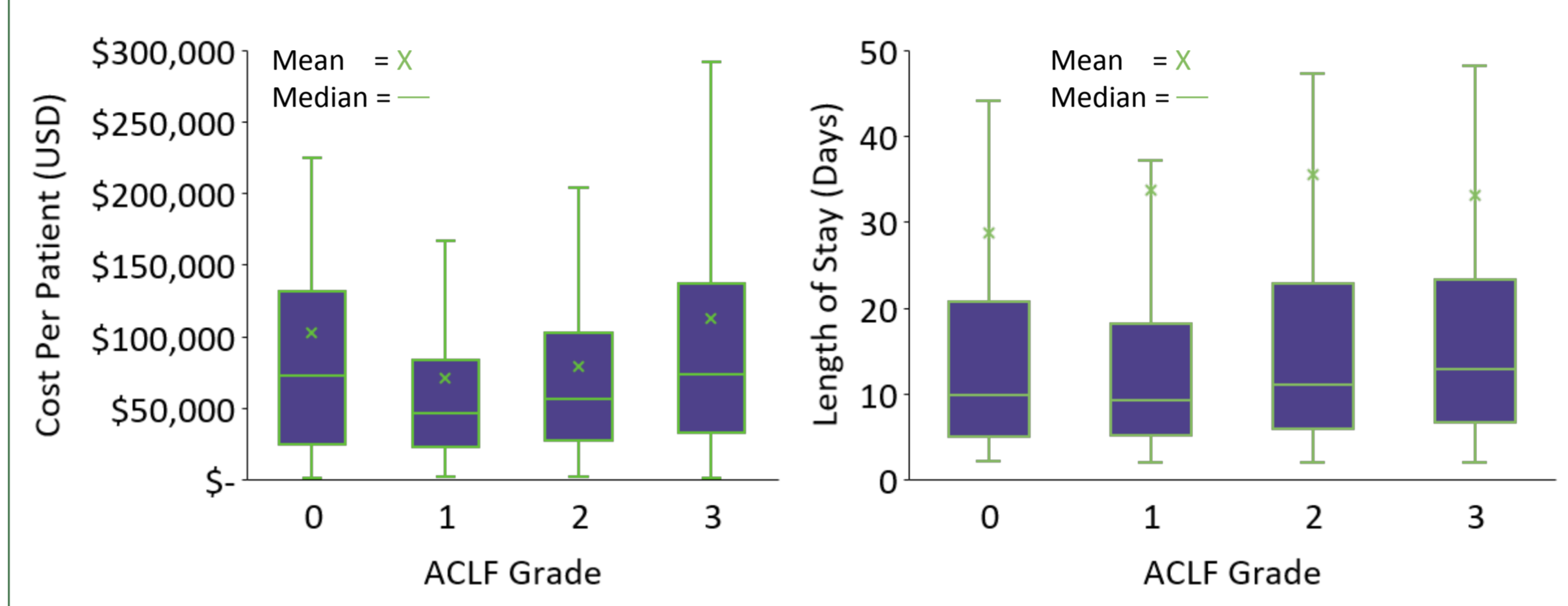


Figure 3: HRS Initial Visit Mortality Rate and Associated Costs

- The HRS mortality rate was 37% during initial hospitalization
- Sample sizes for each class are: Not Deceased = 1605 and Deceased = 937
- The mean cost associated with deceased patients (\$106,288) outpaced the cost associated with patients discharged alive (\$85,568) by \$20,720. Sample sizes: Not Deceased = 413 and Deceased = 214. Ten patients excluded due to missing discharge information

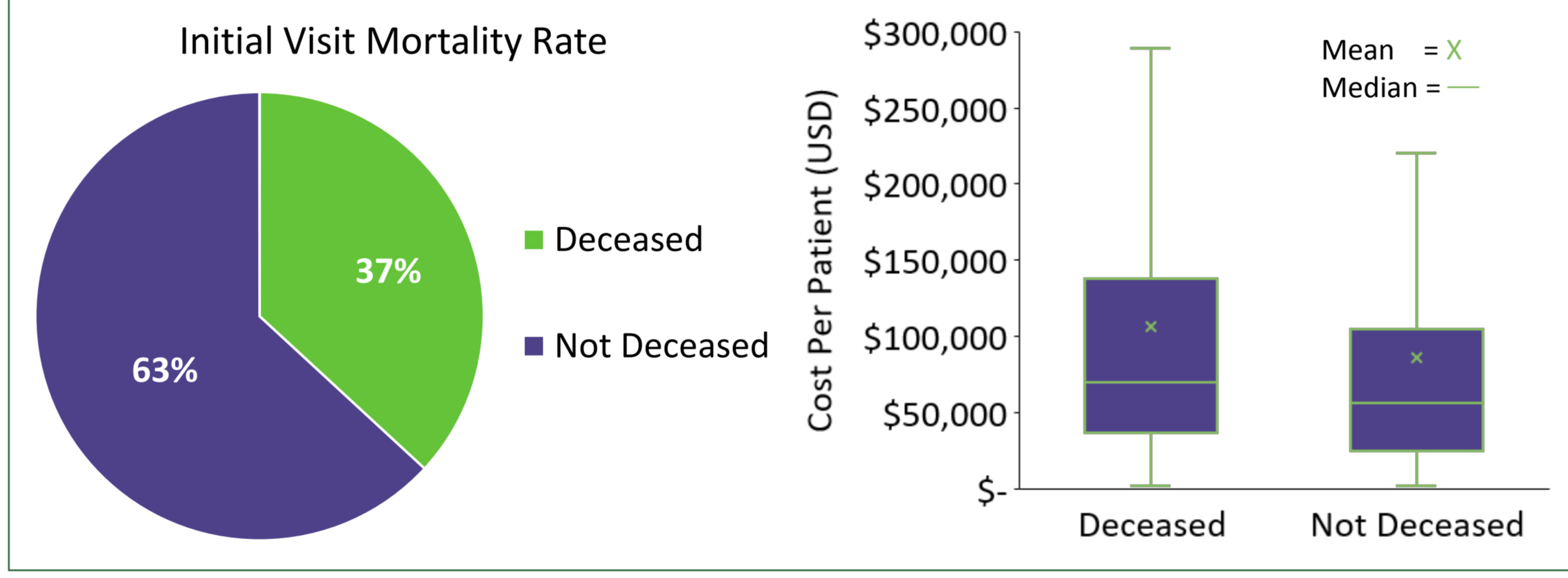


Figure 4: HRS Readmission Rate and Associated Costs

- The 30-day readmission rate for HRS patients was 28%, with 16% planned and 12% unplanned readmission
- Sample sizes: None = 826, Planned = 193, Unplanned = 135
- Unplanned readmissions (\$92,154) were associated with nearly \$20,000 more in average costs than planned admissions (\$73,616)
- Sample sizes: None = 294, Planned = 69, Unplanned = 56



Table 3: Identification of Cost Drivers in HRS Treatment

- A generalized linear model was constructed using 466 patients (see methods)
- Treatment with hemodialysis and discharge to a nursing facility resulted in 69% and 62% higher costs per patient

Parameter	Coefficient	P Value
Hemodialysis	0.7374	<0.0001
Discharge to Nursing Facility	0.5227	0.0017
Mortality	0.2297	0.0863
Teaching Hospital	0.2339	0.0502
Length of Stay	0.1323	0.0073
Transfer to Inpatient	-0.5014	0.0262

CONCLUSION

- Hepatorenal syndrome (HRS) places a significant burden on the health system, with a mean cost for all patients of \$91,504 and hospitalization LOS average of 29 days
- Both cost and length of stay correlated with increasing severity, as demonstrated by CTP Class and ACLF Grade
- HRS exhibits a high mortality rate, with 37% of patients in the analysis succumbing in their first hospitalization
- The overall readmission rate was 28% (excluding patients that were deceased or discharged to hospice) and the unplanned readmission rate was 12%
- Patients with unplanned readmissions incurred higher average costs than planned readmissions (\$92,154 vs. \$73,616)
- Primary cost drivers for HRS patients included length of stay, hemodialysis, and discharge to a nursing facility
- New and better treatments are required to further improve clinical outcomes and reduce the cost of care and burden of disease associated with HRS
- Earlier reversal of HRS may improve patient outcomes and therefore decrease the need for dialysis and mortality rates

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DISCLOSURES

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