

**Final Report of Center-Specific Survival Rates
NMDP Facilitated Transplants Occurring between
January 1, 2002 through December 31, 2006**

Submitted September 27, 2007

Introduction

The purpose of this study is to provide potential stem cell transplant recipients, their families and the general public with a comparison of survival rates among the centers in the NMDP network. Reporting center-specific survival rates has most recently been called for by the Stem Cell Therapeutic and Research Act of 2005, along with the 1990 Transplant Amendments Act. Because centers vary considerably in the risk level of the cases treated, a statistical model has been developed to adjust for several risk factors known or suspected to influence outcome. The outcome reported here is one-year overall survival. No attempts have been made to incorporate other outcomes, such as relapse or disease-free survival.

The NMDP has been reporting center-specific risk-adjusted comparisons since 1994¹. In December 1999, a committee consisting of transplant physicians, HRSA representatives, recipient advocates and biostatisticians met to discuss the best way to conduct the analysis and present the results. Changes based on that committee's recommendations were incorporated into the year 2000 version of the analysis. In 2001, the statistical model was switched from partial logistic fixed effects regression² to a mixed effects linear model using logistic regression. Because the random effects component of this mixed effects model made the validation and data interpretation processes somewhat confusing, the 2003 report utilized a fixed effects regression model to predict center-specific survival proportions. In the 2005 and 2006 reports a censored data logistic regression model^{3,4} was used to allow for inclusion of recipients with incomplete one-year follow-up. This same model was used for the 2007 report.

Results will be published in the 2007 *NMDP Transplant Center Access Directory* in a format similar to that used in previous years. A risk adjusted one-year survival rate has been calculated for each center based on results of the censored data logistic regression. A risk score is also included with each center's survival results, indicating the sickness-severity level of the recipient population at that center. Raw numbers of transplants and surviving recipients will also be published for each center stratified by diagnosis and age.

It should be emphasized that a comparison of 2007 center-specific predicted survival results is only meaningful in comparison to the 2003, 2005, and 2006 reports since reports from previous years employed a fundamentally different statistical model. There are also several changes in medical practice that are reflected in the 2003, 2005, and 2006 reports but not in the earlier reports. (*Note: the 2004 center-specific report was not performed as a result of the NMDP's corrective action plan and the backlog at transplant centers in reporting recipient outcomes.*)

A total of 119 NMDP network transplant centers are represented in the 2007 analysis. Each of these transplant centers performed at least one transplant over the five-year window of time from January 1, 2001 to December 31, 2005.

Methods

Recipients and Data

The 2007 analysis includes the five-year time interval from January 1, 2001 to December 31, 2005. This time interval allows for a minimum of one-year follow-up for all eligible cases. Centers were eligible to participate in the 2007 analysis based on the criteria that they were a U.S. transplant center, had performed at least one transplant in the time interval, and had submitted at least 75% of the expected follow-up data. A total of 119 US transplant centers are included in this year's analysis. Seven centers were excluded from the analysis, for a total of 71 transplant procedures excluded. These centers had poor follow-up, and at the time of the analysis they were considered inactive centers. Inclusion of centers with poor follow-up runs the risk of introducing bias in the survival estimates because of possible early reporting of deaths.

Only recipients with a prior allogeneic transplant were excluded from the analysis; however, a previous autologous transplant was not an exclusion criterion. Of the 7,840 eligible cases, there were 10 cases where no follow-up data were available, leaving a total of 7,830 cases eligible for analysis. Demographics of these cases are given in Table 2. Follow-up data were provided to the NMDP Coordinating Center at the time of transplant (baseline), and at 100 days, 6 months and annually post-transplant using standardized forms. Race was self-reported by recipients.

There were three key clinical differences between the 2003 analysis and analyses from previous years. These key clinical differences are represented even more strongly in the 2007 analysis. These differences are:

- 1) A decreased number of CML cases were included reflecting the use of imatinib (Gleevec[®]) as a first-line therapy. In 2007 only 4% of transplants were for first chronic phase CML, whereas in 2006, 2005 and 2003 6.2%, 9.2% and 18% respectively were for first chronic phase CML.
- 2) Peripheral blood stem cell (PBSC) transplants were included. In the 2007 report, PBSC transplants have increased to 52% of all transplants, up from 43% in the 2006 report, 32.4% in the 2005 report and 6% in the 2003 report.
- 3) Transplants utilizing a non-myeloablative / reduced intensity conditioning regimen were included. Non-myeloablative / reduced intensity transplants increased from 7% in 2003 to 28% in 2005, 27% in 2006, and 36% in 2007.

In addition, cord blood transplants were included for the first time in the 2005 analysis (N=188, 3%). The number of cord blood transplants in subsequent analyses have increased to N=277 (4%) in the 2006 report and N=443 (6%) in the 2007 report.

Statistical Analysis

Rationale for a Fixed Effects Censored Data Logistic Regression Model

Since one of the NMDP's key goals for the transplant center-specific analysis is to predict survival that is fair and accurate given the center's number of transplants performed coupled with its recipient case mix, a fixed effects censored regression model was utilized for the 2007 transplant center-specific report. The fixed-effect logistic regression model provides information about how the recipients actually treated in a particular center would have fared had they been transplanted at a "generic" transplant center within the NMDP network. This model assumes *no center effect*. In other words, it assumes that recipients are dying at the same uniform rate across all NMDP network transplant centers, after adjusting for covariates. In addition, this model adequately accounts for the recipients with incomplete follow-up at one year.

Every effort was made to update follow-up information on each recipient. However, some recipients are lost to follow-up and final survival status at one year is unknown. To address the problem, the analysis only includes centers that demonstrated 75% completeness, meaning that the one year status was known for at least 75% of their transplanted recipients. However, there are still some recipients for whom survival status at 1 year is incomplete (411 or 5.2% with less than 12 months of follow-up, although many of them had follow-up done just prior to one year). If these recipients are excluded from the center-specific analysis, it may bias the survival estimates. A censored data version of logistic regression based on pseudo-values proposed by Andersen et al.³, Klein and Andersen⁴, and Klein et al.⁵ addresses this issue. This method is a generalization of logistic regression which simplifies to logistic regression when there is no censoring present. This regression technique is used only to estimate the fixed effects and predict the recipients' survival probability; the rest of the center-specific analysis is unchanged.

Details of Fixed Effects Censored Data Logistic Regression and Confidence Limits

1. Definition of pseudo-values

To compute the pseudo-value for recipient i , first compute the pooled sample Kaplan-Meier estimate of survival at one year based on the entire sample, $\hat{S}_p(1)$. Next we compute the Kaplan-Meier estimate of survival at one year based on the entire dataset with observation i removed $\hat{S}_p^{(i)}(1)$. The i th pseudo-value is defined by

$$\hat{\theta}_i = n\hat{S}_p(1) - (n-1)\hat{S}_p^{(i)}(1).$$

If there is no censoring then the i th pseudo-value is simply the indicator that the i th recipient was alive at one year. These pseudo-values will then be used in a regression model using a logit link, similar to a standard logistic regression model, as described in the next section. The parameters of the regression model can be estimated using generalized estimating equations (GEE), which is implemented in PROC GENMOD in SAS.

II. Model-Building

Let (Z_{i1}, \dots, Z_{ip}) denote the set of covariates in the final model for recipient i . We first fit a fixed effects censored data logistic regression model with no center effect,

$$\varphi_i = \ln \frac{\theta_i}{1 - \theta_i} = \beta_0 + \sum_{l=1}^p \beta_l Z_{il} .$$

III. Center Risk Group Assignments

Using the regression model to define recipients with the lowest likelihood of death in the first year up to those with the highest likelihood of death, a risk score for each recipient's set of characteristics can be calculated. A risk score for each center can then be computed by averaging the risk scores (or log-odds) for all recipients transplanted at that center.

$$RS_j = \frac{1}{n_j} \sum_{i \in C_j} \hat{\varphi}_i ,$$

where n_j is the number of recipients at that center and C_j represents the set of recipients at center j .

Centers are then characterized in 5 equal sized groups; each containing 20% of the centers. Assignment to each risk group is based upon the percentiles of the average risk scores across recipients in each center.

In general, centers in risk group 1 treated recipients with lower average risk scores than centers assigned to the higher risk groups. Thus the risk group scores for each center generally reflects the adjusted hazards faced by recipients treated at each center. The risk score is provided as a guide for the reader as the score is already accounted for in the calculation of the predicted survival and confidence intervals for recipients treated at each center.

IV. Predicted and Observed Survival

From the fitted logistic regression model, each recipient has an estimated survival rate

$$\hat{p}_i = \frac{\exp(\hat{\varphi}_i)}{1 + \exp(\hat{\varphi}_i)}$$

based on his or her risk characteristics. The predicted survival rate at center j based on recipient characteristics $E(S_j)$, is the average of the estimated survival rates for all recipients at center j ,

$$E(S_j) = \left(\sum_{i \in C_j} \hat{p}_i \right) * \frac{1}{n_j} .$$

The observed 1-year survival rate at center j can be computed using the mean of the pseudo-values for the recipients at center j . This provides an unbiased estimate of

the true 1-year survival rate at that center, and simplifies to the sample proportion of recipients alive when there is no censoring present.

V. Confidence Limits

Confidence limits were generated using a bootstrapping methodology³. To generate the confidence intervals, we randomly generate a survival outcome for each recipient X_1, \dots, X_n , where each recipient's survival status, X_i , is assumed to have a Bernoulli distribution with probability \hat{p}_i .

This process is repeated $B = 10,000$ times, so that we end up with 10,000 random samples of survival results for each recipient, X_1^b, \dots, X_n^b for $b = 1, \dots, B$.

For each generated sample of survival results, we compute the survival rate occurring at each center,

$$S_j^b = \left(\sum_{i \in C_j} X_i^b \right) * \frac{1}{n_j}.$$

Then the 95% predicted confidence bounds for survival at center j are obtained by taking the 2.5th and 97.5th percentile of S_j^b .

This confidence interval refers to the survival rate we might have observed at that center if there were no center effect and those recipients had been transplanted at any center in the network. The observed survival rate can be compared with this confidence interval to see if there is evidence of the center over-performing or under-performing the overall network.

Results

Risk Factors

After careful discussion with clinical and statistical transplant experts, the following essential risk factors were considered as candidate effects for the model building process:

- diagnosis (and disease stage)
- coexisting disease *
- HLA- matching
- recipient and donor age
- recipient and donor gender
- donor parity
- recipient and donor cytomegalovirus (CMV) serology
- recipient and donor race (self-reported)
- cell dose (nucleated cells per unit recipient body weight)
- recipient Karnofsky / Lansky Performance Status score at transplant
- WBC at diagnosis
- prior autologous transplant
- resistant disease (NHL only)

- stem cell source (marrow vs. PBSC vs. cord blood)
 - non-myeloablative / reduced intensity transplant preparative regimen †
 - T-cell lineage in ALL
 - year of transplant
 - duration of CR1 (acute leukemia)
 - number of previous remissions (acute leukemia)
- * The NMDP captures the presence or absence of coexisting diseases for transplant recipients on the baseline case report form. If a clinically significant coexisting disease is present, which is roughly 25% of the time, the form then requires the physician to indicate a more specific type of diagnosis from a list of 28 broad-based conditions including cardiovascular, central nervous system, and gastrointestinal conditions, among others.
- † Non-myeloablative/reduced intensity regimens are defined as total body irradiation < 500 cGY and < 800 cGY given as multiple fractions; < 9 mg/kg busulfan; < 150 mg/m² melphalan; fludarabine/cladribine at any dose.

Based on review by the statistical center of the CIBMTR, several changes were made to the incorporation of the candidate factors in the model, compared to previous years, as follows:

- Added donor parity as a candidate factor.
- Removed time from diagnosis to transplant as a candidate factor, except for CML patients in 1st chronic phase. This variable was felt to be too confounded with disease, and it was felt to be captured adequately by disease status.
- Changed the classification of Karnofsky/Lansky score at transplant to be more clinically meaningful, as ≥ 90 vs. < 90 vs. missing
- Removed recipient BMI as a candidate factor. This was thought to be confounded with age and disease, and was considered too difficult to appropriately account for it in the model.
- Improved the adjustment for HLA matching, so that we use the best available matching information at HLA-A, -B, -C, and -DRB1 for PBSC and marrow transplants. Each patient-donor pair is classified as well-matched, partially matched, or mismatched according to an analysis of survival by best available matching information done by the CIBMTR (unpublished). For cord blood transplants, we consider low-resolution at HLA-A and -B, and high resolution at -DRB1 only.
- Broke down disease/status into more categories: 3 sub-categories for MDS (RA, RAEB/RAEB-IT, and OTHER), and 3 sub-categories for Other Malignant Diseases (Hodgkin lymphoma, plasma cell disorders, and other malignant diseases).

Of the candidate effects listed above, factors found to be significant in the model-building process are given in Table 4: Risk Factors for Survival. These include: disease / stage; recipient age; donor age; HLA matching; recipient CMV status; recipient race; co-existing disease; Karnofsky / Lansky score interacted with prior autologous transplant; cell dose by stem cell product type (PBSC, marrow, cord blood); year of transplant; conditioning regimen intensity; resistant disease (NHL only); duration of CR1 (ALL and AML only); and T-cell lineage (ALL only). A frequency distribution of diseases and disease stages is displayed in Figure 1. The estimated effects of each of the risk

factors are given in Table 4 via odds ratios. Main and interaction effects for the remaining candidate risk effects were explored, but not included in the model because they did not achieve statistical significance ($p > 0.05$).

The model changed only modestly from the 2006 analysis. Two additional factors (T-cell lineage, and year of transplant) were found to be significant in the 2007 analysis, but not in the 2006 analysis. The effect of non-myeloablative / reduced intensity conditioning regimen was found to only be significant for non-Hodgkin lymphoma and other malignant diseases (Hodgkin lymphoma, plasma cell disorders, and other solid tumors) in the 2007 analysis, but in 2006 was significant for leukemia as well. A significant interaction was found between Karnofsky/Lansky score at transplant and prior autologous transplant, which had not been identified previously.

Center-Specific Results

Final center-specific results are given in Table 5. Number of transplanted recipients at each center, risk score, actual (raw) survival at one year, predicted survival at one year, 95% confidence intervals for predicted survival, and performance status are displayed for each center. Centers whose actual survival is outside the 95% confidence limits for predicted survival have a “-1” in the performance status column if under-performing (12 centers), and a “1” in the performance status column if over-performing (7 centers). Centers with a “0” in the performance status column are performing as predicted. Since the censored data logistic regression model assumes no center effect, centers with smaller numbers of transplants (e.g., $N = 1$ or 2) will *not* have their predicted survival proportion regress toward the network average. Rather, the confidence limits around the predicted survival at that center will simply be much wider than those of larger centers. Figures 2a–f convey the same data, but via a visual box-plot graphic. Centers are arranged by center number, while reading from left to right across these figures. The actual survival at each center is superimposed with each box plot (using the character ‘•’) to give the reader an instantaneous picture of how close to under- or over-performing the center was. Risk score is indicated below each transplant center’s code on the X axis to give the reader an idea of how sick the recipients treated at that center were. The dashed line at 51.5% denotes the overall network survival average, which is the number of surviving recipients at one year divided by the total number of transplants performed. Note that actual survival (51.5%) and predicted survival (51.3%) network-wide differ by only 0.2% using this model.

Comparison of 2003, 2005, 2006, and 2007 Center-Specific Results

Since there is only minor variation between the fixed effects logistic regression model used in the 2003 analysis and the censored data logistic regression model used in the 2005–2007 analyses, results among the four years can be compared. Table 1 shows the total number of centers, and the number of over-performing and under-performing centers for each analysis.

Table 1: Summary Results for 2003, 2005, 2006, and 2007 Analyses.

	2003	2005	2006	2007
Total # of Centers	106	111	112	119
# of centers below predicted lower confidence limit (under performing)	10	12	13	12
# of centers above predicted upper confidence limit (over performing)	5	5	2	7

Of the 12 centers that were identified as under-performing in the 2007 analysis, 9 were also identified as under-performing in the 2006 analysis and 2 centers were identified as under-performing in all four analyses. Of the 5 centers identified as over-performing in the 2003 analysis, 2 continued to be over-performing centers in the 2005, 2006, and 2007 analyses. Table depicts those centers that were either under-performing (-1), or over-performing (1), in the 2003, 2005, 2006, or 2007 analysis. If the center performed within predicted confidence limits for one of those years a "0" is displayed in the cell. Centers not listed in Table were within their predicted confidence limits for all four years of analysis.

Table 2: Change in Performance Status for 2003, 2005, 2006, and 2007 Analyses

Anonymous Center Number	2003	2005	2006	2007
2059	0	-1	-1	-1
2124	-1	0	0	0
2193	-1	0	0	0
2218	0	0	-1	-1
2284	0	0	0	-1
2314	0	-1	0	0
2600	-1	0	0	0
2625	1	0	0	0
3415	0	0	0	-1
3558	-1	0	0	0
4000	0	1	0	0
4350	0	0	0	1
4632	-1	-1	-1	-1
4645				1
4760	0		0	1
4848	0	-1	-1	-1
4862	1	0	0	0
4925	0	-1	-1	0

Anonymous Center Number	2003	2005	2006	2007
5203	-1	-1	-1	-1
6139	0	0	0	1
6310	0	1	0	0
6556	-1	0	0	0
6576	1	1	1	1
6738	0	0	-1	0
7205	1	1	1	1
7404	-1	0	0	0
7531	0	-1	-1	-1
7651	0	-1	-1	0
7782	0	-1	-1	-1
8255	0	-1	-1	0
8513	0	0	0	-1
9187	0	-1	-1	-1
9563	1	0	-1	-1
9714	0	1	0	1
9752	-1	-1	0	0

Summary

A censored data logistic regression model has been fitted to survival data from NMDP-facilitated transplants at U.S. centers January 1, 2001 through December 31, 2005. The model adjusted for disease / stage; recipient age; HLA matching; donor age; recipient CMV status; recipient race; Karnofsky / Lansky score at transplant; prior autologous transplant; co-existing disease; cell dose / stem cell product type (PBSC, marrow, cord blood); duration of CR1 (ALL and AML only); resistant disease (NHL only); T-cell lineage (ALL only); year of transplant; and non-myeloablative / reduced intensity conditioning regimen.

References

1. National Marrow Donor Program Center Specific Report, *Internal NMDP Report*, 1998.
2. Efron, B: Logistic regression, survival analysis, and the Kaplan-Meier curve. *Journal of the American Statistical Association*, 1988; 83:414-425.
3. Andersen, P.K., Klein, J.P., and Rosthøj, S. (2003). Generalized linear models or correlated pseudo-observations with applications to multi-state models. *Biometrika*, 90: 15-27.

4. Klein, J.P. and Andersen, P.K. (2005) Regression modeling of competing risks data based on pseudo-values of the cumulative incidence function. *Biometrics*, 61: 223-229.
5. Klein, J.P., Logan, B.R., Harhoff, M. and Andersen, P.K. Analyzing survival curves at a fixed point in time. *Statistics in Medicine*, Accepted for publication.

Table 3: Demographics

Note: percentiles may not sum to 100% due to rounding.

Disease — Stage	N	Percent
AML — 1st remission	795	10%
AML — 2nd remission	639	8%
AML — 3rd and higher CR and relapse	1025	13%
CML — CP, dx to tx < 12 months	180	2%
CMP — CP, dx to tx ≥ 12 months	180	2%
CML — Accelerated phase / 2 CP	276	4%
CML — Blast phase	58	1%
ALL — 1st remission	400	5%
ALL — 2nd remission	488	6%
ALL — 3rd and higher CR and relapse	406	5%
Chronic lymphocytic leukemia	253	3%
Other leukemia	176	2%
MDS — RA	166	2%
MDS — RAEB/RAEB-IT	341	4%
MDS — other	410	5%
Non-Hodgkin lymphoma	872	11%
Hodgkin lymphoma	279	4%
Plasma cell disorders	176	2%
Other malignant disease	57	1%
Severe aplastic anemia	326	4%
Other non-malignant	327	4%
Total	7830	100%

Recipient Age at Transplant	N	Percent
0–10 years	1084	14%
11–17 years	663	8%
18–30 years	1267	16%
31–40 years	1105	14%
41–50 years	1500	19%
51–60 years	1638	21%
> 60 years	573	7%
Total	7830	100%

Donor Age at Transplant (PBSC and Marrow only)	N	Percent
18–30 years	2342	32%
31–45 years	3857	52%
≥ 46 years	1188	16%
Total	7387	100%

Donor / Recipient CMV status	N	Percent
Positive / Positive	1531	20%
Positive / Negative	950	12%
Negative / Positive	2325	30%
Negative / Negative	2198	28%
Unknown	826	11%
Total	7830	100%

Recipient Race	N	Percent
African American	454	6%
Asian / Pacific Islander	165	2%
Caucasian	6840	87%
Hispanic	182	2%
Other / Unknown	189	2%
Total	7830	100%

Donor Race	N	Percent
African American	337	4%
Asian / Pacific Islander	205	3%
Caucasian	6163	79%
Hispanic	510	7%
Other / Unknown	615	8%
Total	7830	100%

Donor / Recipient Gender	N	Percent
Male / Male	3070	39%
Male / Female	1881	24%
Female / Male	1542	20%
Female / Female	1286	16%
Unknown	51	1%
Total	7830	100%

Donor Parity	N	Percent
0 / Male	5486	70%
≥ 1	1443	18%
Unknown	901	12%
Total	7830	100%

Coexisting Disease	N	Percent
Present	3996	51%
Absent	3834	49%
Total	7830	100%

Karnofsky / Lansky Score at Transplant	N	Percent
90–100	4901	63%
< 90	2022	26%
Missing	907	12%
Total	7830	100%

Product Type	N	Percent
Cord Blood	443	6%
Peripheral Blood	4045	52%
Bone Marrow	3342	43%
Total	7830	100%

HLA Match Status – PBSC or Marrow^a (best available typing at HLA-A, -B, -C, -DRB1)	N	Percent
Well-matched	4640	63%
Partially matched	1986	27%
Mismatched	754	10%
Missing	7	0%
Total	7387	100%

HLA Match Status – Cord Blood (serological at HLA-A, -B; allele at -DRB1)	N	Percent
6 of 6	72	16%
5 of 6	164	37%
≤ 4 of 6	179	40%
Double cord	28	6%
Total	443	100%

Year Transplant was Performed	N	Percent
2001	1167	15%
2002	1420	18%
2003	1566	20%
2004	1757	22%
2005	1920	25%
Total	7830	100%

Conditioning Regimen	N	Percent
Traditional Ablative		
Cy+TBI > 500 cGY single TBI > 800 cGY fract	2798	36%
Cy+VP16+TBI	5	0%
Bu+Cy	1287	16%
RIC		
TBI < 500 cGY single TBI < 800 cGY fract	270	3%
LPAM ≤ 150 mg/m ²	727	9%
Bu ≤ 9 mg/kg	741	9%
BEAM	55	1%
CBV	27	0%
Non-myeloablative		
TBI = 200 cGY	119	2%
Flud+TBI = 200 cGY	555	7%
Flud+Cy	349	4%
Flud+ARA-C	3	0%
Non-traditional ablative		
TBI ≥ 500cGY single-TBI ≥ 800 cGY-fract	250	3%
LPAM > 150 mg/m ²	106	1%
Bu > 9mg/kg	372	5%
Bu+LPAM	34	0%
Other	132	2%
Total	7830	100%

Prior Autologous Transplant	N	Percent
No	6777	87%
Yes	1053	13%
Total	7830	100%

Conditioning Intensity (Leukemia only)	N	Percent
Non-myeloablative / RIC	1626	28%
Myeloablative	4164	72%
Unknown	3	0%
Total	5793	100%

Conditioning Intensity (NHL only)	N	Percent
Non-myeloablative / RIC	543	62%
Myeloablative	329	38%
Total	872	100%

Conditioning Intensity (HL only)	N	Percent
Non-myeloablative / RIC	229	82%
Myeloablative	50	18%
Total	279	100%

Conditioning Intensity (PCD only)	N	Percent
Non-myeloablative / RIC	149	85%
Myeloablative	27	15%
Total	176	100%

Conditioning Intensity (OMD only)	N	Percent
Non-myeloablative / RIC	51	89%
Myeloablative	5	9%
Unknown	1	2%
Total	57	100%

T-cell lineage (ALL)	N	Percent
Non T-cell lineage	1131	87%
T-cell lineage	163	13%
Total	1294	100%

Sensitivity to Chemotherapy (NHL only)	N	Percent
Sensitive	490	56%
Resistant	280	32%
Unknown	102	12%
Total	872	100%

Duration of CR1 (AML, ALL > CR1)	N	Percent
≤ 6 months	765	36%
> 6 months	1350	63%
Missing	26	1%
Total	2141	100%

WBC at diagnosis (AL only)	N	Percent
High (≥ 100)	426	11%
Low (< 100)	2781	74%
Missing	546	15%
Total	3753	100%

Cell Dose (10⁸/kg): Bone Marrow only	N	Percent
≤ 1.7	914	27%
1.7–3.2	1135	34%
> 3.2	1287	39%
Missing	6	0%
Total	3342	100%

Cell Dose (10⁸/kg): PBSC only	N	Percent
≤ 3.2	1036	26%
3.2–5.5	1240	31%
> 5.5	1493	37%
Missing	276	7%
Total	4045	100%

Cell Dose (10⁸/kg): Cord Blood only	N	Percent
≤ 0.25	109	25%
> 0.25	322	73%
Missing	12	3%
Total	443	100%

^a Donor-recipient HLA match for PBSC and BM was defined as follows:
 Well-matched: categories 1,7,10 and 16
 Partially matched categories 2,3,8,11,13,17,21
 Mismatched categories 4,5,6,9,12,14,18,22,23,24,25

HLA categories

-
- 1 Matched 8/8 at high-res HLA-A, -B, -C and -DRB1
 - 2 Single allele MM (7/8) at high-res HLA-A, -B, -C and -DRB1
 - 3 Single antigen MM (7/8) at high-res HLA-A, -B, -C and -DRB1
 - 4 ≥2 allele MM (<7/8) at high-res HLA-A, -B, -C and -DRB1
 - 5 ≥2 MM with 1 antigen MM (<7/8) at high-res HLA-A, -B, -C and -DRB1
 - 6 ≥2 MM with 2 or more antigen MM (<7/8) at high-res HLA-A, -B, -C and -DRB1
 - 7 Matched 8/8 at high-res HLA-A, -B and -DRB1 and low-res at HLA-C
 - 8 Single MM (7/8) at high-res HLA-A, -B and -DRB1 and low-res at HLA-C
 - 9 ≥2 MM (<7/8) at high-res HLA-A, -B and -DRB1 and low-res at HLA-C
 - 10 Matched 8/8 at low-res HLA-A, -B and -C and high-res at HLA-DRB1
 - 11 Single MM (7/8) at low-res HLA-A, -B and -C and high-res at HLA-DRB1
 - 12 ≥2 MM (<7/8) at low-res HLA-A, -B and -C and high-res at HLA-DRB1
 - 13 Matched 8/8 at low-res HLA-A, -B and -C and -DRB1
 - 14 Single MM (7/8) at low-res HLA-A, -B and -C and -DRB1
 - 15 ≥2 MM (<7/8) at low-res HLA-A, -B and -C and -DRB1
 - 16 Matched 6/6 at high-res HLA-A, -B and -DRB1 (HLA-C unknown)
 - 17 Single allele MM (5/6) at high-res HLA-A, -B and -DRB1 (HLA-C unknown)
 - 18 Single antigen MM (5/6) at high-res HLA-A, -B and -DRB1 (HLA-C unknown)
 - 19 ≥2 allele MM (<5/6) at high-res HLA-A, -B and -DRB1 (HLA-C unknown)
 - 20 ≥2 MM with 1 antigen MM (<5/6) at high-res HLA-A, -B and -DRB1 (HLA-C unk.)
 - 21 Matched 6/6 at low-res HLA-A and -B and high-res at HLA-DRB1 (HLA-C unknown)
 - 22 Single MM (5/6) at low-res HLA-A and -B and high-res at HLA-DRB1 (HLA-C unk.)
 - 23 ≥2 MM (<5/6) at low-res HLA-A and -B and high-res at HLA-DRB1 (HLA-C unk.)
 - 24 Matched (6/6) at low-res HLA-A and -B and -DRB1 (HLA-C unknown)
 - 25 Single MM (5/6) at low-res HLA-A and -B and -DRB1 (HLA-C unknown)
 - 26 Two MM (4/6) at low-res HLA-A and -B and -DRB1 (HLA-C unknown)
 - 27 Three MM (3/6) at low-res HLA-A and -B and -DRB1 (HLA-C unknown)
-

Figure 1: Disease — Disease Stage Distribution among 7,830 Transplanted Recipients

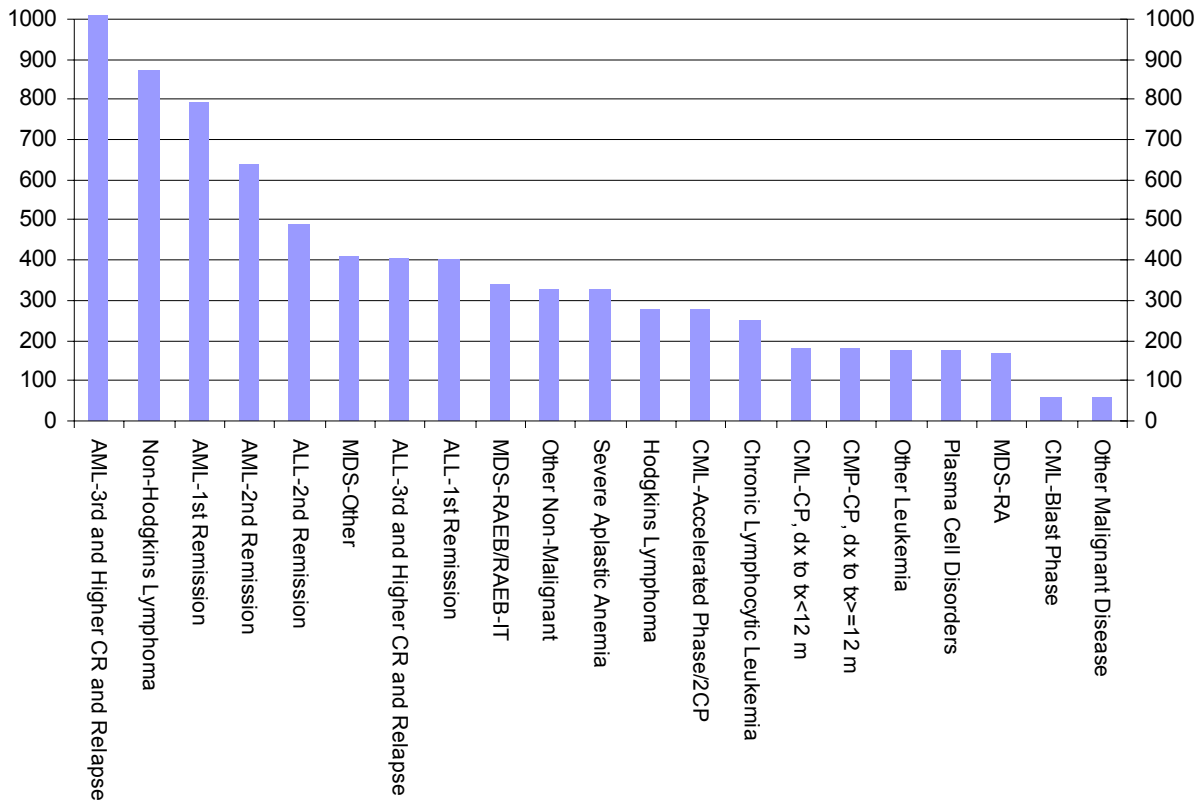


Table 4: Risk Factors for Survival

* – A missing outcome for this variable was collapsed or “imputed” into this category, representing either the median or the mode of the observations. This was done to eliminate unstable parameter estimates from small sample sizes for the missing category, which would result in a poor or unstable prediction for a recipient with that variable missing.

^a – An odds ratio greater than 1.00 denotes a higher relative one year survival probability.

Disease — Stage	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
AML – 1st remission	795	1.00			
AML – 2nd remission	639	0.75	0.59	0.97	0.030
AML – 3rd and higher CR and relapse	1025	0.34	0.27	0.42	0.000
CML – CP, dx to tx < 12 months	180	1.67	1.15	2.43	0.007
CMP – CP, dx to tx ≥ 12 months	180	1.10	0.78	1.56	0.589
CML – Accelerated phase / 2 CP	276	0.88	0.66	1.18	0.401
CML – Blast phase	58	0.55	0.30	0.99	0.046
ALL – 1st remission	400	1.10	0.85	1.43	0.480
ALL – 2nd remission	488	0.61	0.45	0.81	0.001
ALL – 3rd and higher CR and relapse	406	0.30	0.23	0.41	0.000
Chronic lymphocytic leukemia	253	1.03	0.76	1.38	0.869
Other leukemia	176	0.80	0.56	1.14	0.222
MDS – RA	166	1.04	0.73	1.48	0.835
MDS – RAEB/RAEB-IT	341	0.73	0.56	0.96	0.022
MDS – other	410	0.78	0.61	1.00	0.049
Non-Hodgkin lymphoma	872	0.59	0.44	0.80	0.001
Hodgkin lymphoma	279	1.35	0.96	1.90	0.089
Plasma cell disorders	176	0.94	0.64	1.38	0.763
Other malignant disease	57	0.18	0.10	0.36	0.000
Severe aplastic anemia	326	1.22	0.91	1.63	0.183
Other non-malignant	327	0.83	0.60	1.13	0.229

Recipient Age at Transplant	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
0–10 years	1084	1.00			
11–17 years	663	0.68	0.54	0.86	0.001
18–30 years	1267	0.69	0.56	0.85	0.000
31–40 years	1105	0.58	0.47	0.73	0.000
41–50 years	1500	0.50	0.40	0.62	0.000
51–60 years	1638	0.45	0.36	0.56	0.000
> 60 years	573	0.37	0.28	0.48	0.000

Donor Age at Donation	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
18–30 years	2342	1.00			
31–45 years	3857	0.86	0.77	0.96	0.007
≥ 46 years	1188	0.87	0.75	1.01	0.076

HLA Match Status (PB and BM only) (Best available typing at HLA-A,-B,-C, -DRB1)	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
Well-matched *	4647	1.00			
Partially matched	1986	0.71	0.63	0.79	0.000
Mismatched	754	0.41	0.35	0.50	0.000

HLA Match Status (CB only) (Serological at HLA-A,-B; allele at -DRB1)	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
6 of 6	72	1.00			
5 of 6	164	0.83	0.45	1.51	0.535
≤ 4 of 6	179	0.87	0.48	1.59	0.647
Double cord	28	0.72	0.28	1.83	0.485

Recipient CMV Status	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
Negative	3501	1.00			
Positive	4266	0.84	0.76	0.92	0.000
Unknown	63	0.74	0.44	1.25	0.260

Recipient Race	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
Caucasian	6840	1.00			
African American	454	0.71	0.57	0.87	0.001
Asian / Pacific Islander	165	0.89	0.64	1.25	0.517
Hispanic	182	0.59	0.42	0.84	0.003
Other / Unknown	189	0.76	0.55	1.03	0.074

Coexisting Disease	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
Absent	3834	1.00			
Present	3996	0.78	0.71	0.86	0.000

Karnofsky / Lansky Score at Transplant; Prior Autologous Transplant	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
90–100; no prior auto	4301	1.00			
< 90; no prior auto	1696	0.60	0.53	0.68	0.000
Score missing; no prior auto	780	0.94	0.80	1.11	0.472
90–100; prior auto	600	0.89	0.72	1.11	0.296
< 90; prior auto	326	0.32	0.24	0.43	0.000
Score missing; prior auto	127	0.61	0.41	0.90	0.013

Cell Dose (10 ⁸ /kg)	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
Marrow, ≤ 1.7	914	1.00			
Marrow, 1.7–3.2 *	1141	1.15	0.95	1.40	0.141
Marrow, > 3.2	1287	1.32	1.10	1.60	0.004
PBSC, ≤ 3.2	1036	1.10	0.90	1.35	0.337
PBSC, 3.2–5.5	1240	1.32	1.09	1.61	0.005
PBSC, > 5.5	1493	1.18	0.98	1.43	0.080
PBSC, cell dose missing	276	1.37	1.01	1.85	0.041
Cord blood, ≤ 0.25	109	0.61	0.32	1.18	0.141
Cord blood, > 0.25 *	334	0.77	0.44	1.34	0.355

Year of Transplant	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
2001	1167	1.00			
2002	1420	1.10	0.92	1.30	0.294
2003	1566	1.36	1.15	1.61	0.000
2004	1757	1.32	1.12	1.56	0.001
2005	1920	1.63	1.38	1.94	0.000

Conditioning Regimen Intensity (Leukemia only)	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
Myeloablative *	4167	1.00			
Non-myeloablative / RIC	1626	1.13	0.97	1.31	0.111

Conditioning Regimen Intensity (NHL, HL, PCD and other malignant diseases)	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
Myeloablative	411	1.00			
Non-myeloablative / RIC *	972	2.58	1.90	3.50	0.000

Non-Hodgkin Lymphoma	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
Sensitive	490	1.00			
Resistant	280	0.46	0.33	0.64	0.000
Unknown	102	0.75	0.47	1.20	0.231

ALL and AML in 1 st Complete Remission	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
≤ 6 months ‡	767	1.00			
> 6 months ‡	1374	1.38	1.15	1.66	0.001

‡ Missing data were imputed into the median category based on disease and disease status

T-cell Lineage (ALL only)	N	Odds Ratio ^a	95% Confidence Interval		p-value
			Lower	Upper	
Non T-cell lineage	1131	1.00			
T-cell lineage	163	0.68	0.47	0.97	0.032

Table 5: Center-Specific Results

Anonymous Center Number	N	Risk Group	Survival		95% Confidence Interval		Performance Interval			
			Actual	Predicted	Lower ¹	Upper ¹	2003	2005	2006	2007
2059	17	1	11.6%	57.8%	35.3%	82.4%	0	-1	-1	-1
2124	81	1	65.4%	60.3%	50.6%	70.4%	-1	0	0	0
2145	85	1	60.1%	58.1%	48.2%	68.2%	0	0	0	0
2193	32	4	38.1%	46.9%	31.3%	62.5%	-1	0	0	0
2218	40	3	27.2%	53.1%	37.5%	67.5%	0	0	-1	-1
2235	50	3	58.1%	50.1%	38.0%	62.0%		0	0	0
2284	8	5	0.0%	37.0%	12.5%	75.0%	0	0	0	-1
2314	54	4	49.8%	46.1%	33.3%	57.4%	0	-1	0	0
2497	4	1	25.0%	57.7%	0.0%	100.0%	0	0	0	0
2555	63	2	44.4%	54.5%	42.9%	66.7%	0	0	0	0
2600	15	5	53.4%	41.7%	20.0%	66.7%	-1	0	0	0
2623	23	1	39.2%	57.6%	39.1%	78.3%	0	0	0	0
2625	50	1	53.9%	58.5%	46.0%	72.0%	1	0	0	0
2642	89	4	54.9%	48.8%	39.3%	58.4%	0	0	0	0
2819	17	3	52.9%	49.8%	29.4%	70.6%	0	0	0	0
2840	72	2	65.0%	56.4%	45.8%	66.7%	0	0	0	0
2855	33	3	45.4%	48.5%	33.3%	63.6%	0	0	0	0
2930	113	1	49.5%	57.0%	47.8%	65.5%			0	0
3113	7	1	56.9%	58.4%	28.6%	85.7%				0
3415	22	5	18.1%	40.3%	22.7%	59.1%	0	0	0	-1
3506	39	1	56.5%	58.9%	43.6%	74.4%	0	0	0	0
3558	60	1	53.0%	57.5%	45.0%	70.0%	-1	0	0	0
3665	127	1	66.1%	60.5%	52.8%	68.5%	0	0	0	0
3806	21	5	33.2%	45.1%	23.8%	66.7%		0	0	0
3934	11	5	45.4%	45.4%	18.2%	72.7%		0	0	0
3982	27	4	33.3%	49.3%	33.3%	66.7%	0	0	0	0
4000	101	4	52.4%	48.8%	39.6%	57.4%	0	1	0	0
4166	50	2	60.0%	53.7%	40.0%	66.0%	0	0	0	0
4238	39	5	35.9%	44.1%	28.2%	59.0%	0	0	0	0
4284	62	4	38.6%	47.1%	35.5%	58.1%	0	0	0	0
4288	13	1	53.6%	61.9%	38.5%	84.6%		0	0	0
4346	251	4	50.5%	48.4%	42.2%	54.2%	0	0	0	0
4350	181	4	60.5%	47.4%	40.9%	54.1%	0	0	0	1

Anonymous Center Number	N	Risk Group	Survival		95% Confidence Interval		Performance Interval			
			Actual	Predicted	Lower ¹	Upper ¹	2003	2005	2006	2007
4461	22	2	49.9%	54.3%	36.4%	72.7%	0	0	0	0
4487	30	3	59.5%	49.1%	33.3%	66.7%	0	0	0	0
4507	2	1	49.8%	67.4%	0.0%	100.0%				0
4591	26	5	57.7%	42.6%	26.9%	61.5%		0	0	0
4620	54	3	42.6%	49.2%	37.0%	61.1%		0	0	0
4632	57	3	31.4%	50.9%	38.6%	63.2%	-1	-1	-1	-1
4645	7	2	85.8%	55.1%	28.6%	85.7%				1
4661	66	5	34.5%	44.0%	32.6%	56.1%	0	0	0	0
4760	23	5	47.6%	45.0%	26.1%	65.2%	0	0	0	0
4760	67	3	63.4%	51.7%	40.3%	62.7%	0		0	1
4798	90	2	57.5%	56.1%	46.7%	65.6%	0	0	0	0
4848	54	4	30.8%	47.0%	35.2%	59.3%	0	-1	-1	-1
4859	1	5	79.8%	29.7%	0.0%	100.0%				0
4862	223	3	46.9%	50.5%	44.4%	56.5%	1	0	0	0
4925	68	4	41.2%	49.1%	38.2%	60.3%	0	-1	-1	0
5035	76	3	59.0%	52.9%	42.1%	63.2%	0	0	0	0
5092	8	4	37.5%	47.7%	12.5%	75.0%	0	0	0	0
5203	31	4	29.0%	48.0%	32.3%	64.5%	-1	-1	-1	-1
5245	60	1	56.0%	60.8%	48.3%	71.7%	0	0	0	0
5381	15	2	49.2%	52.7%	26.7%	73.3%			0	0
5637	8	5	37.4%	33.9%	12.5%	62.5%		0	0	0
5700	28	2	41.4%	53.5%	35.7%	71.4%	0	0	0	0
5702	92	3	44.4%	48.8%	39.1%	58.7%	0	0	0	0
5724	170	2	50.5%	54.5%	47.1%	61.2%	0	0	0	0
5735	5	1	59.8%	73.7%	40.0%	100.0%			0	0
5763	198	5	47.5%	45.8%	39.4%	52.0%	0	0	0	0
5994	63	5	36.2%	43.9%	33.3%	55.6%	0	0	0	0
6119	39	1	53.0%	60.2%	46.2%	74.4%	0	0	0	0
6139	61	2	67.3%	53.1%	41.0%	65.6%	0	0	0	1
6152	41	3	53.2%	52.2%	36.6%	65.9%	0	0	0	0
6195	39	3	43.5%	53.0%	38.5%	66.7%	0	0	0	0
6254	23	4	39.1%	47.4%	30.4%	65.2%	0	0	0	0
6280	414	3	52.5%	49.3%	44.7%	53.9%	0	0	0	0
6310	164	2	59.2%	56.6%	49.4%	64.0%	0	1	0	0

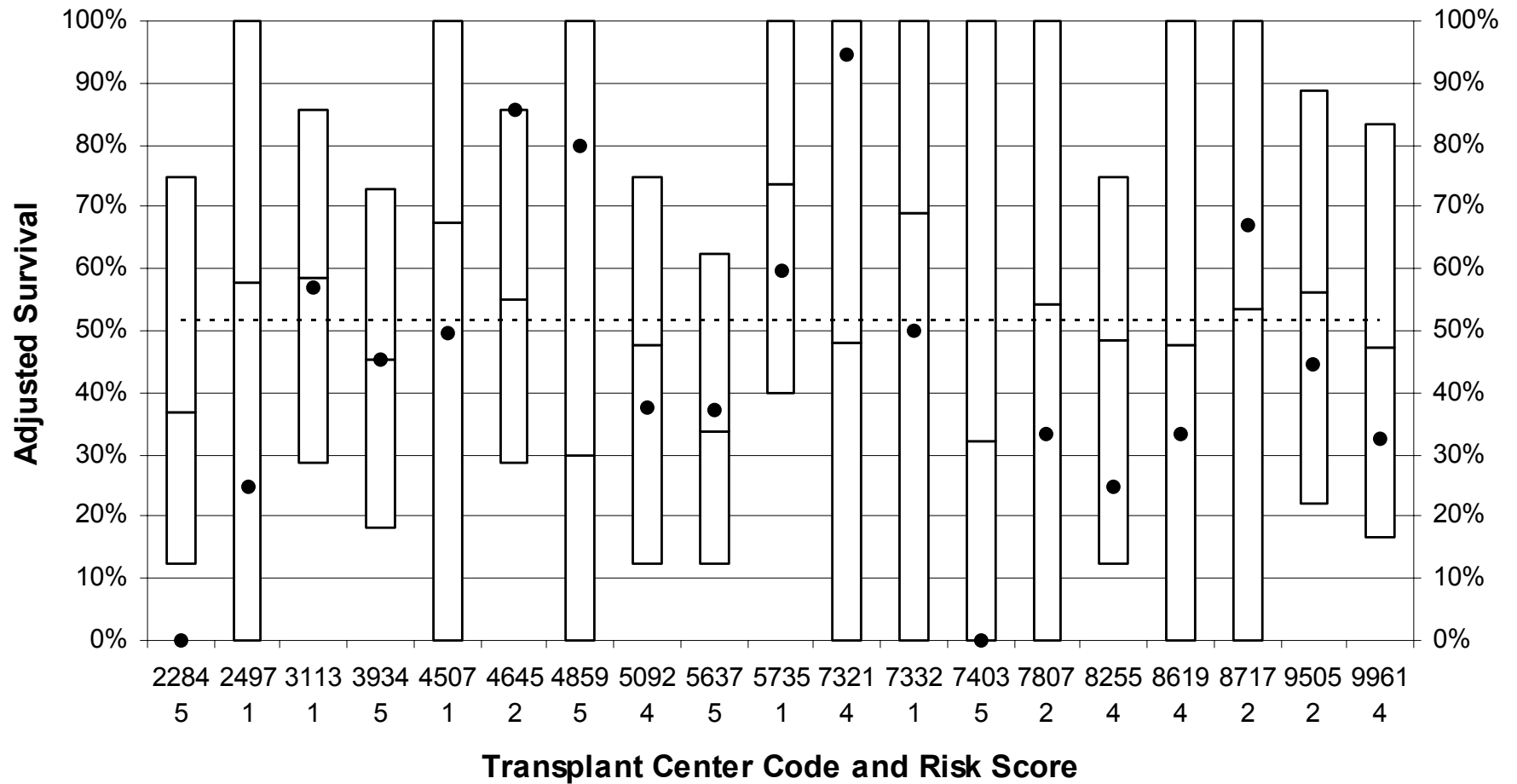
Anonymous Center Number	N	Risk Group	Survival		95% Confidence Interval		Performance Interval			
			Actual	Predicted	Lower ¹	Upper ¹	2003	2005	2006	2007
6537	13	1	69.4%	63.9%	38.5%	84.6%		0	0	0
6556	109	1	62.3%	68.1%	59.6%	76.1%	-1	0	0	0
6576	312	3	57.9%	48.9%	43.6%	54.2%	1	1	1	1
6663	80	2	57.4%	54.5%	43.8%	65.0%	0	0	0	0
6691	65	5	43.0%	40.2%	29.2%	50.8%	0	0	0	0
6709	14	1	70.1%	65.4%	42.9%	85.7%		0	0	0
6738	60	4	43.2%	47.4%	35.0%	60.0%	0	0	-1	0
6898	48	3	47.9%	52.2%	39.6%	66.7%	0	0	0	0
7118	34	2	59.0%	55.7%	41.2%	70.6%	0	0	0	0
7205	551	2	60.8%	53.7%	49.7%	57.5%	1	1	1	1
7207	21	5	42.0%	41.4%	23.8%	61.9%	0	0	0	0
7295	45	3	51.1%	48.9%	35.6%	62.2%		0	0	0
7297	42	3	47.6%	49.2%	35.7%	64.3%	0	0	0	0
7321	3	4	94.7%	47.9%	0.0%	100.0%				0
7332	2	1	49.9%	68.8%	0.0%	100.0%				0
7403	1	5	0.0%	32.0%	0.0%	100.0%				0
7404	24	3	45.8%	48.6%	29.2%	66.7%	-1	0	0	0
7531	100	4	38.0%	49.2%	40.0%	58.0%	0	-1	-1	-1
7635	135	4	50.8%	46.8%	39.3%	54.8%	0	0	0	0
7650	121	3	45.2%	49.3%	41.3%	57.9%	0	0	0	0
7651	21	5	32.8%	45.5%	28.6%	66.7%	0	-1	-1	0
7694	30	1	66.8%	64.2%	46.7%	80.0%	0	0	0	0
7748	34	5	32.2%	40.5%	26.5%	55.9%			0	0
7782	17	5	17.6%	40.7%	17.6%	64.7%	0	-1	-1	-1
7792	39	5	43.5%	46.0%	30.8%	61.5%	0	0	0	0
7800	39	5	51.3%	45.4%	30.8%	59.0%	0	0	0	0
7802	82	3	51.2%	50.4%	40.2%	59.8%	0	0	0	0
7807	3	2	33.4%	54.1%	0.0%	100.0%				0
7978	67	2	55.1%	53.9%	42.5%	65.7%	0	0	0	0
8045	61	2	52.4%	53.5%	41.0%	65.6%	0	0	0	0
8167	90	5	45.4%	43.0%	33.3%	52.2%	0	0	0	0
8204	78	1	53.8%	59.9%	48.7%	70.5%	0	0	0	0
8255	8	4	24.9%	48.6%	12.5%	75.0%	0	-1	-1	0
8513	32	4	31.1%	47.3%	31.3%	62.5%	0	0	0	-1

Anonymous Center Number	N	Risk Group	Survival		95% Confidence Interval		Performance Interval			
			Actual	Predicted	Lower ¹	Upper ¹	2003	2005	2006	2007
8533	79	4	43.0%	45.5%	35.4%	57.0%	0	0	0	0
8619	3	4	33.4%	47.6%	0.0%	100.0%			0	0
8625	95	2	58.6%	54.3%	45.3%	64.2%	0	0	0	0
8717	3	2	66.9%	53.6%	0.0%	100.0%		0	0	0
8949	15	2	73.5%	56.2%	33.3%	80.0%	0	0	0	0
8985	155	5	44.3%	44.9%	37.4%	52.3%	0	0	0	0
9187	52	3	36.5%	49.9%	38.5%	61.5%	0	-1	-1	-1
9274	158	2	60.7%	53.4%	46.2%	60.8%	0	0	0	0
9292	30	1	56.8%	58.6%	43.3%	73.3%	0	0	0	0
9505	9	2	44.5%	56.2%	22.2%	88.9%		0	0	0
9560	64	5	45.3%	45.1%	32.8%	56.3%	0	0	0	0
9563	148	3	42.6%	51.7%	44.6%	59.5%	1	0	-1	-1
9641	38	3	41.5%	53.1%	36.8%	68.4%	0	0	0	0
9660	63	4	45.8%	48.3%	36.5%	60.3%		0	0	0
9714	302	2	60.3%	54.1%	48.7%	59.6%	0	1	0	1
9752	21	2	66.7%	55.9%	33.3%	76.2%	-1	-1	0	0
9889	26	4	42.3%	47.6%	30.8%	65.4%	0	0	0	0
9961	6	4	32.6%	47.4%	16.7%	83.3%	0	0	0	0
Overall	7,830		51.5%	51.3%						

¹ 95% Confidence Limits derived by bootstrapping method via 10,000 Monte Carlo dataset simulations

Figure 2a: Center-Specific Results

Adjusted Survival Rates for Transplant Centers with 1–11 Transplants Adjusted Survival with 95% Confidence Interval

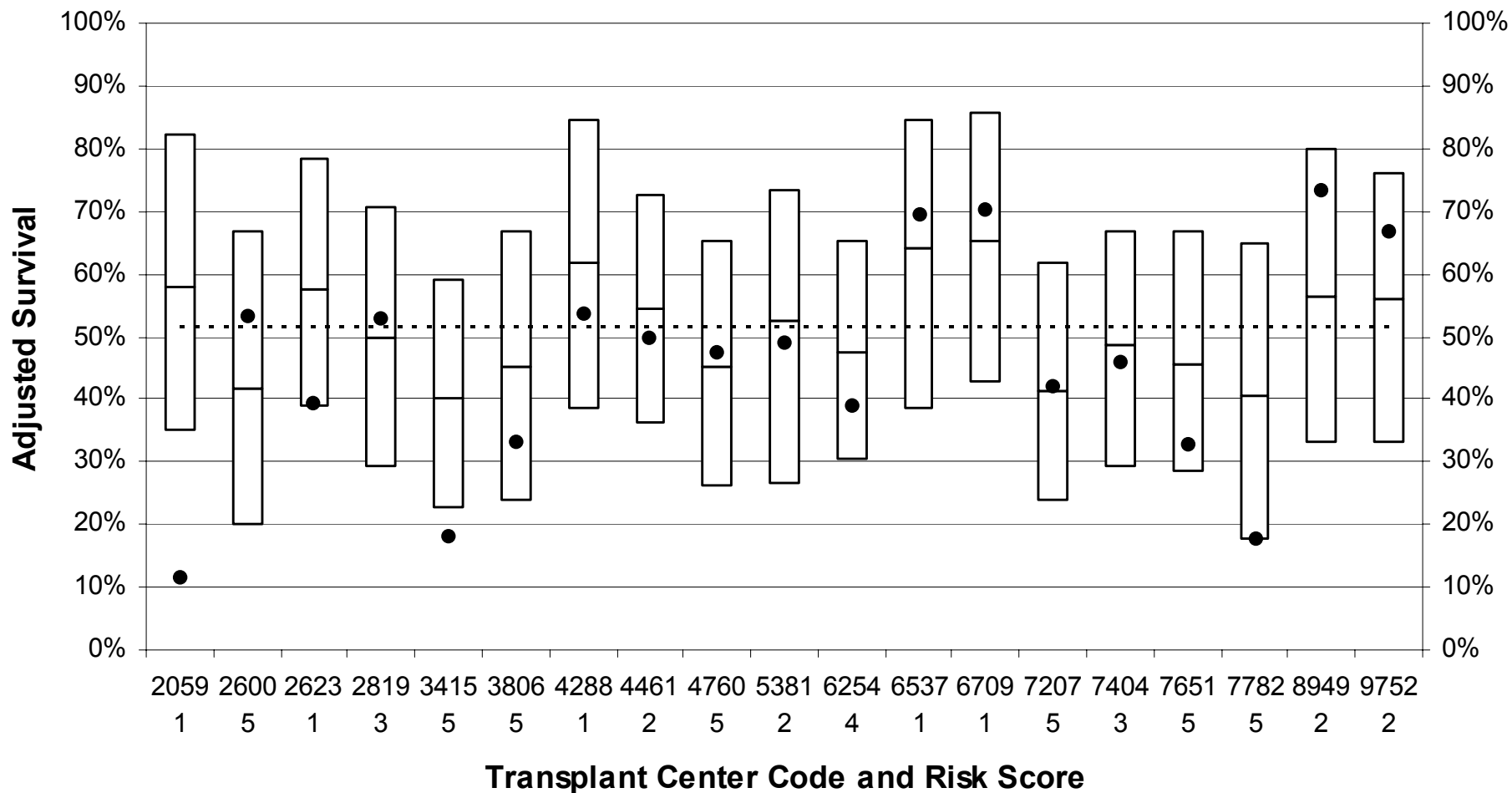


Dashed line indicates overall network survival rate of 51.5%. A dot below (above) the box indicates an under (over)-performing center relative to the network.

Figure 2b: Center-Specific Results

Adjusted Survival Rates for Transplant Centers with 12–25 Transplants

Adjusted Survival with 95% Confidence Interval

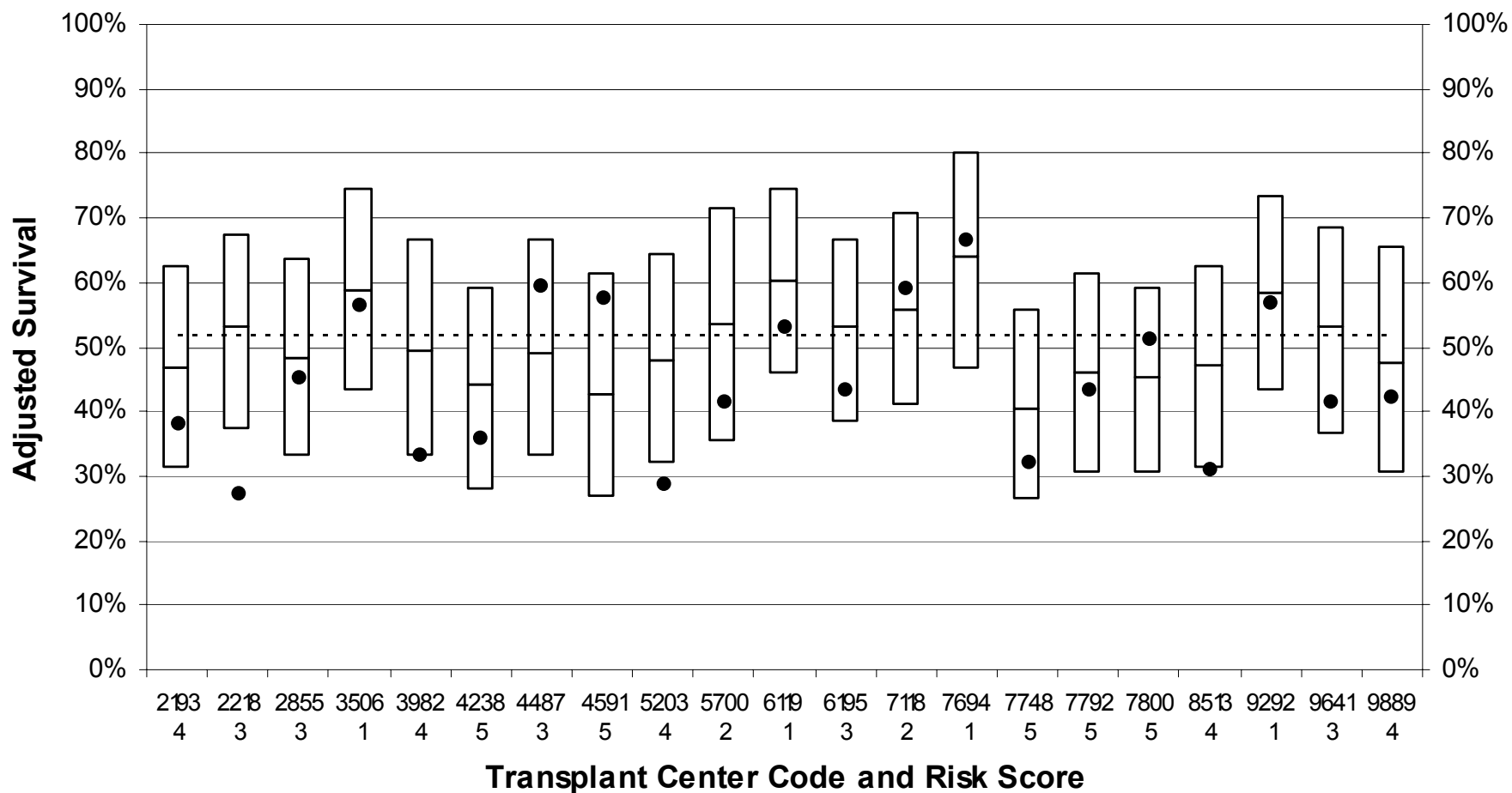


Dashed line indicates overall network survival rate of 51.5%. A dot below (above) the box indicates an under (over)-performing center relative to the network.

Figure 2c: Center-Specific Results

Adjusted Survival Rates for Transplant Centers with 26–40 Transplants

Adjusted Survival with 95% Confidence Interval

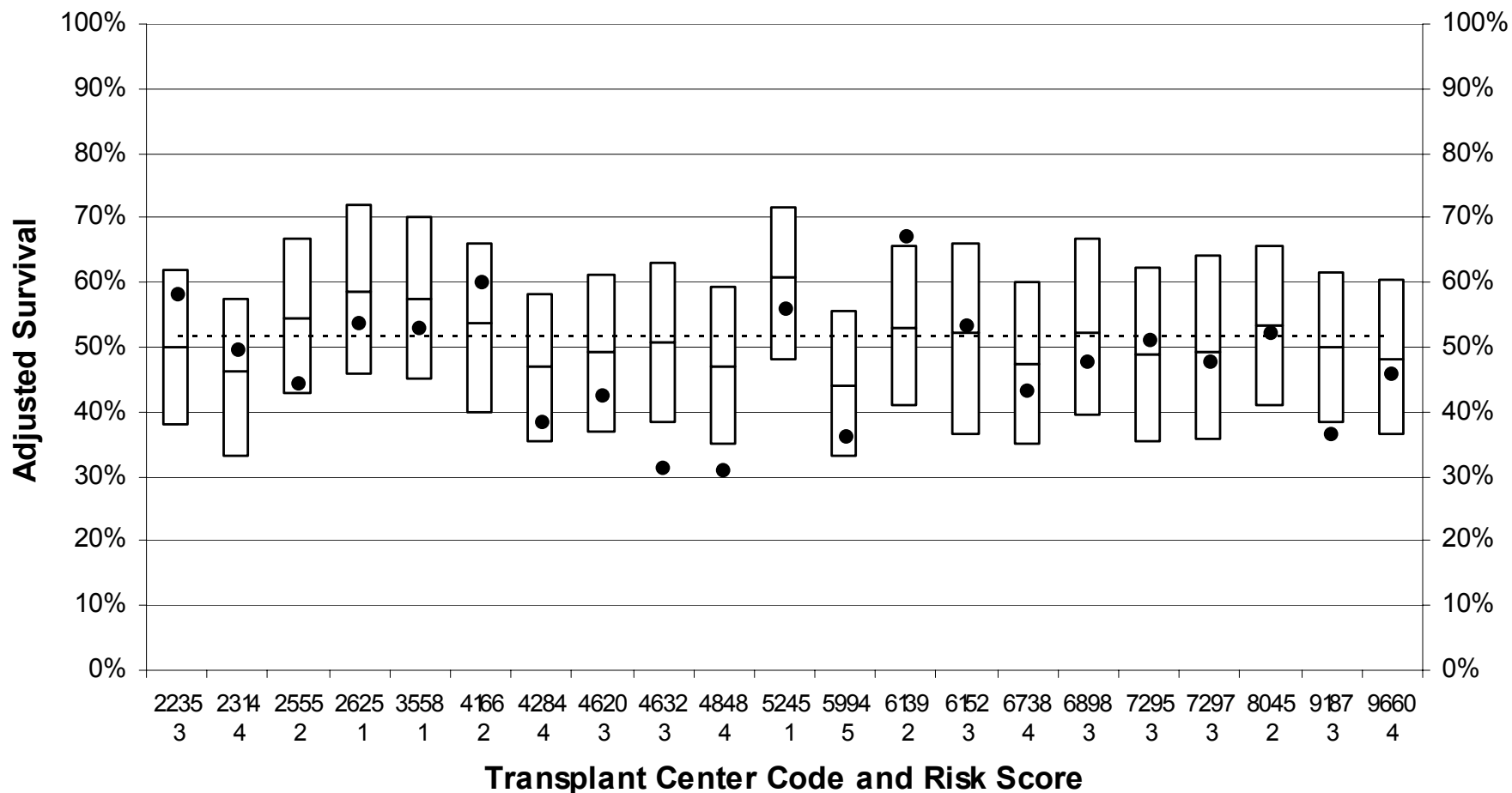


Dashed line indicates overall network survival rate of 51.5%. A dot below (above) the box indicates an under (over)-performing center relative to the network.

Figure 2d: Center-Specific Results

Adjusted Survival Rates for Transplant Centers with 41–63 Transplants

Adjusted Survival with 95% Confidence Interval

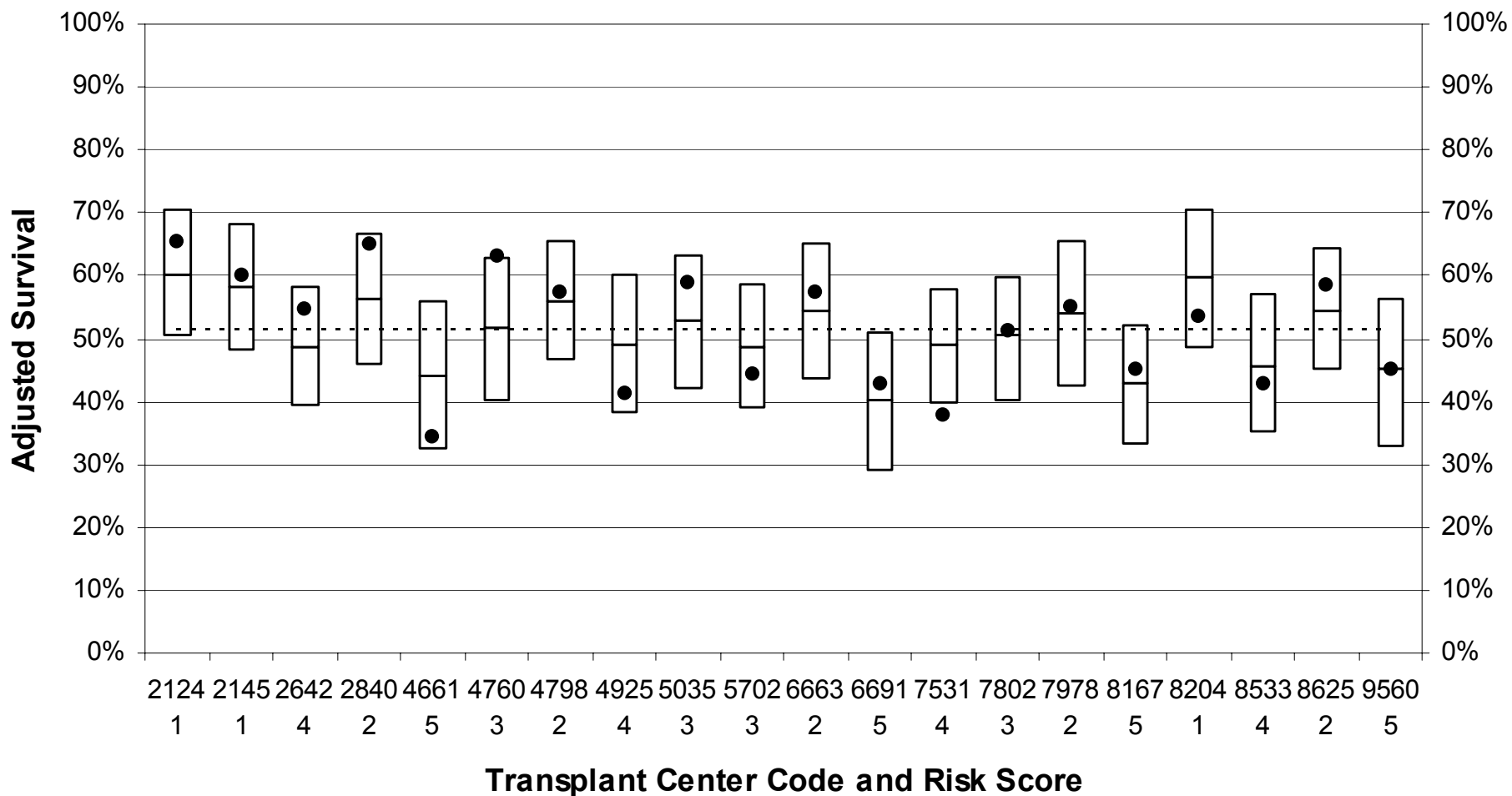


Dashed line indicates overall network survival rate of 51.5%. A dot below (above) the box indicates an under (over)-performing center relative to the network.

Figure 2e: Center-Specific Results

Adjusted Survival Rates for Transplant Centers with 64–100 Transplants

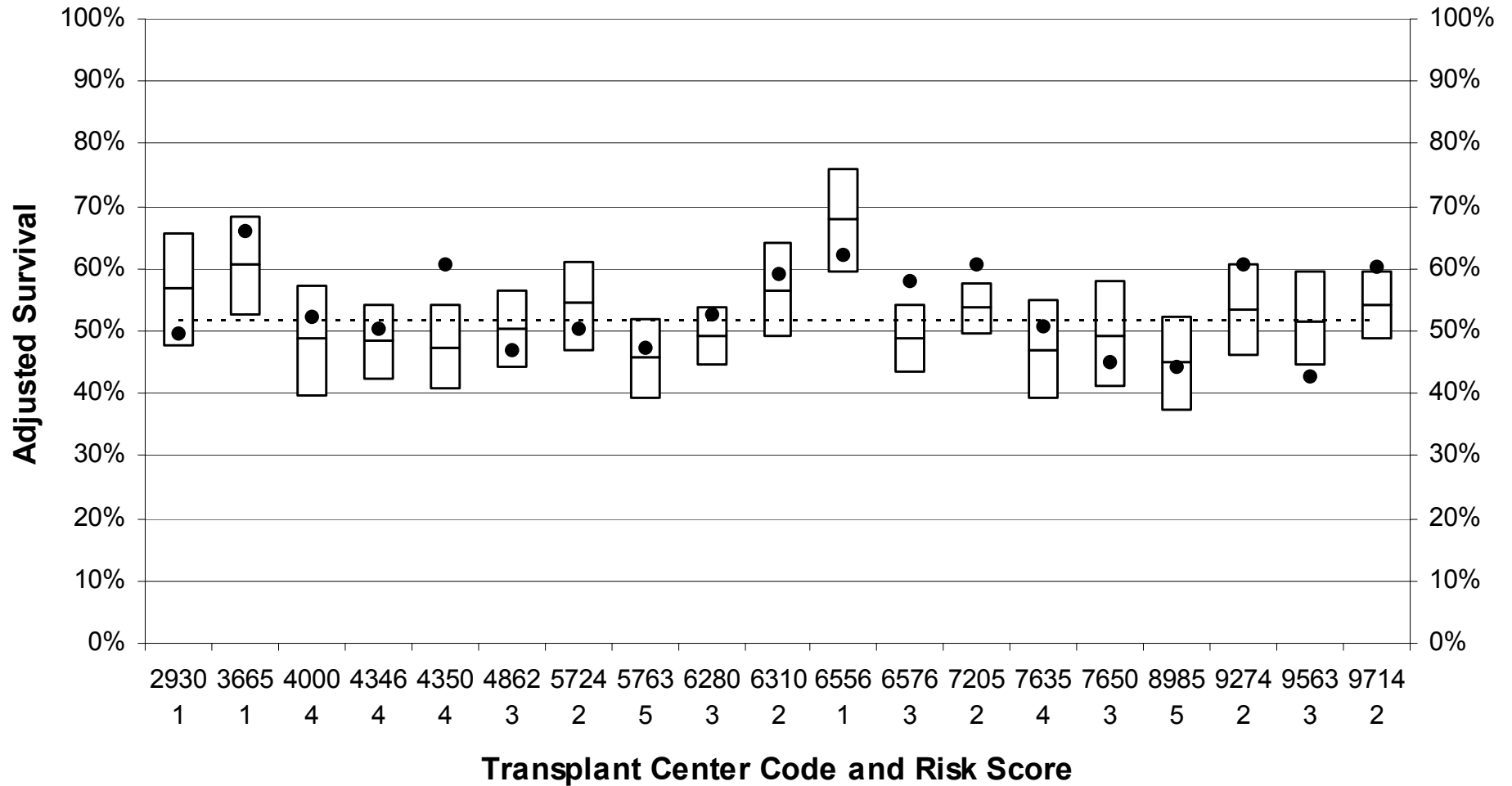
Adjusted Survival with 95% Confidence Interval



Dashed line indicates overall network survival rate of 51.5%. A dot below (above) the box indicates an under (over)-performing center relative to the network.

Figure 2f: Center-Specific Results

Adjusted Survival Rates for Transplant Centers with More Than 100 Transplants Adjusted Survival with 95% Confidence Interval



Dashed line indicates overall network survival rate of 51.5%. A dot below (above) the box indicates an under (over)-performing center relative to the network.

APPENDIX 1.

Proposed Preamble Language for Center-Specific Directory

1. What is the recipient and unrelated donor HLA matching level required at this center?

HLA are proteins that are present on most cells of the body. These antigens help characterize each individual's tissue type. The HLA-A, -B, -C and -DR proteins are important in matching recipients and donors for a blood stem cell transplant. A person inherits a complete set (HLA-A, -B, -C, and -DR) from each parent, for a total of eight proteins.

When a transplant center looks at the match level, it is looking at how alike the tissues of the recipient and the donor are. The NMDP's minimum match requirement is at least 5 of 6 antigens for HLA types: -A, -B, and -DR. Some transplant centers will consider additional HLA antigens in donor selection.

Different transplant centers accept different levels of HLA matching. The minimum match level required by a specific transplant center can be found on the first page under "Match Criteria." A sample of this section can be found in Appendix 2.

2. What is the time period covered in this analysis for transplanted recipients?

The center specific analysis covers only recipients who received their transplants between January 1, 2001 and December 31, 2005. It includes data on transplant outcomes through one year post-transplant. All transplant recipients were included in the analysis whose donor's cells came from bone marrow, peripheral blood stem cell or cord blood products. This analysis presents results on recipients with at least one-year minimum follow-up after transplantation. In order to provide at least one year of follow-up, recipients transplanted more recently could not be included. Similarly, excluding recipient transplants from the earlier years (for example 2001 and 2002), while it would make the analysis more current, would limit the ability to detect statistically meaningful differences¹.

3. What do the statistics mean for different transplant centers?

This guide can help potential transplant recipients compare survival rates at all United States NMDP transplant centers. Under each transplant center's individual listing you will find a box labeled "Center Specific Analysis."

This analysis considered many recipient-specific factors, such as age, diagnosis, disease stage, general health, etc., known to influence transplant survival. Based on these factors and the actual transplant results, the analysis calculated the impact of each risk factor upon survival. This information then allowed us to calculate the "average" risk of the recipient population at each transplant center. Centers were subsequently divided into five equally-sized groups, based on the average risk of

¹ In statistical terms, the ability to detect a difference is called "power." In general, the higher the number of cases for analysis, the higher the power. So this analysis needed to strike a balance between having enough recipients included for sufficient statistical power and "examining data on recent recipient outcomes."

recipients at that center, with the groups ranked from lowest average risk (risk level low) to highest average risk (risk level high)².

For each transplant center, you will find a summary paragraph displaying results that can help you compare its performance with that of other NMDP Transplant Centers.

4. Example Results paragraph:

This center had 80 recipients between January 1, 2001 and December 31, 2005, included in the analysis. The risk level of these recipients placed the center in the medium-high risk group. The estimated actual one-year survival of the 80 recipients was 40.0%. The center-specific analysis predicted a one-year survival for these recipients of 42.6%, with 95% statistical confidence that the predicted survival was between 32.5% and 52.5%. This center's actual results are similar to the predicted range. The national one year survival was 51.5% in the 7,830 recipients transplanted in the United States.

Three items in the results are specific for each center:

- 1) **The risk level.** This level refers to the average “risk” level of recipients treated at that transplant center. It is a measure of the recipient’s characteristics that predict better or worse survival after transplantation, not the risks of being treated at that center. It is measured on a scale from 1 to 5 (from low to medium-low to medium to medium-high to high). In the example, the transplant center has a risk level of “medium-high” meaning that this center has treated recipients whose disease is more aggressive, were older or had a less than perfectly matched unrelated donor. In contrast, a transplant center with a risk level of “low” treated a greater number of lower risk recipients who might have been younger recipients, in an early disease stage or had a perfectly matched donor. Centers treating larger numbers of children will usually have a lower risk level, even if their adults were of higher risk because the risk level is an adjusted average of all recipients treated at that center.
- 2) **The estimated actual one year survival rate of all recipients transplanted at the transplant center from January 1, 2001 – December 31, 2005.** This number reflects the percentage of recipients who are alive one year after transplant.
- 3) **The risk adjusted one-year survival rate.** This is the survival rate predicted by the center specific analysis adjusted for the mix of risk factors that can affect recipient survival. Examples of these types of factors include:
 - HLA matching
 - recipient age
 - CMV status

² This is not the same as asking whether it is “risky” to go to that center. This ranking is asking whether the recipients at that center had high risk characteristics that would affect success. Some centers are willing to offer transplants to higher risk or sicker recipients. The analysis adjusts for that approach as possible. The ability of individual recipients to influence their own risk level is limited; for example, age and diagnosis are characteristics that cannot be controlled. On the other hand, recipients may have limited influence over some factors, such as time from diagnosis to transplantation.

- overall health of the recipient before transplant
- disease and disease stage at transplant

The predicted one year survival rate represents the percent of this center's mix of recipients with various risk factors who would be alive at one year if they had all been transplanted at a "national average" transplant center. The confidence interval reflects the statistical certainty of this prediction (like a newspaper opinion poll where the results are accurate \pm a few percentage points).

If the center's estimated actual one-year survival falls within the calculated confidence interval, the results are stated to be similar to the predicted range. If the results are outside of the confidence interval, the center's results are stated to be either lower than or higher than the predicted range. Even for centers whose actual survival is outside the predicted range of survival for that center, there is an approximate 5% probability that this is attributable to random chance.

These statistics are only some of many important factors to be considered when selecting a transplant center.

For a more detailed explanation of the methods used to determine survival rates, please call the National Marrow Donor Program's Office of Patient Advocacy toll-free at 1 (888) 999-6743 or (612) 627-8140.

APPENDIX 2.

Sample of Match Criteria Section

UT Blood & Marrow Transplant Center #308

1331 Union Avenue
Suite 800
Memphis, TN 38104
Direct phone: (901) 722-0622
<http://www.utbmtc.org>

The UT Blood and Marrow Transplant Center is a state-of-the-art facility for cellular therapies. Outpatient and inpatient care are provided at Methodist University Hospital next to the University of Tennessee Cancer Institute. Guest rooms are available when needed.

Contact Information

If you have transplant-related questions, please contact Robin Tauer, transplant center coordinator, at (901) 722-0620, or by e-mail at rtauer@utcancer.com.

Program Type:	Adult (ages 18 to 80)
Match Level:	Standard HLA match level* for marrow or peripheral blood stem cell (PBSC) transplant with an unrelated donor: 10 of 10 match at A, B, C, DR and DQ antigens
<i>*The match level is a measure of how alike the tissues of the patient and the donor are. Please review this information with your doctor.</i>	A mismatch is allowed: on a case-by-case basis
	Minimum HLA match level for an unrelated cord blood transplant: 4 of 6 antigen match (for adult patients only)
Financial Services:	Resources for financial information
<i>Financial services at this center could include:</i>	If you have questions about costs and financial services at this transplant center, you can contact the center's financial representative, Daniel Stanton at (901) 516-7270 or by e-mail at stantond@methodisthealth.org .
<ul style="list-style-type: none">• Health insurance information• Financial assistance• Patient-related resources	Many organizations exist to help patients with lodging, transportation and other transplant-related expenses. Visit the NMDP's Patient Organizations database at www.marrow.org/resources for more information. Financial assistance resources are also listed in this guide.

Unrelated Donor Search & Other Pre-transplant Costs

Costs differ from transplant center to transplant center and from person to person. Costs depend on many factors, including your health insurance coverage. For this transplant center, pre-transplant costs could include (but are subject to change):

- Activation of formal search: \$700 - 1,860
- DR testing of donor (per donor): \$290 - 900
- CT typing (per sample): \$320 - 1,400
- Infectious Disease Marker (IDM) testing (per donor): \$200 - 2,280
- Marrow or PBSC procurement: \$24,420 - 41,250
- Cord blood procurement (including shipping cost): \$9,870 - 44,340
- Deposit *: \$0

The costs listed above are only a small part of the total cost of a transplant. Talk with the transplant center to learn more about the costs of the transplant itself and follow-up treatment.

**Coverage of anticipated donor search expenses not covered by the patient's insurance*

APPENDIX 3. Sample of Match Criteria Section

TC#405

Transplant Experience

This center has been performing allogeneic transplants since 1991 and has been an NMDP transplant center since June 1996.

Center Specific Analysis

1. This center had **136** patients transplanted from Jan. 1, 2000, through Dec. 31, 2004, using (unrelated) NMDP donors. A minimum one-year follow up for each patient was required for the statistical analysis.
2. The overall disease condition of patients treated at this center was in the medium-low category (2 on a scale of 1 to 5).
3. The estimated actual one-year survival of these patients was 46.7%.
4. Considering the various risk factors for patients treated at this center, the predicted one-year survival was 50.1% (with 95% statistical confidence that the predicted survival was between 41.9% and 58.1%).
5. This center's actual results are similar to the predicted range for this center. National one-year estimated actual survival was 48.5% in the 7,312 patients transplanted in the United States.

For help with understanding these statistics, please read page 4 of this guide called "Understanding the Statistics."

Transplants Performed (From Jan. 2000 - Dec. 2004)	Related Adult	Related Pediatric	Unrelated Adult	Unrelated Pediatric	Total
Allogeneic Marrow	12	29	56	17	114
Allogeneic PBSC	86	3	45	9	143
Cord Blood	0	2	1	11	14
Autologous Marrow or PBSC	255	39			294
Non-myeloablative transplants	29	0	12	0	41
Number of transplants, all types, for June 2005 - May 2006					151

To locate centers that perform cord blood transplants, visit www.marow.org/access and use the search tool.

The NMDP also has charts available showing the number of NMDP coordinated transplants by disease category at each U.S. transplant center. To request one of these charts, contact NMDP's Office of Patient Advocacy at 1 (888) 999-6743.

Survival by Patient Diagnosis and Age (marrow, PBSC and cord blood)

Number of NMDP transplant survivors at one year/total number of NMDP transplants performed during the period Jan. 2000 - Dec. 2004. The data also includes one year post-transplant follow-up through Dec. 2005. The number below includes only unrelated donor transplants, not autologous or related donor transplants.

KEY: CP = chronic phase (1st or 2nd) BP = blastic phase AP = accelerated phase
CR = complete remission (1st, 2nd, 3rd or more) RLPS = relapse PIF = primary induction failure

Diagnoses	0-10 Yrs	11-35 Yrs	36 Yrs and Older	Overall
Acute Bilineage Leukemia	--	1 2	--	1 2
Acute Lymphoblastic Leukemia 1CR	1 1	2 5	1 1	4 7
Acute Lymphoblastic Leukemia 2CR	2 5	2 5	--	4 10
Acute Lymphoblastic Leukemia 3+CR	--	0 1	--	0 1
Acute Lymphoblastic Leukemia PIF	--	--	0 1	0 1
Acute Lymphoblastic Leukemia RLPS	0 1	0 1	--	0 2
Acute Myelogenous Leukemia 1CR	--	5 6	8 15	13 21
Acute Myelogenous Leukemia 2CR	--	1 4	5 7	6 11
Acute Myelogenous Leukemia 3+CR/RLPS	--	1 3	1 3	2 6
Acute Myelogenous Leukemia PIF	--	0 1	1 2	1 3
Chronic Lymphocytic Leukemia	--	--	4 4	4 4
Chronic Myelogenous Leukemia 1CP	--	6 9	1 2	7 11
Chronic Myelogenous Leukemia 2CP	--	0 1	1 4	1 5
Chronic Myelogenous Leukemia AP	--	--	1 1	1 1
Familial Erythrophagocytic Lymphohistiocytosis	0 1	--	--	0 1
Glanzmann Thrombasthenia	1 1	--	--	1 1
Hodgkin's Disease	--	1 1	0 1	1 2
Hurler Syndrome	0 2	--	--	0 2
Juvenile Chronic Myelogenous Leukemia	1 4	--	--	1 4

(Chart continued on next page)

Glossary: Words to Know

Actual One-Year Survival — The percent of recipients who are alive one year after transplant at a specific center.

Predicted One-Year Survival — The statistically calculated percent of a specific center's recipients (including their particular mix of diseases, ages and risks) predicted to be alive at one year after transplant if that center's recipients were transplanted at a "national average" transplant center. This predicted survival also includes a calculated confidence interval showing that the results are accurate \pm a few percentage points (like a newspaper opinion poll).

Risk Level — This reflects the mix of clinical risk factors (like HLA match, age, disease and stage of disease and others) in the group of recipients treated at a specific center. It is shown on a five point integer scale from low (1) to medium-low (2) to medium (3) to medium-high (4) to high (5). It reflects the clinical features of the recipients treated, *not* whether it is "risky" to be treated at that center.