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Predictors of re-hospitalization time during the first year after heart transplant

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Abstract

Background—Patient problems after heart transplant (HT) can lead to re-hospitalization.

Objectives—To examine re-hospitalization patterns and identify predictors of the number of days re-hospitalized at the transplant site during the first year after HT surgery.

Methods—Hierarchical regression identified predictors of greater re-hospitalization time from chart data collected from two transplant sites during the first post-transplant year on 269 adult HT recipients. Variables (total = 32) were entered in six steps: clinical site, demographics, peri-operative variables, cardiac function, immunosuppressant dosages, post-HT complications.

Results—The number of days re-hospitalized at the transplant site during the first year after HT ranged from 0–142 (mean = 25, median = 16); 64% were re-hospitalized; 37% were re-hospitalized more than once. Main reasons were rejections, infections, cardiovascular problems, and GI problems. The regression model explained 48.7% of the variance in re-hospitalization time, with post-HT complications explaining the most variance. Ten predictors were significant: IV-treated infections, treated acute rejections, shorter stay for HT surgery, GI complications, higher prednisone dose, female gender, coma, sex mismatch between donor and recipient, renal complications, and clinical site.

Conclusion—Sixty-four percent of the patients were re-hospitalized at the transplant site during the first year after HT surgery (with a median of 16 hospital days); 37% were re-hospitalized more than once. Significant predictors of the amount of time re-hospitalized pertained to five types of complications (rejections, infections, GI, renal, coma), shorter HT surgical stay, female gender, higher prednisone dose, sex-mismatched donor, and clinical site.

Implications—The study identifies who uses the most hospital resources during the first year after HT.

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Keywords

re-hospitalization time after heart transplant

Background

It is well known that heart transplantation (HT) improves the survival of patients with end-stage heart failure; however, HT recipients can experience many problems after the transplant. Clinical experience shows that these problems can include complications of transplantation such as acute rejection and cardiac allograft vasculopathy, and complications of anti-rejection drugs such as infection, diabetes, GI bleeding, hypertension, renal insufficiency, osteoporosis, and cancer. Many of the problems can result in re-hospitalization; however, it is not known which of the problems are significant predictors of the amount of time re-hospitalized, and how much patients are re-hospitalized and for how long.

Therefore, a literature search was conducted to identify research on the number of days that HT patients are re-hospitalized during the first year after surgery, but no studies were found, thus showing the need for this study. The literature search was then widened to focus on variables related to morbidity after HT because those factors can lead to re-hospitalization; morbidity variables are summarized on Table I.¹⁻²⁸ The variables identified in the literature review provide a basis for predictors to consider for the present study on re-hospitalization time.

Objectives

The objectives of this research were: (1) to examine the number of days that HT recipients are re-hospitalized at the transplant site following the surgical admission for the rest of year one, the number of times re-hospitalized, and the reasons for re-admissions; and (2) to identify predictors of a greater number of days re-hospitalized during the first year after HT surgery.

Methods

Sample

The sample consisted of 269 adult HT recipients who finished the first year of chart review follow-up after HT surgery at Loyola University of Chicago and the University of Alabama at Birmingham. Patients were transplanted from 1988 to 1996. The study used a prospective design in which patients on the HT waiting list at the two sites were enrolled in a NIH-funded study on quality of life outcomes. Patients were then followed during the wait for a heart donor and up to five years after the transplant. The research was approved by the Institutional Review Board at both sites, and subjects gave written consent for study participation.

Out of the 550 HT candidates enrolled in the NIH study (79% of the 696 adults on the HT waiting list), 348 were transplanted before the study ended. During the first post-HT year 52 patients died and 6 dropped out of the study for medical or personal reasons. One patient was excluded from the sample because of missing data on the number of days re-hospitalized. This resulted in 269 HT recipients for this analysis who reached the one-year anniversary before the study ended.

Several characteristics of the study sample were similar to patients in the HT registry at the time of data collection^{29–31} and also to the current HT population.³² Study patients were 81% male (as compared to 78% in 1995 registry report²⁹ and 77% in 2007 report³²) and 87% white (as compared to 83% in 1996;³⁰ race not noted in recent reports). Mean age of the study patients at transplant was 52 (range: 21–71) (as compared to 47 in 1998³¹ and 51 in 2007³²). Thirteen percent of the study patients were under the age of 40 and 22% were 60 or older, similar to the 25% over the age of 60 in 2007.³² (In 1995,²⁹ 54% were noted as being over the age of 50.) Almost half of the study patients had attended college. Only 25% were working by one year after HT (vs 15% right before HT), comparable to the 27% reported as working at one year after transplant in 1998 registry data.³¹ The majority of study patients (86%) had private insurance; other coverage included Medicare (21%) and Medicaid (8%).

More than half of the study patients (55%) had coronary artery disease listed as the reason for HT (see Table II for clinical characteristics), which is higher than the 44% reported by the HT registry in 1995²⁹ and the 41% in 2007.³² Nearly half were classified as urgent priority for HT. Nine percent of the patients were on a ventricular assist device or artificial heart at the time of transplant. Four percent received their second HT (comparable to 3% in 2007³²).

For maintenance immunosuppression during year one, most patients in the study were on a regimen of cyclosporine (100% of patients), prednisone (100%), and azathioprine (87%). The initial dose of cyclosporine was 5–8 mg/kg/day; follow-up doses were adjusted based on trough blood levels. Prednisone was tapered from 1 mg/kg/day after HT to 0.1 mg/kg/day by one year. Initially, the azathioprine dose was 2 mg/kg/day and was then adjusted to maintain a white blood cell count of >4000/mm³. Other immunosuppressants were mycophenolate mofetil (10%), methotrexate (6%), cyclophosphamide (5%), and tacrolimus (<1%).

Data Collection

The data used in this analysis were collected from patient charts by RN research assistants (RAs) employed by the NIH grant. During the first year after HT surgery, chart data were collected at 1, 3, 6, 9, and 12 months post-operatively, and covered the entire time from surgery to one year later. Chart data included the medical and surgical history, HT intra-operative and post-operative information, hospitalizations (with dates of admission and discharge), acute rejections and infections plus other complications, treatments (including mechanical assist devices), medications (immunosuppressant and other types), laboratory results, and donor data. Discharge diagnoses recorded by the physician on the chart were also retrieved for each hospitalization to determine the reason(s) for admission. Therefore, there was no subjectivity bias on the part of the nurse RA collecting the data, and RAs did not make decisions on what constituted various complications. It should be noted that the study could only track data from the two transplant sites funded for this research; therefore we acknowledge that patients might occasionally have been hospitalized elsewhere.

A Chart Review Form was used to transcribe data from the clinical records. The study form listed specific items to record along with directions for different content areas, plus the starting and ending dates of the time period under review. The form was developed by the research team who had experience in the care of heart transplant and heart failure patients. An experienced RA accompanied a new RA for training purposes whenever a chart review was being done for the first time.

Examples of specific types of medical data collected follow. For acute rejections, the following information was required on the study form: date of diagnosis of each rejection,

severity of the rejection using the standard severity ratings from the International Society for Heart and Lung Transplantation, and the type of treatment (specific anti-rejection medications were listed plus other types of treatment such as total lymphoid irradiation). Similar documentation for infections was recorded on the form: date, type (as bacterial, viral, fungal), location, and treatment (IV, oral, topical). For other types of complications, specific common complications in each category (e.g., cardiovascular, pulmonary, neurologic) were listed to be checked off, plus space was provided for recording other complications of each type not already listed.

Data Verification

To determine the reliability of the data recorded, a systematic sample of 25% of the chart review data for the entire study was manually verified by comparison with the original chart information. In addition, a systematic sample of 25% of the data was also verified to assess the accuracy of the coding and computer entry of the data, based on the coding manual developed for the study. The systematic samples were determined by keeping a log of which patients were verified for which time periods, so that the data on many of the subjects would be verified for some of the pre-operative and post-operative time periods.

To further evaluate data reliability, computer listings of selected variables were run by patient ID number across time periods and inspected for inconsistencies (e.g., a patient coded as diabetic at one time period but not following time periods, or patients showing extreme weight fluctuations from one time period to the next). Computer listings were also run on related variables by patient ID to uncover illogical relationships (e.g., a patient on a respirator coded as working during that time period). In addition, frequency distributions were run to identify illogical values, outliers, and missing data. Suspicious data were verified and corrected.

Analysis

Descriptive statistics were used to examine the number of days re-hospitalized after HT surgery during the rest of year one, and the number of times re-hospitalized and why. Hierarchical regression was used for the predictive analysis, with dummy variable coding (0,1) for categorical variables. The dependent variable for regression was the number of days re-hospitalized during year one. Variables from the literature review (Table I) were selected for the regression model based on: clinical importance, absence of high correlations with other predictors (to avoid redundancy in variables), and no missing data in the final variables chosen for analysis. Post-hoc comparisons between selected subgroups were examined with chi-square for categorical variables and t-tests for continuous variables. Significance was set at $p < .05$.

Predictor Variables

The hierarchical regression model contained six sets of predictors (total = 32) entered sequentially to determine the impact of each component on re-hospitalization time. The variables were: (1) **clinical site**, because outcome may vary by site; (2) **patient demographics**, to examine the effects of age, sex, and race; (3) **peri-operative variables**, because of their potential impact on re-hospitalization: donor age, sex mismatch between donor and recipient, racial mismatch, weight mismatch of more than 20%, donor ischemic time, whether the patient received induction therapy at the time of HT to reduce rejection, and HT length of stay; (4) **cardiac function**, because it was related to the success of the transplant: measured by the left ventricular ejection fraction (LVEF) for post-HT year one from radionuclide ventriculography; (5) **immunosuppressant medications**, because they were the cause of many of the post-transplant complications: measured by the mean daily dose during year one of the three main immunosuppressants: cyclosporine, prednisone,

azathioprine; and (6) **post-HT complications** during year one: number of treated acute rejections, number of IV-treated infections, number of each of six additional types of complications (cardiovascular, pulmonary, renal, neurologic, hematologic, GI), whether the patient had any of eight serious complications during year one (lymphoma, diabetes, stroke, coma, respiratory failure, acute congestive heart failure, renal or liver failure), and patient body mass index (weight adjusted by height: $BMI = \text{kg/m}^2$) at the end of year one (because of steroid-induced weight gain).

Results

The number of days re-hospitalized at the transplant site after the HT surgical admission during the rest of year one ranged from 0–142 days (mean = 25, SD = 26), with a median of 16 days in the hospital (not counting the transplant stay). Patients were re-hospitalized anywhere from 0–5 times during year one (mean = 1.2, SD = 1.3); 64% were re-hospitalized during the first year after HT, and 37% were re-hospitalized more than once.

We also collected the reasons for re-admissions, based on the discharge diagnoses recorded by the physician on the chart. Because there were often multiple discharge diagnoses for one admission, the percentage of re-admissions by diagnosis could not be calculated from our data. However, we could determine how many patients had specific discharge diagnoses (Table III). The foremost reasons for re-hospitalization during post-transplant year one were acute rejections, infections, cardiovascular complications, and GI problems.

The hierarchical regression model with six sets of variables explained 48.7% of the variance in the number of days re-hospitalized at the transplant site during the first year after HT surgery. Post-transplant complications explained most of the variance (41.3%), followed by the peri-operative variables, immunosuppressant dosages, patient demographics, clinical site, and cardiac function (Table IV). Ten of the 32 variables were significant predictors of greater re-hospitalization time: more IV-treated infections and treated acute rejections during year one, shorter stay for the HT surgery, more GI complications during year one, higher prednisone dose for year one, female gender, coma, sex mismatch between donor and recipient, more renal complications during year one, and clinical site. See Table V for a complete list of predictors.

Discussion

A total of 64% of the patients were re-hospitalized at the transplant site during the first year after HT surgery (37% were re-hospitalized more than once). This percentage is higher than the 43% reported for the first year after surgery by the HT registry³¹ at the time of data collection; main reasons for re-hospitalization in the registry data were acute rejections and infections.³¹

Understandably, the two strongest predictors of a greater number of days re-hospitalized during the first year after HT in our sample were the well-known problems of infection and acute rejection following transplant surgery (measured in this analysis as a greater number of IV-treated infections and treated acute rejections). The third strongest predictor was the length of stay for the HT surgery (mean = 20 days). However, the relationship was inverse: a shorter surgical stay meant more days re-hospitalized during the rest of year one.

Other significant complication predictors of increased hospital time were GI problems, renal problems, and coma. Even though coma was recorded in the charts of only two patients, this variable still emerged as an influential factor in a greater number of days re-hospitalized in the first year after HT surgery. However, a much larger percentage of patients (27%) experienced GI complications during year one. Most often these were gastroduodenal ulcer,

GI bleeding, and gall bladder disease, but also recorded were hepatitis, liver failure, and pancreatitis. Although some of the GI problems may be unrelated to the transplant, many were probably due to prednisone and mofetil. In addition, gall bladder disease can be caused by cyclosporine.³³

Almost one-quarter of the patients (24%) had renal complications recorded on their charts during the first year after HT surgery. The most common problem was renal insufficiency, due to the well-known nephrotoxicity of cyclosporine.³² In three of the patients (1%), the renal insufficiency had progressed to renal failure and they were on dialysis. Other renal complications were kidney abscess and kidney stones.

Patients who were on a higher dose of prednisone during year one were also re-hospitalized more days during that year. Steroids are well known for increasing infections, frequently leading to more hospital time. Supporting this is a significant correlation between a higher prednisone dose and more infections during year one ($r = .14$, $p = .027$).

Recipient gender also predicted hospital time. Female patients (52, 19%) spent significantly more time re-hospitalized during the first post-HT year than male patients (mean = 33 days vs 23 days; $t = -2.13$, $p = .037$). To try to determine why female patients were re-hospitalized more days, post-hoc analysis was conducted on age and medical variables. Age was not significantly different between women and men, but women were much more likely (54% vs 13%) to receive a sex-mismatched heart (chi square = 42.66, $p = .000$) because the majority of heart donors are males²⁶ (see below for discussion of sex-mismatch variable).

Women were also more likely than men (40% vs 27%) to receive a weight-mismatched heart from a donor at least 20% larger or smaller in body size (chi square = 3.77, $p = .040$), using the formula by Costanzo et al³ for calculating the percent difference between donor and recipient weights. In one-third of the women in our sample, the heart received was from a person at least 20% larger in body size, which was probably related to receiving a male heart. Some research has found that over-sizing of donors (i.e., heart from larger donor put into smaller recipient) resulted in higher mortality after HT,³ whereas other research reported that under-sizing caused higher mortality.³⁴ Mortality differences could not be examined in the present analysis because the sample consisted only of HT survivors.

In addition, women were more likely to receive induction therapy (e.g., OKT3) at the time of HT to reduce rejection (92% vs 81%; chi square = 4.03, $p = .030$). Induction has been shown to increase infections,⁹ and in our sample, female patients did have more infections than male patients, but not significantly so. Also, women had more hematologic complications than men, which approached significance ($p = .060$). Others have documented additional adverse outcomes in female HT recipients, such as more acute rejections and infections, and greater mortality.^{35–38} In our study, post-hoc analysis revealed no significant differences in rejections and infections between women and men during the first post-transplant year, but the results were in the expected direction (i.e., more rejections and infections in women).

Receiving a heart from the opposite sex also impacted on hospital time. Mismatch between the sex of the donor and the sex of the recipient resulted in significantly more days re-hospitalized during the first year after HT surgery (mean = 33 days for recipients of sex-mismatched hearts vs 23 days for same-sex recipients; $t = 2.04$, $p = .045$). A total of 21% of this sample were mismatched on sex (56/269). Male donor to male recipient *match* was 87% (189/217 males), so 13% of the males received female hearts. However, female donor to female recipient *match* was only 46% (24/52 females), so 54% of the females received male hearts. As noted above, this difference in sex-mismatched donors for males (13%) vs females (54%) was statistically significant ($p = .000$).

Post-hoc analysis showed no *significant* differences in the clinical variables measured in this study for HT recipients who were mismatched on sex (when type of mismatch was not taken into account). However, most of the complications (rejections, infections, cardiovascular, pulmonary, renal, hematologic, GI) occurred more frequently in patients who received sex-mismatched hearts, but not significantly so. Therefore, the increased frequency of all of these complications could help to explain the greater hospital time in sex-mismatched HT recipients.

Gender mismatch has been cited by HT studies as significantly related to other adverse outcomes of more acute rejections and higher mortality.^{10,25,38–41} Prendergast et al⁴⁰ found that gender mismatching in female recipients significantly increased rejection episodes during the first year after HT, whereas gender mismatching in male recipients significantly reduced one-year survival. Furthermore, Keogh et al⁴¹ reported higher steroid requirements in female recipients of male hearts, due to more acute rejections. In our study, post-hoc analysis showed no significant difference in mean prednisone dose for year one in female patients who received a male heart vs a female heart, although the result was in the expected direction (i.e., higher prednisone dose in females receiving a male heart). In addition, females who received a male heart had more treated acute rejections during year one, which approached significance ($p = .08$). As noted earlier, more rejections and higher prednisone dose resulted in a greater amount of time re-hospitalized.

Lastly, clinical site was a significant predictor of the amount of time re-hospitalized during post-HT year one, with Alabama patients showing more days re-hospitalized than Loyola patients (mean = 30 days vs 19 days) (Table VI). Post-hoc analysis showed several significant differences in clinical variables that might help to explain the variance in hospital time by site (Table VI). Alabama patients had more treated rejections during year one than Loyola patients. The Alabama site reported lower cyclosporine and azathioprine doses during year one, which could help to explain more rejections. Alabama patients also experienced more hematologic complications (e.g., anemia, leukopenia, thrombocytopenia) due to the immunosuppressants. Mean daily prednisone dose for year one was also higher at Alabama. In addition, Alabama patients were more overweight, possibly as a result of the higher prednisone dose. On the other hand, Loyola reported more cardiovascular and renal complications, and also longer donor ischemic time.

Clinical Implications

Determination of the predictors of greater re-hospitalization time documents which types of patients consume more hospital resources during the first year after HT surgery. In addition, this study can alert clinicians to be aware of those factors related to more days re-hospitalized. The results of this study also point to the need for interventions to reduce the amount of time re-hospitalized in female HT patients and in sex-mismatched recipients. Because higher prednisone dose predicted more hospital time, it seems imperative to taper the prednisone dose as rapidly as possible without jeopardizing adequate immunosuppression.

Research Implications

Because we found no research on predictors of the amount of time re-hospitalized during the first year after HT surgery, we could not compare predictors from this sample with more recently transplanted patients. This points out the need for further research in this area and replication of this study. Also, since this study focused only on demographic and medical factors impacting on re-hospitalization time, other research needs to be conducted on behavioral predictors (e.g., compliance) and psychosocial predictors (e.g., depression, social support resources).

Study Limitations

A limitation of this study is that re-hospitalization data could only be tracked at the two transplant sites funded for this research. Therefore these results might underestimate the amount of time re-hospitalized during the first year after HT surgery, because patients could occasionally have been hospitalized elsewhere in addition to the transplant site.

Furthermore, since these patients were transplanted from 1988 to 1996, it might be suggested that some of the predictors of re-hospitalization time have changed since then. Only more research can determine if the predictors of shorter HT surgical stay and sex-mismatched donor have changed. As noted above, female gender of the recipient has been a documented factor in adverse HT outcomes, supporting the ongoing relevance of this predictor. Since prednisone continues to be a key ingredient in the post-transplant regimen,³² this predictor is still relevant at this time. Moreover, it is unlikely that the many complications due to anti-rejection medications (which explained most of the variance) will diminish in significance as predictors of re-hospitalization time in the foreseeable future, unless there are dramatic changes in the types of drugs used to prevent organ rejection. Although tacrolimus is used more often now than cyclosporine,³² and mofetil is used more than azathioprine,³² the newer immunosuppressants have similar side effect profiles as the older drugs. Therefore, the main complication predictors reported here will likely remain the same.

Conclusion

Sixty-four percent of the patients were re-hospitalized at the transplant site during the first year after HT surgery (with a median of 16 hospital days), and 37% were re-hospitalized more than once. Main reasons for re-admission were rejections, infections, cardiovascular complications, and GI problems. Significant predictors of a greater number of days re-hospitalized during the first post-transplant year pertained to five types of complications (rejections, infections, GI, renal, coma), shorter HT surgical stay, female gender, higher prednisone dose, sex-mismatched donor, and clinical site. Identification of which groups of patients are re-hospitalized more days after the HT surgical admission documents who uses the most hospital resources during the first year following transplant.

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Table I

Examples of variables examined in research on morbidity after heart transplant surgery

Variable	References
Recipient/donor characteristics or recipient/donor mismatch on: age, sex, race, weight, CMV status	1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26
Pre-transplant variables:	
IV inotropic support	26
Mechanical assist devices	4, 23, 25, 26, 27
Hemodynamic variables	6, 10, 27, 28
LVEF, CMV, PRA	6, 11, 12, 16, 26, 27
Diabetes	16, 19, 21, 26
Other co-morbidities	10
UNOS status	5
Time on HT waiting list	22
Cause of heart disease	2, 5, 10, 16, 22, 25, 26
Retransplant	4, 24, 25, 28
Peri-operative variables:	
Donor ischemic time	23, 25, 26, 28
Induction therapy	9, 12, 13, 14, 20, 23
HT length of stay	6
Post-transplant variables:	
Immunosuppressants	1, 2, 17, 20, 21, 24
Acute rejections	6, 2, 8, 17, 19, 28
Infections	12, 19, 23, 26
Other complications (ex: CAV, HTN, renal insufficiency, post-HT diabetes, GI problems, lymphoma, skin cancer)	5, 13, 14, 16, 17, 18, 20, 21, 22, 24, 26, 28

CMV, cytomegalovirus; LVEF, left ventricular ejection fraction; PRA, panel reactive antibodies; UNOS, United Network of Organ Sharing; HT, heart transplant; CAV, cardiac allograft vasculopathy; HTN, hypertension.

Table II

Clinical characteristics of heart transplant sample (N = 269)

Characteristic	% or Mean (SD, Range)
Cause of heart disease	
Coronary artery disease	55%
Dilated cardiomyopathy	36%
Valvular heart disease	<2%
Congenital heart disease	<2%
Other causes	6%
Wait for heart donor	288 days (297, 3–1838)
More urgent UNOS status 1	48%
Second heart transplant	4%
On ventricular assist device or artificial heart at transplant	9%
IV inotropic support at transplant	57%

UNOS, United Network for Organ Sharing.

Table III

Reasons for hospital re-admissions in HT recipients during the first post-transplant year (N = 269)

Reason for Re-admission	% of Patients
Acute rejection	49
Infections (not CMV or pneumonia)	23
CMV infections	14
Miscellaneous cardiovascular (e.g., atrial fibrillation, mitral regurgitation, cardiac arrest, pericardial effusion, cardiac tamponade)	12
Pneumonia	12
GI: esophagitis, gastritis, ulcer	9
Pulmonary (not pneumonia) (e.g., respiratory failure, pulmonary edema, pulmonary embolism)	8
Miscellaneous GI (e.g., gall stones, pancreatitis, hepatitis, liver failure, bowel obstruction)	7
Hematologic (e.g., anemia, leukopenia, thrombocytopenia)	7
Acute congestive heart failure	6
Diabetes	5
Chronic renal insufficiency & renal failure	5
Neurologic (e.g., stroke, coma, encephalitis, seizures)	5
Orthopedic (e.g., avascular necrosis of hip, spinal fracture, back pain)	5
Cardiac arrhythmias	4
Syncope	4
Eye, ear, nose, & throat	3
Post-HT coronary artery disease	2
Miscellaneous endocrine (not diabetes) (e.g., hypothyroidism, parathyroidism)	2
Psychiatric (e.g., depression)	2
Lymphoma	2
Miscellaneous renal (not renal insufficiency) (e.g., kidney stones, kidney abscess)	2
Peripheral vascular disease	1
Dermatologic	1

HT, heart transplant; CMV, cytomegalovirus.

Percentages are rounded to the nearest whole number.

Reasons for re-admission are based on discharge diagnoses recorded by physician on the chart; multiple diagnoses could be recorded for an admission. Level of specificity differs because some diagnoses were combined for brevity.

Table IV

Hierarchical regression model for number of days re-hospitalized during the first year after heart transplant surgery (N = 269)

Order of Entry of Sets of Variables	# of Variables	F	p	% Variance Explained
1. Clinical site	1	8.06	.005	1.0
2. Patient demographics	3	2.86	.038	1.1
3. Peri-operative variables	7	4.20	.000	3.6
4. Cardiac function	1	0.94	.335	0.1
5. Immunosuppressant dosages	3	4.28	.006	1.6
6. Post-transplant complications	17	19.56	.000	41.3

Regression model explained 48.7% of the variance in the time re-hospitalized.

Table V

Hierarchical regression predictors of number of days re-hospitalized during the first year after heart transplant surgery (N = 269)

Predictor	% or Mean (SD, Range)	r with DV	p	Std. Beta	F	p
Clinical Site:						
Loyola vs Alabama *	47%, 53%	-.22	.000	-.153	8.06	.005
Patient Demographics:						
Sex *	19% female	-.16	.010	-.125	8.56	.004
Race	87% white	.06	.355	.015	0.14	.711
Age at transplant	52 years (10, 21–71)	-.02	.794	-.010	0.07	.793
Peri-operative Variables:						
HT length of stay *	20 days (17, 4–168)	-.02	.721	-.192	21.10	.000
Sex mismatch *	21%	.15	.011	.090	4.85	.029
Weight mismatch >20%	29%	.05	.456	.054	2.04	.155
Racial mismatch	29%	.16	.011	.030	0.58	.446
Donor ischemic time	176 minutes (58, 42–353)	.07	.265	.029	0.56	.457
Donor age	26 years (9, 12–55)	-.13	.042	-.058	0.23	.636
Induction therapy	83%	.13	.031	.004	0.01	.912
Cardiac Function:						
LVEF	56 (7, 30–79)	-.16	.010	-.042	0.94	.335
Immunosuppressants:						
Prednisone dose *	16 mg (5, 5–54)	.32	.000	.163	12.59	.000
Azathioprine dose	115 mg (52, 20–322)	-.26	.000	-.043	0.87	.352
Cyclosporine dose	389 mg (144, 132–1498)	-.10	.012	-.033	0.62	.431
Post-HT Complications:						
# of IV-treated infections *	0.9 (1.6, 0–11)	.62	.000	.394	64.53	.000
# of treated acute rejections *	2.4 (2.5, 0–13)	.56	.000	.280	30.90	.000
# of GI complications *	0.5 (0.9, 0–6)	.28	.000	.166	15.45	.000
Coma *	1%	.25	.000	.098	4.99	.027

Predictor	% or Mean (SD, Range)	r with DV	p	Std. Beta	F	p
# of renal complications *	0.4 (0.8, 0-4)	.12	.059	.081	3.92	.049
Lymphoma	2%	.18	.003	.075	3.26	.073
Acute congestive heart failure	6%	.18	.003	.057	1.61	.207
# of neurological complications	0.4 (0.9, 0-4)	.18	.003	.058	1.58	.210
# of pulmonary complications	0.6 (1.0, 0-7)	.36	.000	.055	1.36	.246
# of hematologic complications	1.1 (1.6, 0-8)	.53	.000	.064	1.34	.249
Stroke	2%	.09	.132	.050	1.14	.288
# of cardiovascular complications	8.4 (2.7, 2-25)	.13	.032	.043	0.83	.362
Renal failure	1%	.16	.007	.036	0.41	.522
Respiratory failure	5%	.32	.000	.029	0.38	.537
Liver failure	1%	.08	.192	.025	0.21	.647
Weight (in BMD) at the end of year one	28 (5, 17-43)	-.13	.033	-.018	0.17	.685
Diabetes	29%	.05	.409	.005	0.02	.900

DV, dependent variable (# of days re-hospitalized); Std. Beta, standardized beta coefficient; HT, heart transplant; LVEF, left ventricular ejection fraction; 55 or higher is normal; BMI, body mass index; 25-29 is overweight; 30 or higher is obese.

* indicates significant variables.

Categorical variables indicate percentage of patients; percentages are rounded to the nearest whole number.

All variables are for the first year after HT surgery, unless otherwise noted.

Table VI

Significant differences between sites

Variable	Alabama Mean (SD) (N = 143)	Loyola Mean (SD) (N = 126)	t	p
Days re-hospitalized after HT	30 (27)	19 (22)	-3.77	.000
Treated acute rejections	3.4 (2.7)	1.3 (1.4)	-8.10	.000
Hematologic complications	1.5 (1.8)	0.7 (1.2)	-4.23	.000
Prednisone dose	17 mg (6)	14 mg (4)	-4.58	.000
Cyclosporine dose	360 mg (116)	421 mg (165)	-3.51	.001
Azathioprine dose	102 mg (47)	126 mg (53)	-3.49	.001
Weight (in BMI) at the end of year one	29 (4)	27 (5)	-2.65	.009
Cardiovascular complications	7.6 (2.9)	9.2 (3.1)	5.02	.000
Renal complications	0.3 (0.7)	0.5 (0.9)	2.53	.012
Donor ischemic time (minutes)	163 (55)	191 (57)	4.02	.000

HT, heart transplant; BMI, body mass index: 25–29 is overweight; 30 or higher is obese.

All variables are for the first year after HT surgery, except for weight and ischemic time.

Alabama coded as 0 and Loyola coded as 1.