Regionalization of AAA and CLI Care

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Disclosures
Consultant agreements
- Terumo
- SilkRoad Medical
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- W.L. Gore & Associates
- Terumo
- Medtronic
- Cook
- Carestream

Role for Regional Care
- Model for delivery outside United States
- Payors pay regardless of quality, so every hospital does everything it can
- Patients have a strong desire for local care

Critical Limb Ischemia
Endovascular Bypass
Amputation

Methods - Cohort
- Inclusion criteria
  - Age > 18
  - Diagnostic codes: rest pain, ulceration, gangrene
  - Procedure codes indicative of revascularization procedure or amputation
  - First CLI admission
- Exclusion criteria
  - A patient had a CLI admission from 2000-2003
  - Distance > 100 miles

Methods – Outcome Measures
- Major Amputation
  - Lower extremity amputation ICD-9 (84.13-84.17)
- Mortality
  - SPARCS death database within 30 days after admission

Methods - Analysis
- Distance: straight line between zip codes
- Multivariable Regression:
  - Age
  - Sex
  - Race
  - Insurance type
  - Zip code population density, median income
Proximity Increases Amputation (travel to save your leg…)

Proximity Increases Mortality (travel to save your life…)

Procedure Volume Reduces Amputation

Procedure Volume Reduces Mortality

Vascular Procedure Volume vs Distance

Zip Code Population Density vs Distance
Abdominal Aortic Aneurysm
- Elective AAA Repair
- Widespread adoption of EVAR
- Patient selection criteria: move from physiological to anatomical indications

Background
- Most studies use arbitrary volume cutoffs
- No validated minimum volume thresholds for superior outcomes

Hazard Ratio Maximization

Results — Population Statistics
### Results — Population Statistics

<table>
<thead>
<tr>
<th></th>
<th>Volume &lt; 6</th>
<th>Volume ≥ 6</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (11,086)</td>
<td>4,429</td>
<td>6,657</td>
<td></td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>71±0.1</td>
<td>72±1.0</td>
<td>&lt;0.0001</td>
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<tr>
<td>Sex (% male)</td>
<td>73.7±0.6</td>
<td>75.0±0.5</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Race (% white)</td>
<td>80.0±0.6</td>
<td>88.0±0.4</td>
<td>&lt;0.0001</td>
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<tr>
<td>CCI</td>
<td>2.2±0.02</td>
<td>2.0±0.01</td>
<td>&lt;0.0001</td>
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<tr>
<td>Hypertension (%)</td>
<td>58.4±0.7</td>
<td>61.8±0.6</td>
<td>&lt;0.001</td>
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<tr>
<td>Diabetes (%)</td>
<td>13.0±0.5</td>
<td>12.4±0.4</td>
<td>NS</td>
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<tr>
<td>Dyslipidemia (%)</td>
<td>30.7±0.7</td>
<td>30.0±0.6</td>
<td>0.01</td>
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<tr>
<td>Hx of Smoking (%)</td>
<td>18.0±0.6</td>
<td>18.5±0.5</td>
<td>NS</td>
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<tr>
<td>Hx of CABG (%)</td>
<td>12.7±0.5</td>
<td>16.7±0.5</td>
<td>&lt;0.001</td>
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<tr>
<td>Arrhythmia (%)</td>
<td>25.4±0.7</td>
<td>22.4±0.5</td>
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<td>Obesity (%)</td>
<td>2.6±0.2</td>
<td>2.6±0.2</td>
<td>NS</td>
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<tr>
<td>Renal Disease (%)</td>
<td>7.4±0.4</td>
<td>5.0±0.3</td>
<td>&lt;0.001</td>
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</table>

### Results — 30-day Outcomes

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<tr>
<td>30-d Mortality (%)</td>
<td>7.0±0.4</td>
<td>3.6±0.2</td>
<td>&lt;0.001</td>
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<td>LOS (d)</td>
<td>13±1.2</td>
<td>9.9±0.2</td>
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<td>Readmit (%)</td>
<td>2.3±0.2</td>
<td>1.9±0.2</td>
<td>NS</td>
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<td>Cox Adjusted Hazard Ratio for 30-d Mortality</td>
<td>0.459±0.08</td>
<td>&lt;0.0001</td>
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### Results — 5-year Outcomes

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<tr>
<td>5-yr Mortality (%)</td>
<td>29.8±0.7</td>
<td>26.3±0.5</td>
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<td>Cox Adjusted Hazard Ratio for 5-yr Mortality</td>
<td>0.201±0.06</td>
<td>&lt;0.0001</td>
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### Discussion

- Positive association between volume and outcome up to around 40 cases per year
- Even a cutoff point of two procedures per year reduces mortality
- Tradeoff between access and outcomes
- Up to 150 patients could have avoided perioperative mortality if all procedures had been performed by high-volume surgeons

### Conclusion

- For complex problems like aortic repair and CLI, surgeon and center volume drive outcome
- Patients should not seek care at low-volume centers
- Need for tiered credentialing
- US healthcare finances do not scale to address