Welcome

Frank Shannon, MD
Presented by the STS Task Force on Quality Initiatives

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<thead>
<tr>
<th>Guy Paone, Chair</th>
<th>Felix Fernandez</th>
<th>John Mayer</th>
<th>Judy Tingley</th>
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<tr>
<td>Iman Aziz</td>
<td>Tony Furnary</td>
<td>Jim McClurken</td>
<td>Paul Uhlig</td>
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<td>Bruce Bollen</td>
<td>Kris George</td>
<td>Rich Prager</td>
<td>Rob Welsh</td>
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<td>Bill Burfeind</td>
<td>Fred Grover</td>
<td>Syma Prince</td>
<td>Elaine Weiss</td>
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<td>Bill Caine</td>
<td>Baron Hamman</td>
<td>Dan Raymond</td>
<td>Rob Welsh</td>
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<td>Joseph Cleveland</td>
<td>Jeff Jacobs</td>
<td>Ed Savage</td>
<td>David Wormuth</td>
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<td>Kathy Cornelius</td>
<td>Cathy Knoff</td>
<td>Dave Shahian</td>
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<tr>
<td>Fred Edwards</td>
<td>Donald Likosky</td>
<td>Frank Shannon</td>
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<tr>
<td>Chris Feindel</td>
<td>Kevin Lobdell</td>
<td>Alan Speir</td>
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Presenters

Frank Shannon, MD

Glenn J. R. Whitman, MD

Kevin W. Lobdell, MD
POCMA
Phase of Care Mortality Analysis

Frank Shannon, MD
Director, CV Surgery Quality and Research Programs
Beaumont Health
Royal Oak, MI
Disclosures

- Collaborator
  - ARMUS Corporation

- Venture Partner
  - BioStar Ventures

- Collaborator
  - AtriCure

- MIVS Trainer
  - St. Jude Medical

- TAVR Trainer
  - Edwards

- MIVS Instrument Design
  - GEISTER
A Novel Method to Evaluate Surgical Mortality
POCMA

- Systems method of analysis to identify the **root cause** of death following cardiac surgery
- Based on assumption that there are 3 primary components which interact within each episode of surgical care
  - **Patient configuration**: constellation of physiological attributes, organ system reserve, co-morbidities and responses to care
  - **Elements of surgical care**: evaluation, diagnosis, monitoring, treatment, errors of omission and commission
  - **Random clinical events**: unexpected reactions to treatment, natural history of disease or *de novo* catastrophes
Phase of Care

- Interval defined by its temporal relationship to the primary surgical procedure
- Each phase has a characteristic set of therapeutic goals, care pathways and recovery expectations
- Divides process of care into interdependent compartments that contain multiple agents and layers of interaction
- Parsing clinical course into time segments facilitates focus on specific elements for quality improvement
- Derived from Fred Grover’s QI project involving VA Cardiac Surgery Services

Root Cause = Seminal Event

• One of the 3 primary elements in the episode of care which triggers a cascade of deterioration culminating in death
• Is the most proximal component in the sequence of care
• Similar to “Outlandish Proverb No. 499”

‘For want of a nail a horseshoe was lost,
for want of a horseshoe a horse went lame,
for want of a horse a rider never got through,
for want of a rider a message never arrived,
for want of a message an army was never sent,
for want of an army a battle was lost,
for want of a battle a war was lost,
for want of a war a kingdom fell,
and all for want of a nail.’

George Herbert, 1640
Avoidable Surgical Death

**Avoidable:**

1. Processes of care are available to *prevent seminal event* or *rescue the patient from* the cascade of decompensation
2. System *lacks the expected* resources, competence or personnel for primary prevention or rescue

**Unavoidable:**

1. Seminal event *could not have been* prevented or attenuated with more than 50% likelihood
2. Patient’s constellation of attributes constitute an unavoidable risk for death or inability to be rescued
Avoidable Surgical Death

<table>
<thead>
<tr>
<th>Phase of Care Mortality Analysis:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Operative Phase</strong></td>
</tr>
<tr>
<td><strong>Cardiac risk factor profile e.g.</strong></td>
</tr>
<tr>
<td><strong>Cardiogenic shock</strong></td>
</tr>
<tr>
<td><strong>Myocardial viability</strong></td>
</tr>
<tr>
<td><strong>Non-cardiac risk factor profile</strong></td>
</tr>
<tr>
<td><strong>Renal failure on dialysis</strong></td>
</tr>
<tr>
<td><strong>COPD</strong></td>
</tr>
<tr>
<td><strong>Cirrhosis</strong></td>
</tr>
<tr>
<td><strong>Combination</strong></td>
</tr>
<tr>
<td><strong>Judgment</strong></td>
</tr>
<tr>
<td><strong>Timing of surgery</strong></td>
</tr>
<tr>
<td><strong>Risk benefit</strong></td>
</tr>
<tr>
<td><strong>Patient preparation</strong></td>
</tr>
<tr>
<td><strong>Medical optimization failure</strong></td>
</tr>
<tr>
<td><strong>Patient evaluation</strong></td>
</tr>
<tr>
<td><strong>Functional class</strong></td>
</tr>
<tr>
<td><strong>ID occult disease(s)</strong></td>
</tr>
<tr>
<td><strong>Other:</strong></td>
</tr>
</tbody>
</table>

| **Intra-Operative Phase**        |
| **Anesthesia**                   |
| **Technical lines, TEE, ET**     |
| **Pharmacologic management**     |
| **Recognition/treatment of**     |
| **decompensation**               |
| **Surgeon**                      |
| **Judgment**                     |
| **Technical (sacs, grafts, embol)** |
| **Myocardial protection**        |
| **Cardiopulmonary By-Pass**      |
| **Perfusion (i.e., MAPP, mVAD)** |
| **CVA**                          |
| **Catastrophic event (specify):**|
| **Other:**                       |

| **Post-Op ICU Phase**            |
| **Hemodynamic management**       |
| **Inotropic titration**          |
| **Adequate CPB delivery**        |
| **Respiratory care**             |
| **Prevent lung injury and VAP**  |
| **Appropriate support plan**     |
| **ICU care (Keystone criteria)** |
| **DVT/PE prophylaxis**           |
| **Sepsis prevention/treatment**  |
| **Nutritional support**          |
| **Multi-System Organ Failure**   |
| **Failure to Thrive**            |
| **Surveillance/recognition/Rx of**|
| **decompensation**               |
| **Catastrophic event (specify):**|
| **Other:**                       |

| **Post-Op Floor Phase**          |
| **Pharmacologic management**     |
| **Coadmin**                      |
| **Other**                        |
| **Pulmonary embolism**           |
| **CVA**                          |
| **Dysrhythmia (Atrial or Vent)** |
| **Surveillance/recognition/Rx of**|
| **decompensation**               |
| **Catastrophic event (specify):**|
| **Other:**                       |

| **Discharge Phase**              |
| **Appropriate disposition: e.g.**|
| **Nursing home/ICF vs. home**    |
| **Pharmacologic details**        |
| **Adequate instruction and**     |
| **support network**              |
| **Catastrophic event (specify):**|
| **Other:**                       |

<table>
<thead>
<tr>
<th>Event and Mortality Avoidable?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
</tr>
<tr>
<td><strong>No</strong></td>
</tr>
<tr>
<td><strong>If Yes: How:</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If Avoidable: What has been implemented to prevent future similar event:</th>
</tr>
</thead>
</table>
• Defined modes of death after CABG

• Seminal event equated to “different processes and systems of clinical care yield different results” (i.e. surgeons)

• “better understanding of (different) processes of care and ...their relationship to ...heart failure” – avoidability implied
Deductive Reasoning in the Lifelong Continuing Education of a Cardiovascular Surgeon

- 80% of a CV surgeon’s education should occur after formal residency training
- “Imperfect results” of surgery are reviewed by analysis of “serial decision-making ...in detail”

Frank Cole Spencer, MD
President of STS

Spencer FC, Arch Surg, 1976
POCMA – Phases of Surgical Care

Complex Adaptive System

- Each phase has unique goals, agents, tasks, responsibilities and interactions
- Surgeon is not primary agent
# Evolution of Quality Improvement in Cardiac Surgery

<table>
<thead>
<tr>
<th>Salient Features</th>
<th>Old School 1960 - 2000</th>
<th>Current 2000 - present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>Vertical – Chain of command</td>
<td>Horizontal - Team</td>
</tr>
<tr>
<td>Communication Style</td>
<td>Military Command &amp; control</td>
<td>Mindful Defer to expertise</td>
</tr>
<tr>
<td>Improvement Methods</td>
<td>M &amp; M conference “Blame &amp; Shame”</td>
<td>Systems analysis Human factors</td>
</tr>
<tr>
<td>Focus</td>
<td>Work harder and devise better operation</td>
<td>Work smarter and better in teams</td>
</tr>
</tbody>
</table>
Clinical Scenarios
Case Scenario 1: Analysis
Case Scenario 2: Analysis

- Seminal Mortality Event
- Pre-op
- Intra-op
- ICU
- Floor
- Discharge

- Cirrhosis
- Cardiomyopathy
- TVCAD

- Hepatorenal Failure

- Sternal Infx

- DEATH
Case Scenario 3: Analysis

- **Seminal Mortality Event**
- **Pre-op**
- **Intra-op**
- **ICU**
- **Floor**
- **Discharge**

- **Re-do Sternotomy**
- **Aortic laceration**

- **Volume and clotting factor replacement**
- **Optimal multi-organ support**

- **Patient “rescued”**
Michigan Society of Thoracic and Cardiovascular Surgeons (MSTCVS)
Initial report on statewide adoption of POCMA as analytic and quality improvement tool for cardiac surgery

Review of 1,905 mortalities out of 53,674 adult cardiac operations from January 1, 2006 to June 30, 2010 yielded a POCMA profile of seminal events and determination of avoidable death in 41%
MSTCVS

- Founded 1965
- Currently 91 Board Certified Thoracic Surgeons
- Statewide quality initiative
  - 2001: 17 hospitals met to review STS NCD results for 1998 to 2000
  - 2006: Grew to include 28 hospitals and POCMA started
  - 2008: Site visit program initiated (O/E ratio > 1.5)
  - 2011: BCBS hospital “bonus” for collaborative participation and improved outcomes
MSTCVS

Local Case Review
- Concurrent
- Surgeon-directed
- Multi-disciplinary

Collaborative Review
Review mortality summary and POCMA record

85% - Agree

15% - MORG Adjudication
Decade of POCMA: 2006 - 2015

Rich Prager, MD
Decade of POCMA: 2006 - 2015

2006 – 2015
112,581 Cardiac Procedures

3.4% Mortality (3824)

+ STS Risk Model 84,067
No Risk Model 28,514
Annual Procedure Trends
POCMA – Phase Distribution

- Cardiac RFP less often
- Judgment more often
- More avoidable catastrophes
- Better hemodynamic Rx

- Similar scenarios, just different context
- Rescue rate for complications variable
Avoidable Deaths – All Procedures

Overall Avoidable = 38%
Pre-op Phase: Sub-categories
ICU Phase: Sub-categories
Intra-op: Sub-categories
## Top Seminal Events

<table>
<thead>
<tr>
<th>Phase</th>
<th>Sub-category</th>
<th>n</th>
<th>% Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU</td>
<td>Catastrophe</td>
<td>506</td>
<td>14.4%</td>
</tr>
<tr>
<td>Pre-op</td>
<td>Cardiac RFP</td>
<td>476</td>
<td>13.6%</td>
</tr>
<tr>
<td>Pre-op</td>
<td>Judgment</td>
<td>358</td>
<td>10%</td>
</tr>
<tr>
<td>Intra-op</td>
<td>Surgeon</td>
<td>334</td>
<td>9.5%</td>
</tr>
<tr>
<td>Intra-op</td>
<td>Catastrophe</td>
<td>252</td>
<td>7.2%</td>
</tr>
<tr>
<td>Surveillance</td>
<td>ICU &amp; Floor</td>
<td>209</td>
<td>5.9%</td>
</tr>
<tr>
<td>Floor</td>
<td>Catastrophe</td>
<td>206</td>
<td>5.8%</td>
</tr>
</tbody>
</table>
## Catastrophic Events

<table>
<thead>
<tr>
<th>Events</th>
<th>Intra-op</th>
<th>ICU</th>
<th>Floor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% phase</td>
<td>n</td>
<td>% phase</td>
<td>n</td>
</tr>
<tr>
<td>CVA</td>
<td>17%</td>
<td>447</td>
<td>8%</td>
<td>75</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>12%</td>
<td>79</td>
<td>21%</td>
<td>197</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>2%</td>
<td>13</td>
<td>10%</td>
<td>94</td>
</tr>
<tr>
<td>GI</td>
<td>-</td>
<td>-</td>
<td>10%</td>
<td>94</td>
</tr>
<tr>
<td>Other</td>
<td>4%</td>
<td>26</td>
<td>4%</td>
<td>37</td>
</tr>
</tbody>
</table>
Focused Improvement Topics and Projects

- Focus list derived from top 5 avoidable mortality list
- Improvement plans elaborated by MSTCVS physicians

Pre-op
- Surgeon Judgment
- Myocardial viability
- High risk patient evaluation
- Operative choice/execution

Intra-op
- Appropriate staffing
- Enhanced monitoring
- Dedicated intensivists
- Better O² delivery

ICU

Floor
- Support systems
- Earlier follow-up

Discharge

Optimization
- Improved communication and hand-offs
- Better recognition and prevention of catastrophes
Conclusions

• POCMA is a reproducible and efficient approach to identifying the root cause of surgical mortalities
• Process of conducting the POCMA analysis is conducive to surgical “team” participation and learning
• Identification of avoidable surgical deaths and rescue pathways facilitates focused quality improvement
• Analytic framework of POCMA allows elaboration of new seminal events as surgical care evolves
Insights Derived from POCMA

Glenn J.R. Whitman, MD

Director, CVSICU
Johns Hopkins Hospital
Baltimore, MD
Disclosures

- None
Phase of Care Mortality Analysis: Comparing Mortality Differences Among TAVR and Surgical AVR Patients

Todd C Crawford, MD¹, J Trent Magruder, MD¹, Joshua C Grimm, MD¹, Kaushik Mandal, MD¹, Joel Price, MD¹, Jon R Resar, MD², Matthew Chacko, MD², Rani K Hasan, MD², Glenn J Whitman, MD¹, John V Conte, MD¹

¹ Division of Cardiac Surgery, Johns Hopkins University School of Medicine, Baltimore, MD.
² Division of Cardiology, Johns Hopkins University School of Medicine, Baltimore, MD.
Background (POCMA)

- Introduced in 2012 by the Michigan Society of Thoracic & Cardiovascular Surgeons (MSTCVS)
- Principle: each in-hospital mortality is rooted in a seminal event
- Promotes a culture of transparency
- Has led to quality initiatives and ultimately resulted in improved morbidity and mortality

Background (POCMA)

- **Aortic Stenosis**
  - 1-2% of patients > 65 yo
  - 1 year mortality for symptomatic AS -> 25-30%, 50% in those denied surgery
- **Available Interventions**
  - SAVR – traditional approach to aortic valve disease, involves cardiopulmonary bypass
  - TAVR – transcatheter aortic valve replacement
    - High risk or extreme risk patients that are not fit to undergo SAVR
    - PARTNER A trial – TAVR mortality at 1 year was non-inferior in comparison to SAVR in high risk patients
    - CoreValve US Pivotal Trial – superior mortality at 1 year compared to SAVR in high risk patients

Objective

• To utilize a novel analytical tool to compare differences in sentinel events among TAVR and SAVR populations that ultimately culminate in in-hospital mortality
Methods

• Patient Selection
  • Any adult patient that underwent isolated TAVR or SAVR at our institution between 1/1/2011 and 3/31/2015 and expired during the postoperative hospital course
  • Included patients enrolled in research trials as well as those receiving commercially-available valves
  • TAVR population included both extreme and high risk patients
POCMA Methodology

- Five “Phases” of Care
- Subcategories within each phase of care
- Goal: identify mortality triggers
The JHH POCMA Committee

- Every in-hospital death reviewed in the Cardiac Surgery Mortality & Morbidity Conference
- Conference includes:
  - Cardiac Surgery Faculty
  - Cardiac Surgery Fellows
  - Cardiac Surgery ICU Intensivists (anesthesia, cardiac anesthesia, pulmonary and critical care physicians)
- JHH modified POCMA form completed during conference
- For TAVR mortalities, interventional cardiologists provided input regarding the phase of care associated with the mortality
Results

• Study Population: n=770 (isolated SAVR or TAVR)
  • 240 TAVR, 12 in-hospital mortalities (5.0%)
  • 530 SAVR, 10 in-hospital mortalities (1.9%)

• TAVR
  • Transfemoral – 93.8%
  • Hemi-sternotomy (direct aortic access) – 2.5%
  • Transaxillary – 2.1%
  • Transapical – 1.7%
## Characteristics of Those Who Died

<table>
<thead>
<tr>
<th>Variables</th>
<th>SAVR (n=10)</th>
<th>TAVR (n=12)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>74 (66-84)</td>
<td>84 (81.5-88.5)</td>
<td>0.008</td>
</tr>
<tr>
<td>Male Gender</td>
<td>6 (75.0%)</td>
<td>2 (16.7%)</td>
<td>0.074</td>
</tr>
<tr>
<td>Calculated BMI (kg/m(^2))</td>
<td>28.0 (25.1-29.6)</td>
<td>24.2 (21.1-25.7)</td>
<td>0.114</td>
</tr>
<tr>
<td>Pre-operative GFR (mL/min)</td>
<td>41.4 (19.3 - 50.3)</td>
<td>21.8 (17.3-39.0)</td>
<td>0.282</td>
</tr>
<tr>
<td>Hypertension</td>
<td>10 (100%)</td>
<td>11 (91.7%)</td>
<td>1.000</td>
</tr>
<tr>
<td>Diabetes</td>
<td>4 (40.0%)</td>
<td>1 (8.3%)</td>
<td>0.135</td>
</tr>
<tr>
<td>Peripheral Vascular Disease</td>
<td>3 (30.0%)</td>
<td>3 (25.0%)</td>
<td>1.000</td>
</tr>
<tr>
<td>Pre-existing Lung Disease (Mild, Moderate, or Severe)</td>
<td>5 (55.6%)</td>
<td>8 (66.7%)</td>
<td>0.673</td>
</tr>
<tr>
<td>Previous Myocardial Infarction</td>
<td>2 (20.0%)</td>
<td>5 (41.7%)</td>
<td>0.381</td>
</tr>
<tr>
<td>LVEF (%)</td>
<td>50.0 (40.0-60.0)</td>
<td>62.5 (60.0-72.5)</td>
<td>0.016</td>
</tr>
<tr>
<td>Congestive Heart Failure</td>
<td>7 (70.0%)</td>
<td>12 (100%)</td>
<td>0.078</td>
</tr>
<tr>
<td>NYHA I</td>
<td>0</td>
<td>1 (9.1%)</td>
<td></td>
</tr>
<tr>
<td>NYHA II</td>
<td>3 (42.9%)</td>
<td>2 (16.7%)</td>
<td></td>
</tr>
<tr>
<td>NYHA III</td>
<td>3 (42.9%)</td>
<td>3 (25.0%)</td>
<td></td>
</tr>
<tr>
<td>NYHA IV</td>
<td>1 (14.3%)</td>
<td>6 (50.0%)</td>
<td></td>
</tr>
<tr>
<td>Prior Balloon Aortic Valvuloplasty</td>
<td>0</td>
<td>4 (33.3%)</td>
<td>0.096</td>
</tr>
<tr>
<td>STS Predicted Risk for Mortality (%)</td>
<td>8.0 (3.5-8.2)</td>
<td>11.7 (6.7-23.6)</td>
<td>0.08</td>
</tr>
<tr>
<td>STS Predicted Mortality for Entire Study Population (%)</td>
<td>1.7 (1.0-3.1)</td>
<td>9.7 (5.4-12.0)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

\( ^{a} = \) out of 9 patients
Characteristics of Those Who Died
In-Hospital SAVR Mortalities

- Pre-operative Phase (n=4, 40% of Mortalities)
  - Cardiac Risk Factor Profile (3 out of 4)
  - Two of these patients presented with endocarditis
- Post-operative ICU Phase (n=5, 50% of Mortalities)
  - Catastrophic Events (3 out of 5)
    - Refractory GI bleed, intestinal ischemia, intracranial hemorrhage
  - Only one mortality attributable to intra-operative phase
In-Hospital TAVR Mortalities

- Intra-operative Phase of Care (75% of mortalities)
  - Technical Errors (Surgeon/Cardiologist)
    - Coronary Ischemia
    - Acute aortic valve insufficiency
    - Wire perforations/tamponade

- Catastrophic Events
  - Embolic stroke
  - Vascular complication

- Pitfalls
  - Narrow Sinus of Valsalva
  - Low-lying coronary ostia
  - Bulky aortic valve leaflets
Limitations

- Single institution
  - Low event rate
    - TAVR program initiated in 2011
    - ~100 isolated AVRs annually
- Preoperative phase of care consideration for TAVR
  - High risk/Extreme risk population
  - Preoperative comorbidities and anatomical features may contribute to technical challenges and postoperative complications
Conclusion

• Distinct differences exist with regard to the phase of care in which seminal events arise that contribute to in-hospital mortality after SAVR or TAVR
  • SAVR mortalities were related to patient selection and postoperative ICU care
  • TAVR mortalities were often the result of intraoperative events
• Knowledge of the timing and location of these events may enable providers to implement strategic interventions that reduce mortality
Conclusion
Conclusion

Adding Avoidable Mortality as a Metric to POCMA
Phase of Care Analysis

Kevin W. Lobdell, MD

Professor & Director of Regional Quality, Education, and Research
Atrium Health
Charlotte, NC
Disclosures

• None
IN ONE DAY AT ATRIUM HEALTH

31,750+ patient encounters (1 every 3 seconds)
23,000 physician visits | 4,200 ED visits | 600+ home health visits
85+ new primary care patients | 13,975 virtual care encounters
88 babies delivered | 550+ surgeries

$5.6 million each day in uncompensated care and other benefits to our community.

We’re on a quest to revolutionize how people get and stay healthy.
Bringing access to care to more people. Making care more affordable. Improving health for all communities.
At Atrium Health, Wake Forest Baptist Health and Wake Forest University, it’s the quality of care we provide as we work to create a next generation health system to face the future and communities of health. Together, we stand.

Together, we have an extraordinary opportunity to create a world-class academic health system focused on a singular and defining purpose: continuously improving health for every community we serve.
### CARDIAC SURGERY
**Experience Where It Counts**

<table>
<thead>
<tr>
<th>1,086</th>
<th>656</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac surgeries</td>
<td>total CABG procedures</td>
</tr>
</tbody>
</table>

| ISOLATED CABG QUALITY METRICS | (Rolling year data ending 12/31/18) |
|-----------------------------|
| 8.5% | 0.8% |
| 30-day observed readmission rate | 30-day operative mortality rate |
| STS benchmark | (rate-adjusted) |
| 10.2% | 2.4% |

**AREAS OF SPECIALTY**
- Minimally invasive mitral valve repair
- Complex thoracic aortic surgery
- Minimally invasive coronary bypass surgery
- Heart transplant and mechanical support

### VALVE & STRUCTURAL HEART DISEASE
**Making the Most of Transcatheter Innovations**

<table>
<thead>
<tr>
<th>TAVR</th>
<th>Mitral Valve</th>
<th>Left Atrial Appendage Occlusion (LAAB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>873 procedures</td>
<td>59 actual leaflet cly procedures</td>
<td>67 procedures</td>
</tr>
<tr>
<td>289 procedures 2018</td>
<td>0.0% 30-day observed mortality rate (rate-adjusted)</td>
<td>0.0% complication rate Jan.-Dec. 2018</td>
</tr>
<tr>
<td>0.4% unadjusted mortality rate</td>
<td>0.0% 90-day mortality rate (rate-adjusted)</td>
<td>0.0% valve surgery 12/31/18-12/31/19</td>
</tr>
<tr>
<td>Rolling 4-quarter data ending Q4 2018</td>
<td>Rolling 4-quarter data ending Q4 2018</td>
<td></td>
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<td>RELATIVE RISK VALUE: UNPLANNED VENTILATION 1.0%</td>
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**Atrium Health**
Sanger Heart & Vascular Institute
Sanger Heart & Vascular Institute
Quality Improvement Program
Learning Organization
"What's the Risk?" Assessing and Mitigating Risk in Cardiothoracic Surgery

Kevin W. Lohdell, MD, James L. Fann, MD, and Juan A. Sanchez, MD

OUTCOMES ANALYSIS, QUALITY IMPROVEMENT, AND PATIENT SAFETY

Risk Assessment
Ventilation Isolated CAB 2002-2014

Pulmonary Complications

Year


Percentage
# Phase of Care Analysis

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2007-2012 Isolated CAB

- 30.5% had multiple complications
- 56% of prolonged ventilation was isolated
- 66% of mortality was associated with prolonged ventilation
Prolonged Ventilation after Cardiac Surgery

- Literature review
- Collaboration with pulmonary physicians
- Risk assessment tools
- Standardized approach to assessment & risk mitigation strategies (POCA)
- Pulmonary consultations
Prolonged Ventilation after Cardiac Surgery

- Phase of Care Risk Mitigation
- Prolonged Ventilation
- Preop
Prolonged Ventilation after Cardiac Surgery

- Phase of Care Risk Mitigation
- Prolonged Ventilation
- Intraop

### Intra Op Phase

- Tidal Volume of 6-8 ml/kg
- Predicted Body weight
- PEEP 6-8 cmH2O
- Recruitment Maneuvers every 30 minutes
- Use "bag and hold sigh breaths" technique during OR transfer to ICU

- Anesthesia
  - Yes/No
  - 1. Difficulty Airway
  - 2. Status No Rx
  - 3. Bronchodilator Tx

### Handoff

- **Provide details on:**
  - Weakness/Threat (Egret < 15)
  - **Hx of lung disease**
    - Elevated pCO2 > 50
    - Hypoxemia ≤ 60
    - Obstructive or restrictive impairment on spirometry
    - Advanced age with comorbidities
    - Impaired cough
    - Aspiration and or esophaged disorder
    - Morbid obesity: BMI > 35
    - Untreated obstructive sleep apnea

### Intraop Information:

- Procedures
- Volume status
- MUF Volume
- Pump time
- Desaturation
- Difficult airway
- Last pO2
- Blood products/transfusions: Units
- High Pre-op risk
- MAZE or LAA Ligation

- High Risk: >10% STS or Katz Index ≥ 4
- Consider Pulmonary Consult
## Prolonged Ventilation after Cardiac Surgery

### Post Op Phase

**First 24 Hour Mnpt**
- Continue preoperative respiratory medications
- Strict adherence to low tidal volume ventilation, keep plateau pressure < 30
- Careful monitoring of volume status
- Use early extubation protocol < 6 hours

**Prolonged Ventilation**
- Continue preoperative respiratory medications
- Consider excluding from early extubation protocol if:
  - High Pre-op Risk
  - Intensive complications
  - Prolonged CPB
  - MAZE or LAA Ligation
  - Hemodynamic instability
  - Acute kidney injury
  - New neurological deficit
  - Ventilator Bundle/seeding protocol
- MD Pulmonary review & assessment prior to extubation if any of the above criteria met

**Post Extubation Mnpt**
- Oxygen Therapy
  - 
  - \( \text{O}_{2} \) as needed to keep \( \text{SaO}_2 \) >93%
  - Incentive Spirometer
  - Perform \( \text{O}_{2} \) < 12 hours until ambulation
  - Perform \( Q_{4} \text{w} \) after 12 hours
  - If \( Q_{3} \text{w} < 30 \text{ml/kg IBW} \), then add 
  - 
  - NIPPV for increased risk due to decreased LVEF or lung disease
- Early mobilization
- Continue pre-op respiratory medications post-extubation unless contraindiacted
- Some may need to be changed to ventilated therapy using VT driven protocols and in-check device
- Respiratory Therapy:
  - Perform patient assessment 2 – 4 hours post extubation to determine need for and frequency of treatments:
  - Therapy
    - 
    - CPAP
    - HHN/MDI

### Highlights
- Phase of Care Risk Mitigation
- Prolonged Ventilation
- ICU
Prolonged Ventilation after Cardiac Surgery

- CUSUM 2015
Venn diagrams are illustrative tools composed of overlapping circles that demonstrate the relations between different sets of data. They are particularly useful in medical fields like cardiovascular disease, where understanding the relationships among various factors can be critical. In the context of the Heart Team approach, Venn diagrams can help in visualizing the interactions and overlaps between different aspects of patient care, such as diagnostic tests, treatments, and outcomes.

For example, a Venn diagram might show the overlap between patients with ischemic heart disease and those with valvular heart disease, highlighting the significance of a multidisciplinary approach to care. Additionally, diagrams can illustrate the convergence of data from imaging studies, such as echocardiography and computed tomography, to provide a comprehensive view of the patient's condition.

In the Heart Team concept, shown in the diagram, the Heart Team approach involves a collaboration among cardiologists, surgeons, interventionalists, and other specialists to make informed decisions. This interdisciplinary collaboration aims to improve patient outcomes by ensuring that all aspects of care are considered, from the initial diagnosis to the implementation of treatment strategies.

The Heart Team approach emphasizes the importance of shared decision-making, where the team discusses and agrees on the best course of action for each patient. This collaborative approach can lead to more accurate diagnosis, personalized treatment plans, and improved patient outcomes by leveraging the expertise of various specialists.

In conclusion, Venn diagrams are powerful tools in the Heart Team concept, serving as visual aids to enhance understanding and facilitate effective communication among team members. They emphasize the need for a holistic approach to cardiovascular care, ensuring that patients receive the best possible treatment based on a comprehensive assessment of their needs.
Heart Team

Investigating the Causes of Adverse Events

Juan A. Sánchez, MD, Kevin W. Lebdell, MD, Susan D. Moffatt-Bruce, MD, PhD, and James M. Fama, MD

Amsterdam St. Joseph Hospital and Department of Cardiology, Urban Health University School of Medicine and Emergency Institute for Public Health of Catalonia, Barcelona, Spain; Saint John Health Care System, HeartCare HealthCare Group, Charlotte, North Carolina; and Henry Ford Health System, Detroit, Michigan.

If I had to choose one problem and one area on which to focus, it would be the issue of bringing health care to the patients, not focusing in the patient situation or the patient's health care system, but focusing on the people who are delivering care. This is an area where we have had remarkable advances in recent years, and we have seen significant improvements in the health care delivery system. However, there are still many areas where we can improve. We need to focus on the people who are delivering care and how they interact with each other. This is an area where we can make a significant difference.

Despite remarkable advances in surgical care, high-end hospitals, and substantial improvements in the health care delivery system, many of the adverse events that occur in hospitals are preventable. Many of these events are related to the way health care is delivered and the way health care professionals interact with each other. We need to focus on these areas to improve the quality of care and reduce the number of adverse events.

Organization and health care systems should determine the causes of errors and develop strategies to prevent them. However, it is important to recognize that these errors may occur even when all the necessary precautions are taken. This is why we need to focus on identifying the root causes of these errors.

Identifying Causal Factors

The concept of root cause analysis (RCA) is crucial in understanding the root causes of adverse events. RCA involves identifying the underlying factors that contribute to the occurrence of an event. It helps us understand why the event happened and what we can do to prevent it from happening again.

Although many factors may contribute to adverse events, the root causes are often related to organizational factors. These factors may include issues related to communication, training, policies, and procedures. Identifying these root causes allows us to develop strategies to prevent similar events from occurring in the future.

The Joint Commission (2013) provided an example of how meaningful improvements in patient care can be achieved by identifying and addressing root causes. The study highlighted how small errors can occur even when all the necessary precautions are taken. It also emphasized the importance of identifying the root causes to prevent similar events from occurring again.

RCA²

Improving Root Cause Analyses and Actions to Prevent Harm

*RCA² is a trademark of the Institute for Healthcare Improvement
Perfect Care

Innovative Solutions are Helping Bridge North Carolina’s Rural Healthcare Gap

Did you know that North Carolina’s rural population is larger than all other states? Only Texas has a larger number of rural residents. It’s more important than ever to ensure rural areas have the same access to quality healthcare and a unique grant from The Duke Endowment is helping Atrium Health piloting a new model to just that.

For many North Carolina residents—about 40 percent or roughly 4 million people—a large part of a small town and the area to spread out. They reside in one of the state’s counties classified as rural, population density of 500 people per square mile or less.

But when it comes to healthcare, rural areas often have bigger challenges to face, such as an increased rate of chronic diseases, higher numbers of drug and alcohol use, and other issues that leads to higher mortality rates than metropolitan areas.

So how can the healthcare industry help tackle this gap? How can patients who are further from local and major healthcare facilities better connect with their providers and care teams? How do clinicians better monitor what’s happening in real-time with their patient? And ultimately, how can help our rural communities be healthier?

These are the kinds of questions that Atrium Health’s Dr. Emily Lobdell, MD, vice president and system medical director of community health, and her team are asking and are helping to answer. And to help facilitate solutions to these gaps, the Duke Endowment, one of the nation’s largest private foundations with assets of $2.5 billion, has committed $1.1 million in grants to the Atrium Health Foundation so far this year. The goal is to help fund three to address population health, post-partum care, and a novel approach to virtual cardiac care called Perfect Care. Forsyth Health Care and Collaboration. This pilot program utilizes technology to help eliminate disparities in follow-up care following heart surgery. The first of its kind program will eventually be rolled out to six Atrium Health hospitals.

Dr. Lobdell answered some questions about how this novel approach to recovery care will be a game-changer for cardiac patients.

Atrium Health pilot could help narrow rural healthcare gap through emerging tech

An Atrium Health program aims to improve heart care through the use of emerging technologies. High fidelity, non-invasive devices and the use of artificial intelligence and machine learning techniques are helping to improve outcomes for patients with heart disease. These technologies are being used to monitor patients’ vital signs remotely, allowing for early detection of potential issues.

Atrium Health’s Perfect Care program is designed to improve outcomes for patients with heart disease. The program uses an artificial intelligence-powered platform to monitor patients’ vital signs remotely, allowing for early detection of potential issues. This technology has the potential to significantly improve outcomes for patients with heart disease and could be a game-changer for rural communities.

Perfect Care will make it easier for cardiovascular patients to remain in contact with their doctors, which otherwise can be a struggle for people living in rural areas. Patients will be able to check their vitals daily and get their results from their doctors. This will help ensure patients are receiving the care they need while eliminating the need for frequent hospital visits.
POCA Summary

- Proactive - learning system
- Interactive - heart team
- Precise - quantify risk & mitigate risk
- Expert - all phases of care
- Continuity – 24/7/365
- Scalable - system
- Synergy - multiplicative

*RCA2 is a trademark of the Institute for Healthcare Improvement*
Summary
POCMA Summary – Part 1

- POCMA is a reproducible and intuitive template for determining the root cause of adverse clinical outcomes.
- As a template, POCMA is efficient in identifying common causes of surgical mortality and encourages collaborative quality improvement projects among all levels of the CV surgery system.
- Seminal events (death triggers) can be modified as evidence-based treatments and our understanding of proper sequences of care evolve.
POCMA Summary – Part 2

• The determination of avoidable mortalities or complications is a collaborative analytic process that is best conducted within the context of care
• POCMA concept has been cited and used in large scale quality improvement programs with good results
• Comparison of TAVR vs SAVR POCMA profiles gives insight into the system requirements and challenges of each procedure
Questions

Please direct questions, comments and feedback to Sydney Clinton, Senior Coordinator, STS Quality Metrics & Initiatives, at sclinton@sts.org
Thank you for viewing the STS Quality Webinar on Phase of Care Mortality Analysis (POCMA)

Please note that webinar slides and other materials are posted on the STS website