Survival Benefit and Cost of Autologous Hematopoietic Stem Cell Transplantation in Elderly Patients with Multiple Myeloma using the SEER-Medicare Database

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Background

- Between 2005-2009, 40% auto HSCT in US on patients >60yr*

- From 2004 to 2007, most rapid increase in total hospital costs on BMT**
  - 2007: $1.3 billion spent on BMT
  - Medicare covered 12.5% of that cost = 90% increase

* CIBMTR, 2011, **AHRQ Stat Brief#82, 2009
Background – Cost Effectiveness

ICER = \( \frac{(COST \text{ new strategy} - COST \text{ current practice})}{(EFFECT \text{ new strategy} - EFFECT \text{ current practice})} \)

- \(<$50,000 = \) Cost effective
- \(>$100,000 = \) Cost prohibitive
Background – SEER-Medicare

• **Surveillance, Epidemiology and End Results**

• **Medicare**

• **Linkage first completed in 1991 and updated in 2011**
  – All Medicare eligible patients diagnosed with myeloma through 2007
  – Medicare claims through 2009.
Background - Medicare

- **Part A** - hospital, skilled-nursing facility, hospice and some home health care.
  - Almost all beneficiaries have

- **Part B** - physician and outpatient services.
  - 96% of Part A beneficiaries have

- **Part D** - prescription drug
  - 60% of Part A beneficiaries have
  - Only available between 2007-2009 in SEER-Medicare
Project Aims

• To determine the cost effectiveness of auto HSCT in patients with MM >65yr using the SEER Medicare database
Methods – Case Ascertainment

- Multiple Myeloma defined by SEER
- Diagnosis btw 10/1/01 – 12/31/07
- Age >65
- Transplanted Patients
  - Defined by ICD-9 and HCPCS code
- Non-transplanted Patients
  - No transplant code
  - Survive at least 180 days
  - Propensity score matching
Methods - Matching

- **Propensity Score Matching**
  - Age, gender, race, comorbidity, diagnosis year, SEER geographic region
  - 1:1 Greedy match
  - C-statistic
    - Goodness of fit of logistic regression models
    - Range from 0.5 (chance) to 1.0 (perfect match)
    - Reasonable if > 0.7, Strong >0.8
Methods

• Survival
  – 100-day, 1-yr, 3-yr, 5-yr
  – Followed up to 9 yrs
  – Kaplan-Meier and log rank

• Cost
  – 1st yr, Middle yrs, Last yr
  – Inflation adjusted to 2010 US$

• Cost-Effectiveness
  – 3% discounting annually
  – ICER and acceptability curve
Results

SEER-Medicare Myeloma
Diagnosed 2000-2007
N=30,517

Valid Date of Birth
N=26,963

Diagnosed at age >65
N=19,522

Part A & B FFS
N=12,803

Transplant Code
N=270
## Results - Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Transplant</th>
<th>No Transplant</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>270</td>
<td>270</td>
</tr>
<tr>
<td>Female %</td>
<td>40%</td>
<td>38%</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>88%</td>
<td>87%</td>
</tr>
<tr>
<td>Black</td>
<td>8%</td>
<td>9%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Asian</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Other</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Median Age (range)</td>
<td>68.6 (66-92)</td>
<td>68.7 (66-92)</td>
</tr>
<tr>
<td>Charlson Comorbidity Index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>63%</td>
<td>64%</td>
</tr>
<tr>
<td>1+</td>
<td>37%</td>
<td>36%</td>
</tr>
</tbody>
</table>

C-statistic = 0.873
Results - Survival

Median Survival: Transplant 58 mo vs Non Transplant 37mo
Median Survival after Transplant: 47 mo

Comparison Between Kaplan-Meier and Simulated Survival

p=0.0002
## Results – Cost Effectiveness

<table>
<thead>
<tr>
<th></th>
<th>Transplant</th>
<th>No Transplant</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discounted Life Years</td>
<td>4.94</td>
<td>3.57</td>
<td>1.37</td>
</tr>
<tr>
<td>Costs</td>
<td>$299,554</td>
<td>$199,973</td>
<td>$99,581</td>
</tr>
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</table>

ICER = $\frac{\Delta \text{Cost}}{\Delta \text{LY}} = \frac{$99,581}{1.37 \text{ years}} = $72,852/LY gained
Results – Cost Effectiveness

Cost Effectiveness Acceptability Curve, Transplant vs No Transplant

- Probability Cost-Effective
- Willingness to Pay for a Life Year

Transplant and No Transplant curves show the acceptability of each option at different willingness to pay levels.
Conclusions

• Survival after auto transplant in MM pts >65yr (47mo) is comparable to <60 yr (48mo*)

• Although more costly, Auto HSCT for MM >65 yr is cost effective with an ICER of $72,852 due to superior survival.

• Components of cost may help to determine where cost can be decreased

*Attal et al. NEJM 2003
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  – Kellie Sprague
  – Hedy Smith

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  – Aaron Winn
  – Pei-Jung Lin
  – Josh Cohen

• Conquer Cancer Foundation
Transplant Centers Reporting to SEER

- Mayo Clinic Arizona*
- CTI @ Scottsdale Healthcare*
- University of Arizona*
- Emory University
- Northside Hospital
- GA Health Sciences
- Alta-Bates
- City of Hope
- Loma Linda University
- Scripps Green Hospital
- UCSD
- Cedars-Sinai
- USC – Keck Medical Center
- UCLA
- Sutter Medical Center
- UC Davis
- UCSF
- Stanford
- Yale
- Henry Ford
- Karmanos Cancer Center
- Kapi’olani Medical Center
- University of Iowa
- Oklahoma University*
- Cancer Care Associates*
- University of Kentucky
- University of Louisville
- Tulane
- LSU
- Hackensack
- Robert Wood Johnson
- Seattle Cancer Care Alliance
- VA Puget Sound
- LDS Hospital
- University of Utah
- St. Frances Hospital Oklahoma*
### Cases by Seer Region

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<tr>
<th>Region</th>
<th>Transplant</th>
<th>No Transplant</th>
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<tbody>
<tr>
<td>Connecticut</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Detroit</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>Iowa</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>New Mexico</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Seattle</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Utah</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Kentucky</td>
<td>6%</td>
<td>7%</td>
</tr>
<tr>
<td>Louisiana</td>
<td>14%</td>
<td>13%</td>
</tr>
<tr>
<td>New Jersey</td>
<td>31%</td>
<td>29%</td>
</tr>
<tr>
<td>Georgia</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>California</td>
<td>25%</td>
<td>29%</td>
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