also be explained by easing of the criteria for transplant listing and relief of some relative contraindications.

**Conclusions** | The clinicodemographic portrait of liver transplant recipients in the United States is changing. The growing proportion of transplant recipients with comorbidities may warrant additional efforts for optimal management of these patients.

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*Study concept and design:* All authors.  
*Acquisition, analysis, or interpretation of data:* Stepanova, Younossi.  
*Drafting of the manuscript:* Stepanova, Saab, Venkatesan, Younossi.  
*Critical revision of the manuscript for important intellectual content:* All authors.  
*Statistical analysis:* Stepanova, Younossi.  
*Administrative, technical, or material support:* Wai.  
*Study supervision:* Saab, Venkatesan.

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**Previous Presentation:** The data were partially presented as a poster at 2014 Digestive Disease Week 2014; May 3, 2014; Chicago, Illinois.


**Variation in Inpatient Costs of Hematopoietic Cell Transplantation Among Transplant Centers in the United States**

Hematopoietic cell transplantation (HCT) using the patient’s own (autologous) or a donor’s (allogeneic) HCT progenitor cells is a highly effective but costly therapy for life-threatening blood disorders and cancers. Despite the small number of annual procedures (20 000 a year in the United States), HCT hospitalization spending increased from $684 million to $1.3 billion between 2004 and 2007, placing it among the procedures with the most rapid spending increases.1 Those increases reflect rising procedure volume and rising hospitalization costs.1 Prior research2 on HCT costs has been limited to single-institution analyses. To quantify variation in costs of HCT across hospit...
tals, we analyzed data from the Nationwide Inpatient Sample (NIS), the largest hospital database with charge information on all patients admitted to the sampled hospitals regardless of payer.

Methods | International Classification of Diseases, Ninth Revision (ICD-9) procedure codes were used to identify HCT hospitalizations in the 2008-2010 NIS database (autologous: 41.01, 41.04, 41.07, and 41.09; allogeneic: 41.02, 41.03, 41.05, 41.06, and 41.08). We analyzed data for adults from large-volume hospitals performing 30 or more HCT procedures (autologous or allogeneic). Smaller-volume hospitals were excluded because bed size was confounded with hospital HCT volume. We retained less than 5% of hospitals in the NIS survey; therefore, weighting was not needed. Patient age was categorized as adults (18-49 years) and older adults (≥50 years) owing to differences in transplant practices by age. We used ICD-9 diagnosis codes to construct Elixhauser comorbidity index scores.

Cost was discounted to 2008 dollars and measured using an all-payer cost to charge ratio (when unavailable, the hospital's group mean ratio was used). Costs for autologous and allogeneic HCT were modeled separately because of differences in indications, care, and outcomes. Linear regression was used to assess associations between costs and patient and hospital characteristics and to produce age-, sex-, diagnosis-, and comorbidity index–adjusted means. Costs were log-transformed for analysis and then transformed back for reporting. Statistical analyses were conducted with SAS, version 9.3 (SAS Institute Inc).

Results | The adjusted mean cost for autologous HCT was $47,990. Cost varied by a factor of almost 4, from $21,280 to $81,830 (Figure). The highest–cost quintile hospitals had higher proportions of patients who were younger, were non-Hispanic white, were privately insured, and had a diagnosis of lymphoma compared with the lowest–cost quintile hospitals (Table) (P < .01 for all comparisons).

Overall adjusted mean allogeneic HCT cost was $86,580, and hospital means varied 5-fold ($26,580 to $146,090) (Figure). The highest–cost quintile hospitals performing allogeneic HCT had a larger percentage of privately insured patients, patients with 1 or more comorbidities, and fewer non-Hispanic white patients (Table).

Twenty-one hospitals performed both autologous and allogeneic HCTs. There was a significant cost correlation between the 2 procedures in these hospitals (r = 0.54, P = .01).

Discussion | The costs of HCT vary significantly across hospitals in the United States. We were unable to determine how costs correlate with outcomes because the NIS does not contain postdischarge survival data. Future research should explore whether higher HCT costs correlate with better patient outcomes. The major strength of the present study is that the NIS data set allows comparison of HCT costs across hospitals nationally, which has not previously been performed. Limitations of the present study include the use of charge data to calculate costs and the sample size of US hospitals analyzed; HCT is performed in relatively few hospitals. Because the NIS database contains information only on inpatient settings, we could not consider variation in rehospitalizations, which should be a future research priority. Our findings warrant attention to payment policy and price transparency, especially in the context of health care reform, for their potential to reduce cost variation across hospitals.

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Katy B. Kozhimannil, PhD
Will Thomas, PhD
Ezra Golberstein, PhD
### Demographics and Case Mix of HCT Patients

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Autologous HCT, %</th>
<th>Allogeneic HCT, %</th>
<th>P Value&lt;sup&gt;a&lt;/sup&gt;</th>
<th>P Value&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Patients</td>
<td>Lowest-Cost Quintile</td>
<td>Highest-Cost Quintile</td>
<td>All Patients</td>
</tr>
<tr>
<td>No. of hospitals</td>
<td>32</td>
<td>6</td>
<td>6</td>
<td>22</td>
</tr>
<tr>
<td>No. of patients</td>
<td>3164</td>
<td>334</td>
<td>795</td>
<td>1932</td>
</tr>
<tr>
<td>Age, y&lt;sup&gt;b,c&lt;/sup&gt;</td>
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<td></td>
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<tr>
<td>18–49</td>
<td>33.4</td>
<td>30.0</td>
<td>36.9</td>
<td>44.9</td>
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<td>70.1</td>
<td>63.1</td>
<td>55.1</td>
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<tr>
<td>Sex&lt;sup&gt;c&lt;/sup&gt;</td>
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<td></td>
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<td></td>
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<tr>
<td>Male</td>
<td>59.8</td>
<td>56.3</td>
<td>58.4</td>
<td>56.5</td>
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<tr>
<td>Female</td>
<td>40.4</td>
<td>43.7</td>
<td>41.6</td>
<td>43.5</td>
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<td>Race/ethnicity</td>
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<tr>
<td>Non-Hispanic white</td>
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<td>44.3</td>
<td>68.6</td>
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<td>1.0</td>
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<tr>
<td>Diagnosis&lt;sup&gt;b,c&lt;/sup&gt;</td>
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<td></td>
<td></td>
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<tr>
<td>Acute lymphoblastic leukemia,</td>
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<td>5.7</td>
<td>3.7</td>
<td>51.4</td>
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<tr>
<td>acute myeloid leukemia, myelodysplastic syndrome</td>
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<tr>
<td>Lymphoma</td>
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<td>41.0</td>
<td>46.3</td>
<td>17.9</td>
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<td>47.9</td>
<td>40.0</td>
<td>4.4</td>
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<tr>
<td>Other</td>
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<td>5.0</td>
<td>10.0</td>
<td>26.3</td>
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<tr>
<td>Elixhauser comorbidity index&lt;sup&gt;b,c&lt;/sup&gt;</td>
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<td>16.2</td>
<td>17.1</td>
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<tr>
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<td>27.5</td>
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<td>2</td>
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<td></td>
<td>≥3</td>
<td>28.3</td>
<td>28.1</td>
<td>26.7</td>
</tr>
</tbody>
</table>

Abbreviation: HCT, hematopoietic cell transplantation.  
<sup>a</sup>P value comparing hospitals in the lowest and highest cost quintiles.  
<sup>b</sup>Variables included in the final autologous model.  
<sup>c</sup>Variables included in the final allogeneic model.
related to medical bills. In 1984, Paul Starr predicted that as the ideals of professionalism and volunteerism are weakened, the “health center” of one era will become the “profit center” of the next. Unfortunately, that transformation may have already occurred.

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3. 26 USC §501r.

In Reply We appreciate Dr Kornfeld’s comments and agree that the Affordable Care Act (ACA) will alter the way in which hospitals qualify for nonprofit status. In part owing to the difficulty in obtaining data, it had previously been difficult to identify the degree to which nonprofit hospitals provide community benefit.

There are 8 categories of federally “allowable” community benefit, including charity care, unreimbursed Medicaid, other unreimbursed government programs (such as county-sponsored insurance coverage), subsidized health services, community health improvement services, health professional education, research, and cash and in-kind contributions to health-related community groups.1 A recent report found that among Wisconsin hospitals, only 9% of reported community benefit was related to charity care, and the largest single component of the rest was hospital costs related to patients insured under government programs, such as Medicare and Medicaid.2 Hospitals reporting this benefit argue that government programs do not fully cover their costs of caring for their beneficiaries and report incurred costs above and beyond reimbursement as community benefit.

As the ACA is implemented, the need for providing uncompensated or charity care will vary dramatically across states. For example, in Massachusetts, a state with a less than 5% uninsured rate, the need for a nonprofit hospital to provide uncompensated care may be significantly less than in Texas, a state with a 24% uninsured rate that has chosen not to expand Medicaid coverage.3 Nonprofit hospitals have an important role to play in providing care for some of the country’s most vulnerable populations. We agree with Dr Kornfeld that the provisions in the ACA will help move us toward a more consistent, meaningful set of metrics to assess the degree to which nonprofit institutions are meeting those goals.

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Letters

What Is a "Nonprofit" Hospital?

To the Editor: The article “Compensation of Chief Executive Officers at Nonprofit US Hospitals” by Joynt et al1 is an important contribution to our understanding of how health care dollars are used. The authors found that median charity care and other community benefits comprised no more than 1.6% of hospital expenditures.1

This meager amount becomes even more startling when we become aware of the current Internal Revenue Service requirements to establish nonprofit tax-exempt status. Nonprofit hospitals are not required to provide “charity care.” Instead they are required to be “Organized and operated exclusively in furtherance of some purpose considered charitable in the generally accepted legal sense of the term.” Needless to say, “charitable” has been broadly defined.

The Affordable Care Act will bring a major change in those requirements. The following criteria will apply:1

1. Hospitals must perform a community health needs assessment and implementation strategy to meet the needs identified.
2. Uninsured patients must now be billed at the rates generally charged insured patients.
3. Hospitals must create a written financial assistance policy.
4. Hospitals will be prohibited from extraordinary collection actions.

With these requirements, how many nonprofit hospitals may choose to give up their tax exempt status? Perhaps to do so is merely to acknowledge the reality of hospital policy in the 21st century when approximately 60% of bankruptcies are related to medical bills. In 1984, Paul Starr predicted that as the ideals of professionalism and volunteerism are weakened, the “health center” of one era will become the “profit center” of the next. Unfortunately, that transformation may have already occurred.

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5. 26 USC §501r.