Estimating Allogeneic Hematopoietic Cell Transplantation Unmet need

ESRI User Conference 2015
Kelsey Besse, Mary Senneka
About NMDP / Be The Match

Many people with life-threatening blood cancers like leukemia and lymphoma or other diseases, need a life-saving marrow or umbilical cord blood transplant.

Be The Match works with transplant centers to facilitate transplants for patients who need an unrelated donor.

Henry, transplant recipient
Transplants in the U.S. by Donor Type

Allogeneic Transplants
Estimating the Need for Transplant

70+ Diseases:
- Incidence by age – SEER and other sources
- Population – US Census
- Treatment protocols – NCCN guidelines
- Therapy success/failure – scientific literature, expert opinion

<table>
<thead>
<tr>
<th>Age</th>
<th>All Allogeneic Transplants per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 19</td>
<td>5.4</td>
</tr>
<tr>
<td>20 to 54</td>
<td>5.5</td>
</tr>
<tr>
<td>55 to 75</td>
<td>12.3*</td>
</tr>
</tbody>
</table>
The Need is Much Greater than Actual\textsuperscript{1}

- By applying the optimal transplant rate to the U.S. population (2012), the need for allogeneic (related and unrelated) transplant is 20,700 per year.
  - Adult (ages 20-74) – 16,100 per year
  - Pediatric (ages 0-19) – 4,600 per year
System Capacity Initiative

Understand and address institutional barriers and capacity of the health care system to meet the growing need for transplant.

- Three-year
- Multidisciplinary
  - Physician
  - Insurance
  - Infrastructure
  - Other health professionals
Regional Market Mapping

• Although useful for policy purposes, the national need analysis wasn’t helpful to transplant programs in assessing local need
  • What is the need in my market?
  • How is a market defined?
  • Are people leaving this market to get a transplant elsewhere?
  • What else can we learn about the unmet need?
Market Potential Analysis

• Concept:
  – Determine *unmet transplant demand* within individual U.S. geographic markets around transplant center(s)

• Purpose:
  – Visualize growth potential within individual markets to assist program/hospital administration in making informed decisions regarding BMT program expansion
  – Potentially visualize underserved markets within U.S. for additional consideration
  – Apply socioeconomic variables to identify general market barriers for strategic planning & initiatives (in progress)
Unmet Need Calculation by Market Area

- Geocode Patient ZIP code
  - Pediatrics (Ages 0-10)
  - Adult (Younger-Ages 20-54) (Older-Ages 55-74)
  - Tx per MA by age category

- Unmet Need

- Population by Custom age range
- Market Area Thessien Polygons

- SEER, Tx SMFs
  - Tx Incidence Rates
  - Need

National Marrow Donor Program
BE THE MATCH®
Percent Market Saturation, 20-74 years
(Actual / Calculated Demand)
Chicago- Adult Transplant Center and Market Area

<table>
<thead>
<tr>
<th>TRANSPLANT CENTER</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>355 CANCER TREATMENT CENTERS OF AMERICA</td>
<td></td>
</tr>
<tr>
<td>414 LOYOLA UNIVERSITY MEDICAL CENTER</td>
<td></td>
</tr>
<tr>
<td>432 UNIVERSITY OF ILLINOIS MEDICAL CENTER AT CHICAGO</td>
<td></td>
</tr>
<tr>
<td>442 NORTHWESTERN MEMORIAL HOSPITAL</td>
<td></td>
</tr>
<tr>
<td>557 UNIVERSITY OF CHICAGO HOSPITALS</td>
<td></td>
</tr>
<tr>
<td>587 RUSH UNIVERSITY MEDICAL CENTER</td>
<td></td>
</tr>
<tr>
<td>10880 ADVOCATE LUTHERAN GENERAL HOSPITAL</td>
<td></td>
</tr>
</tbody>
</table>
## Market Potential and Patient Flow

<table>
<thead>
<tr>
<th>Chicago</th>
<th>Ages 20-54</th>
<th></th>
<th></th>
<th>55-74</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transplant Demand</strong> = pop x (demand / 100,000)</td>
<td>307</td>
<td>310</td>
<td>311</td>
<td>251</td>
<td>272</td>
<td>279</td>
</tr>
<tr>
<td><strong>2013 Allogeneic</strong> Transplants (related + unrelated)</td>
<td>135</td>
<td>134</td>
<td>134</td>
<td>131</td>
<td>138</td>
<td>113</td>
</tr>
<tr>
<td><strong>Market Potential</strong> = demand - actual</td>
<td>172</td>
<td>176</td>
<td>177</td>
<td>120</td>
<td>134</td>
<td>166</td>
</tr>
<tr>
<td><strong>Percent of Tx:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“In” Market Area</td>
<td>66</td>
<td>78</td>
<td>75</td>
<td>73</td>
<td>80</td>
<td>76</td>
</tr>
<tr>
<td>“Out” of Market Area</td>
<td>18</td>
<td>11</td>
<td>18</td>
<td>14</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Not Assigned</td>
<td>16</td>
<td>11</td>
<td>7</td>
<td>13</td>
<td>9</td>
<td>13</td>
</tr>
</tbody>
</table>
Adult Patient Flow within Market Area
Transplant Demand

Chicago Market Area

<table>
<thead>
<tr>
<th>Year</th>
<th>20-54</th>
<th>55-74</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Allogeneic Transplants
- Unmet Need (Market Potential)
Market Area Patient Flow

Chicago Adults Ages 20-54

Percent Tx Volume

Patient Flow

2011  2012  2013
Market Area Patient Flow

Chicago Adults Ages 55-74

Percent Tx Volume

Patient Flow

Percentages and patient flow data for Chicago adults ages 55-74 from 2011 to 2013.
Adult Patient Distribution
Conclusions

• This analysis may prove to be an aid in capacity planning for regional healthcare
  – The model will work for other diseases or procedures

• May help transplant program directors access future staffing needs and access capital for investment in infrastructure and program development
The Impact

- Developing outreach programs with referring physicians
- Use to inform location of a satellite center outside current market
- National cancer program establishing centers to meet availability
- Working with administrators to garner funding to expand their programs
  - 3 Centers were awarded a combined $40 million FY2012

<table>
<thead>
<tr>
<th></th>
<th>Beds</th>
<th>MD FTE</th>
<th>HCT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>↑ 21%</td>
<td>↑ 19%</td>
<td>↑ 126%</td>
</tr>
</tbody>
</table>
Next Steps

• Further refine the model to determine the attributes of patients represented by the unmet need
  – Race and ethnicity
  – Health Insurance
  – SES

• Develop plans to meet the needs
  – Facility capacity
  – Programs to address SES


Questions or Comments

E-mail:
kbesse@nmdp.org
or
SystemCapacity@nmdp.org
### Supplemental Material

#### Estimating the Need

**Example: Acute myelogenous leukemia**

<table>
<thead>
<tr>
<th>Age in years</th>
<th>2012 U.S. Population</th>
<th>AML Incidence per 100,000</th>
<th>Estimated Annual New Diagnoses</th>
<th>Proportion eligible for HCT</th>
<th>Allo HCT Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pediatric 0-19</td>
<td>82,504,800</td>
<td>0.7</td>
<td>609</td>
<td>0.45</td>
<td>274</td>
</tr>
<tr>
<td>Adult 20-54</td>
<td>149,677,682</td>
<td>1.7</td>
<td>2,552</td>
<td>0.70</td>
<td>1,786</td>
</tr>
<tr>
<td>Adult 55-64</td>
<td>38,586,202</td>
<td>5.2</td>
<td>2,016</td>
<td>0.55</td>
<td>1,109</td>
</tr>
<tr>
<td>Adult 65-74</td>
<td>23,985,392</td>
<td>11.5</td>
<td>2,770</td>
<td>0.25</td>
<td>692</td>
</tr>
<tr>
<td>Total</td>
<td>294,754,076</td>
<td></td>
<td>7,947</td>
<td></td>
<td>3,861</td>
</tr>
</tbody>
</table>
1) Create BDS layer with desired variables (Business Analyst)
   Minority
   Individual Ages 0-74
   Total Population
   Total Income
   Total House Holds
   Total Health Care Expenditures
2) Export BDS layer to shapefile or featureclass
3) Create and calculate the following new columns:
   Ped-> sum counts for individual ages 0-19
   Adult 20-54->sum counts for individual ages 20-54
   Adult 55-74->sum counts for individual ages
4) Use model builder in ArcGIS to manipulate the data (see image below for example of Adult MA)
5) Create and calculate the following new columns by MA:
   Percent Minority->Minority/Total Population
   Average HH Income->Total Income/Total HH
   Average Health Care Expenditures-> Total Health   Expenditures/Total HH