Future Trends in Hematopoietic Cell Transplantation (HCT)

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NMDP Chief Medical Officer
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Current and Future Trends

- Registries of adult donors and cord blood units are growing larger
- Transplant numbers are increasing
- Patient populations are changing
- Transplant survival is improving
World Marrow Donor Association - WMDA

- Association of adult donor registries and public cord blood banks engaged in international delivery of HCs
- Annual member survey assesses worldwide donor numbers and transplantation activity
- www.worldmarrow.org
Adult Donor Registries Reporting to WMDA

[Bar chart showing the number of registries from 1997 to 2006.]

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11/2007
Adult Donors Worldwide

![Graph showing the increase in the number of adult donors worldwide from 1997 to 2006. The graph indicates a steady increase each year, with the number of donors growing from 2.1 million in 1997 to 11.8 million in 2006. The graph also distinguishes between the total number of donors and the total number of ABDR typed donors.]
Cord Blood Banks Reporting to WMDA

![Graph showing the number of participating cord blood registries/banks from 1999 to 2006.](image)
Cord Blood Units Worldwide

![Bar graph showing the number of cord blood units worldwide from 1999 to 2006. The number of units increased from 44 in 1999 to 292 in 2006.]
National Marrow Donor Program
Adult Donors & CBUs– Sept 30, 2007

Adult Donors
6,856,150

Cord Blood Units
69,081
NMDP Transplants Facilitated by Fiscal Year 1987–2007

Year of Transplant

Number of Transplants

- Bone marrow
- Peripheral blood stem cells
- Cord blood

Graph showing the number of transplants facilitated by fiscal year, with bars indicating the number of bone marrow, peripheral blood stem cells, and cord blood transplants for each year from 1987 to 2007.
Worldwide Transplants Facilitated by Calendar Year 1997–2006

- Bone marrow
- Peripheral blood stem cells
- Cord blood

Year of Transplant: 1987 to 2007

Number of Transplants: 0 to 11000

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NMDP Grafts as a Percent of the WMDA Total
by Calendar Year 1997–2006

- Bone marrow
- Peripheral blood stem cells
- Cord blood
- All HCT grafts
Adult Donor Registries Reporting to WMDA

![Graph showing percentage of stem cell donations provided internationally and nationally from 1997 to 2006.]}
Current and Future Trends

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NMDP Transplant Recipients by Diagnosis

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NMDP Transplant Recipients by Diagnosis
More Transplant Recipients are Older

Transplant Patients ≥ 55 Years

- Percentage of All Transplants
- Number of Transplants

Year of Transplant:
- 1991
- 1992
- 1993
- 1994
- 1995
- 1996
- 1997
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005

Percentage:
- 0.0%
- 5.0%
- 10.0%
- 15.0%
- 20.0%
- 25.0%

Number of Transplants:
- 0
- 100
- 200
- 300
- 400
- 500
- 600
Transplant Recipients by Age Group
FY 2006 and FY 2007

Procurements by Age Group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>FY 2006</th>
<th>FY 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>514</td>
<td>600</td>
</tr>
<tr>
<td>11-18</td>
<td>307</td>
<td>358</td>
</tr>
<tr>
<td>19-30</td>
<td>495</td>
<td>534</td>
</tr>
<tr>
<td>31-40</td>
<td>394</td>
<td>428</td>
</tr>
<tr>
<td>41-50</td>
<td>545</td>
<td>574</td>
</tr>
<tr>
<td>Over 50</td>
<td>1035</td>
<td>1322</td>
</tr>
</tbody>
</table>
Transplant Recipients > 50 years Account for Most of the Growth

Procurements by Age Group

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<tr>
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Current and Future Trends

- Registries of adult donors and cord blood units are growing larger
- Transplant numbers are increasing
- Patient populations are changing
- Transplant survival is improving
Improving Survival: All Adults with Malignant Diseases

- These curves show statistically significant improvements in overall survival comparing 4 time periods with similar numbers of patients:
  - 1987 – 94: n = 1674
  - 1995 – 97: n = 1958
  - 1998 – 2000: n = 2185
  - 2001 – 2004: n = 1811
Improving Survival: Adults with High-Risk Malignant Diseases

- Similar results with a more dramatic impact of recent years are seen restricting the analysis to only High-risk adults
  - 1987 – 94: n = 807
  - 1995 – 97: n = 910
  - 2001 – 2004: n = 948
Improving Survival: Adults Aged 18 – 54 with Malignant Diseases

- Excluding patients over age 54 modestly improves survival compared the first set of curves, but note the rise in older patient numbers
  - 1987 – 94: n = 1666, excluded 8
  - 1995 – 97: n = 1897, excluded 61
  - 1998 – 2000: n = 2057, excluded 128
  - 2001 – 2004: n = 1550, excluded 261
Improving Survival: Adults with Non-Malignant Diseases

- These curves show statistically significant improvements in overall survival comparing 4 time periods with similar, but smaller numbers of patients with non-malignant diseases
  - 1987 – 94: n = 81
  - 1995 – 97: n = 56
  - 1998 – 2000: n = 70
  - 2001 – 2004: n = 82
Improving Survival: Pediatrics with Malignant Diseases

- These curves show statistically significant improvements in overall survival comparing 4 time periods with pediatric patients
  - 1987 – 94: n = 646
  - 1995 – 97: n = 666
  - 2001 – 2004: n = 657
Improving Survival: Pediatrics with Non-Malignant Diseases

- These curves show statistically significant improvements in overall survival comparing 4 time periods of pediatric patients with non-malignant diseases:
  - 1987 – 94: n = 225
  - 1995 – 97: n = 228
  - 1998 – 2000: n = 234
  - 2001 – 2004: n = 253
Further Evidence of Improving Survival

- Center-specific analysis – Evaluates one-year survival at all US transplant centers
- Employs a rolling 5-year window

<table>
<thead>
<tr>
<th>Report Year</th>
<th>Period</th>
<th>1-Year Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>1996-2001</td>
<td>42.2%</td>
</tr>
<tr>
<td>2006</td>
<td>2000-2004</td>
<td>48.8%</td>
</tr>
<tr>
<td>2007</td>
<td>2001-2005</td>
<td>51.5%</td>
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Monitoring Survival over Time -
PART: Program Assessment Rating Tool

- Initiative of the President’s Office of Management and Budget (OMB)
- Evaluates government programs on multiple measures
- Must include a Health Outcome Measure
- We proposed:
  - Aggregate 1-year survival for a defined subset of patients evaluated over time
PART: Program Assessment and Rating Tool

- Restricted to patients <50 years age
- Myeloablative regimens only
- Acute leukemias in any remission
- Chronic Myelogenous Leukemia
- MDS – RA or RARS only
- First analysis completed in May 2006
  - 5,432 recipients through December 31, 2003
Factors Considered in the Modeling for the PART Analysis

- Recipient age
- Recipient sex
- Recipient race
- Recipient CMV status
- Recipient BMI
- Disease and Stage
- Time from Dx to Tx
- Disease Risk
- Karnofsky/Lansky
- Coexisting disease
Current and Future Trends

- Registries of adult donors and cord blood units are growing larger
- Transplant numbers are increasing
- Patient populations are changing
- Transplant survival is improving
How Many Transplants Should We Be Doing?

- Approaches to an Answer:
  - Infer from the Matched Sibling Transplants
  - Infer from the Search Activity
  - Infer from knowledge of diseases

- These numbers are U.S.A. only!
The Likelihood of a Match Between Two Siblings is 25%
Probability of a Sibling Match

- Either you do or you don’t
  - Probability of a match = 1 – Probability of no match
- One sibling
  - Probability of a match = 1 – 0.75 = 25%
- Two siblings
  - Probability of a match = 1 – (0.75*0.75) = 44%
- Six siblings
  - Probability of a match = 1 – (0.75)^6 = 82%
- 1.3 siblings
  - Probability of a match = 1 – (0.75)^1.3 = 31%
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How Many Transplants Should We Be Doing?

- Infer from the Matched Sibling Transplants
  - CIBMTR estimates 3,500 matched sibling transplants annually in the U.S.
  - $3,500 / 0.3 = 11,667$ is the “Total Need”
  - $11,667 - 3,500 = 8,167$ are candidates for unrelated transplants
How Many Transplants Should We Be Doing?

- Infer from the Unrelated Donor Search Activity
  - NMDP received 7,249 U.S. preliminary searches in the past 12 months
NMDP Transplant Recipients by Diagnosis

AML | ALL | MDS | OL | CML | NHL | HL | IIS | SAA | Other

2006 | 2007

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How Many Transplants Should We Be Doing?

- Infer from the Knowledge of Diseases
  - Estimate the incidence of disease by age group
  - Calculate the number of new cases annually
  - Estimate those who are candidates for transplantation
  - Partition between sibling and unrelated
How Many Transplants Should We Be Doing?

- Approaches to an Answer:
  - Infer from the Matched Sibling Transplants = 8,167
  - Infer from the Search Activity = 7,249
  - Infer from knowledge of diseases = 8,500 – 10,000
How Many Transplants Should We Be Doing?

- Approaches to an Answer:
  - Infer from the Matched Sibling Transplants = 8,167
  - Infer from the Search Activity = 7,249
  - Infer from knowledge of diseases = 8,500 – 10,000

- None of these considers emerging indications

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Future Trends

- Registries of adult donors and cord blood units continue to grow
- Transplant numbers will increase, approaching 10,000 in the U.S. alone
- Patient populations will continue to evolve
- Successful transplantation will be the expectation
Worldwide Transplants Facilitated by Calendar Year 1997–2006

- Bone marrow
- Peripheral blood stem cells
- Cord blood

Year of Transplant

- 1997
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006

Number of Transplants

- 0
- 1000
- 2000
- 3000
- 4000
- 5000
- 6000
- 7000
- 8000
- 9000
- 10000
- 11000

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