

Inpatient Burden of Illness and Predictors of Charges or Lengths of Stay Among Adult Heart Transplantation Patients



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Abstract

Objective: To assess the role of hospital, patient, payer and clinical factors on inpatient hospital lengths of stay (LOS) and total charges in adults undergoing heart transplantation.

Methods: This analysis utilized the nationally representative inpatient hospital discharge records from the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project (H-CUP) Nationwide Inpatient Sample (NIS) from 2002 to 2005. All patients above 18 years of age receiving a heart transplantation procedure were selected for inclusion. Specific variables of interest included patient demographics (e.g., age, sex, race, income), hospital characteristics (e.g., rural/urban), payer (e.g., Medicare, commercial, uninsured), procedures, diagnoses, case-mix risk adjustment (e.g., all patient refined DRG (APRDRG)), and inpatient mortality. Outcomes analyzed were LOS and total charges. Gamma and negative binomial generalized linear models with log-links were employed with an a priori alpha of 0.05 for statistical significance. Human subjects approval was obtained from the University of Arizona.

Results: Overall, 5911 patients underwent a heart transplantation between 2002-2005, with 74.1% of these patients being males. Mean charges were \$332,617±\$212,403. Average LOS was 41.76±50.16 days. Inpatient mortality was 5.4%. Regression analyses indicated significant associations between charges and number of procedures (Incidence Rate Ratio (IRR)=1.074, 95% CI=1.059-1.089), inpatient mortality (IRR=1.274, 95% CI=1.094-1.483), APRDRG (IRR=1.126, 95% CI=1.061-1.195), African-American race (IRR=0.871, 95% CI=0.783-0.969), and hospital location (IRR small metropolitan=0.799, 95% CI=0.731-0.874, IRR micropolitan/rural=0.741, 95% CI=0.661-0.831). These analyses also indicated significant associations between LOS and number of diagnoses (IRR=0.979, 95% CI=0.960-0.997), number of procedures (IRR=1.104, 95% CI=1.082-1.126), APRDRG (IRR=1.291, 95% CI=1.136-1.467), and hospital location (IRR micropolitan/rural=0.779, 95% CI=0.635-0.958).

Conclusions: This investigation of 5911 adult heart transplant patients suggests that several factors are significantly associated with LOS and charges. Continued research, particularly subgroup analyses and long term follow-up, are warranted.

Study Objective

The objective of this study was to assess the role of hospital, patient, payer and clinical factors on inpatient hospital lengths of stay (LOS) and total charges in adults undergoing heart transplantation.

Background

- In 2007, the American Heart Association (AHA) reported 2210 heart transplantations were performed, with 73.7% of these recipients male, 67.6% white and 74.6% were over the age of 35.¹
- One-year survival rates for males are 87.5% and 85.5% for females.¹
- It is reported that death rates awaiting transplantation, in the year following transplantation, and number of patients awaiting transplantation have all decreased from 1997 to 2006.²

Methods

- The nationally representative inpatient hospital discharge records from the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project (H-CUP) Nationwide Inpatient Sample (NIS) from 2002 to 2005 were utilized.
- All patients above 18 years of age receiving an orthotopic heart transplantation procedure (ICD-9 CM 37.51) were selected for inclusion.
- Specific variables of interest included patient demographics (e.g., age, sex, race, income), hospital characteristics (e.g., rural/urban), payer (e.g., Medicare, commercial, uninsured), procedures, diagnoses, case-mix risk adjustment (e.g., all patient refined DRG (APRDRG)), and inpatient mortality.
- Outcomes analyzed were length of stay (LOS) and total charges for each visit.
- Gamma and negative binomial generalized linear models with log-links were employed with an a priori alpha of 0.05 for statistical significance.
- Sampling weights were employed in all analyses to yield nationally representative estimates.
- Diagnostics utilized to check for model fit included deviance and Pearson residuals to assess overdispersion. Additionally, Anscombe residuals were plotted and checked for normality. Akaike's information criteria (AIC) was also considered in model discrimination.
- SPSS 17.0 and STATA 9.2 were used for data management and analysis.
- Human subjects approval was obtained from the University of Arizona.

Results

- A total of 5911 adult patients underwent heart transplantation between 2002 and 2005.
- Descriptive statistics for categorical variables
 - 74.1% were male
 - 69.9% were white
 - 43.3% had a Medicare or Medicaid payer, with 52.5% having a commercial payer
 - 5.4% died during hospitalization
 - 59.8% of transplants took place in hospitals in large, metropolitan areas
 - 32.2% patients were in the highest income quartile (>\$60,000 per year)
- Descriptive statistics for continuous variables (± standard deviation)
 - Mean age at admission was 51 years (±12.6)
 - Mean LOS was 41.76 days (± 50.16); median LOS was 21 days
 - Mean number of procedures performed during hospitalization was 7.99 (± 4.09)
 - Mean number of diagnoses coded during admission was 10.9 (± 4.74)
 - Mean total charges per stay was \$332,617 (± \$212,403); median charges were \$255,943
- Regression analysis: total charges (Table 1).**
 - Mortality, number of procedures, and more severe illness were all significantly associated with higher total charges.
 - Black race, and hospitals in small metropolitan areas, and those in micropolitan or rural areas were associated with lower charges, as compared to whites and large metropolitan hospitals, respectively.
- Regression analysis: length of stay (LOS) (Table 2).**
 - Number of procedures, and more severe illness are significantly associated with longer LOS.
 - Number of diagnoses, the year of admission, and micropolitan/rural hospitals were associated with significantly shorter LOS.

Table 1. Results from total charges regression

Variable	Exp (b)	Robust Standard Error	P-value	95% Confidence Interval
Age	0.999	0.0017	0.376	0.995, 1.002
Died	1.274	0.0988	0.002	1.094, 1.483
Female	1.001	0.0459	0.990	0.914, 1.094
Number of diagnoses	1.002	0.0055	0.742	0.991, 1.013
Number of procedures	1.074	0.0075	<0.001	1.060, 1.089
Year	0.985	0.0250	0.553	0.937, 1.035
All-patient refined Diagnosis-related group (APRDRG)	1.126	0.0344	<0.001	1.060, 1.195
Race*				
Black	0.871	0.0472	0.011	0.783, 0.969
Hispanic	1.129	0.0931	0.142	0.960, 1.327
Asian/PI/other	1.100	0.1026	0.305	0.917, 1.321
Payer**				
Commercial	1.016	0.0427	0.706	0.936, 1.103
Self/charity/Uninsured/other	0.883	0.0948	0.248	0.716, 1.090
Location***				
Small, metropolitan	0.799	0.0365	<0.001	0.731, 0.874
Micropolitan/Rural	0.741	0.0432	<0.001	0.661, 0.831
Income****				
\$36,000-\$44,999	1.074	0.0611	0.208	0.961, 1.201
\$45,000-\$59,999	1.015	0.0552	0.790	0.912, 1.129
>\$60,000	0.986	0.0568	0.802	0.880, 1.104

*White is the baseline. **Medicare/Medicaid payer is the baseline. ***Large, metropolitan hospital location is the baseline. ****1-\$35,999 is the baseline. Regression: Generalized linear model, gamma family with log-link.

Table 2. Results from LOS regression

Variable	IRR	Robust Standard Error	P-value	95% Confidence Interval
Age	0.998	0.0028	0.538	0.993, 1.004
Died	1.276	0.2302	0.177	0.896, 1.817
Female	1.033	0.0871	0.699	0.876, 1.219
Number of diagnoses	0.979	0.0094	0.026	0.961, 0.997
Number of procedures	1.104	0.0111	<0.001	1.083, 1.126
Year	0.793	0.0372	<0.001	0.723, 0.869
All-patient refined Diagnosis-related group (APRDRG)	1.291	0.0842	<0.001	1.136, 1.467
Race*				
Black	0.918	0.0870	0.368	0.763, 1.106
Hispanic	0.945	0.1205	0.655	0.736, 1.213
Asian/PI/other	1.011	0.1193	0.923	0.803, 1.275
Payer**				
Commercial	0.956	0.0733	0.558	0.823, 1.111
Self/charity/Uninsured/other	1.258	0.3867	0.455	0.689, 2.298
Location***				
Small, metropolitan	1.105	0.1228	0.369	0.888, 1.374
Micropolitan/Rural	0.779	0.0816	0.018	0.635, 0.958
Income****				
\$36,000-\$44,999	1.003	0.1059	0.979	0.815, 1.233
\$45,000-\$59,999	0.941	0.0994	0.566	0.765, 1.158
>\$60,000	0.953	0.1085	0.676	0.762, 1.192

*White is the baseline. **Medicare/Medicaid payer is the baseline. ***Large, metropolitan hospital location is the baseline. ****1-\$35,999 is the baseline. Regression: Generalized linear model, negative binomial family with log-link.

Discussion and Limitations

- Recent published literature in heart transplantation has focused on long-term survival and outcomes associated with drug and device use in patients awaiting or just having received a heart transplant (e.g., Marelli 2008³).
 - The current study assessed factors significantly associated with inpatient lengths of stay and total charges during hospitalization. Several variables were associated with total charges, including inpatient mortality, number of procedures, APRDRG, black race, and hospital location. Factors associated with LOS included number of diagnoses, number of procedures, year, APRDRG, and micropolitan/rural location of the facility.
 - A 2008 study reported median LOS of 17 days for 53 transplant recipients in one institution, with median charges of \$137,679.⁴
 - Factors associated with in-patient mortality should be investigated in future analyses, along with longer-term outcomes and costs.
- Limitations
- This study did not consider interactions between variables, which could explain more variation.
 - More patient (e.g., risk factors) and hospital characteristics (e.g., teaching vs. non-teaching) could also help explain differences in LOS and charges.
 - Sub-group analyses were not conducted, which could provide further insight into disparities.
 - Additionally, this study did not consider clinical measures/outcomes (e.g., ejection fraction), medications utilized, re-transplantation, or the previous use of assist devices (e.g. left ventricular assist device).

Conclusions

- This investigation of 5911 adult heart transplant patients suggests that several factors are significantly associated with LOS and charges.
- Further research is warranted, particularly within subgroups (e.g., pediatrics), longer term outcomes, and factors associated with in-patient mortality.

References

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