A Tale of Two Heart Attacks
How a Lean Process Improvement Initiative Resulted in Regional Collaboration

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Stormont-Vail HealthCare

- 586-bed Acute Care Center
- Level II Trauma Center
- Level III NICU
- Serves multi-county region
- More than 200 employed physicians and a variety of ancillary service
- Encompasses SV Hospital, Cotton O’Neil and PediatricCare clinics

Our Mission | Working to improve the health of our community
Objectives

- Define STEMI, D2B and PCI
- Discuss the Lean process improvement methodology
- Compare two cases before and after the Lean project
- Describe how collaborative efforts in quality initiatives can lead to strengthening an organization and improve regional relationships

STEMI

ST-Elevation Myocardial Infarction

- Diagnosed by EKG
- Life-threatening emergency
- STEMI Culprit: Plaque
- Plaque rupture causes blood clot to form
PCI
Percutaneous Coronary Intervention

During

After

D2B
Door to Balloon
The time of patient arrival at facility to the time of PCI device deployment

Time of Arrival to PCI facility + Time of PCI = D2B
History of D2B PI Initiative

• D2B tracked and reported to national databases
• Guidelines set by American College of Cardiology/ American Heart Association
• Time is muscle
• At SV, good, fairly stable process

Case Summary

Previous “Current State”

• EMS identified STEMI from the field, called radio report to SV ED
• Arrived in ED, EKG repeated
• Meds given and cardiology consult in ED
• Door to balloon time of 60 min
• First Medical Contact to Device 115 min
AMI PI Focus Group

• Set goals, how the initiative was chosen

• Team included:
  • Administrative Director, CV Service Line
  • Director, Cath Lab/ EP
  • Administrative Director, ED
  • Manager, ED
  • ED Medical Director
  • Cardiologists
  • Director, Progressive Care

What is Lean?

- Originated with Toyota in the 1950’s “Toyota production System”
Lean Philosophy

Lean is...

“The endless transformation of waste into value from the customer’s perspective.”
Womack and Jones, Lean Thinking

Lean increases product value by removing waste and slowly driving a process towards perfection

Standard Work

“It is impossible to improve any process until it is standardized. If the process is shifting from here to there then any improvement will just be one more variation that is occasionally used and mostly ignored. One must standardize the process before improvements can be made.”
Masaaki Imai
Manufacturing to Healthcare

Really?!?

The Case for Lean in Healthcare

“It is not necessary to change. Survival is not mandatory.”
- Dr. Deming
The Case for Lean in Healthcare

Source: Commonwealth Fund national Scorecard on U.S. health System Performance, 2011
Adapted with permission by Dr. Eric Dickson

International Comparison of Spending on Health, 1980–2009

Mortality Amenable to Health Care

Source: Commonwealth Fund national Scorecard on U.S. health System Performance, 2011
Adapted with permission by Dr. Eric Dickson
What we pay for... What we get...

Lean is a value-based strategy

Value = Quality / Cost

Adapted with permission by Dr. Eric Dickson

What is Lean?
What is Lean?

Value

Value Stream
Flow
Pull
Perfection

What’s wrong with this picture?

“If you would have asked the customer what they wanted, they would have said a faster horse”
Henry Ford

What is Lean?

Value Stream

Value Stream
Flow
Pull
Perfection

Emergency Medical Services
Clinic
Emergency Department
Tertiary Care
Lab / Radiology
Mental Health Services

Patient
What is Lean?

Flow

Elimination of waste

The 8 Wastes:

- Defects/Rework
- Inventory
- Overproduction
- Motion
- Transportation
- Overprocessing
- Waiting
- Human Potential

Waste

Defects / Rework

Time spent doing something incorrectly, inspecting for errors, or fixing errors

Graban, 2010
Waste

Overproduction

Doing more than what is needed by the customer or doing it sooner than needed.

Graban, 2010

Waste

Transportation

Unnecessary movement of the “product” (patients, specimens, materials) in a system

Graban, 2010
Waste

Waiting

Waiting for the next event to occur or next work activity

Waste

Inventory

Excess inventory cost through financial costs, storage and movement costs, spoilage, wastage

Graban, 2010
Waste

Motion

Unnecessary movement by employees in the system

Graban, 2010

Waste

Overprocessing

Doing work that is not valued by the customer or caused by definitions of quality that are not aligned with patient needs

Graban, 2010
Waste

Human Potential  “The greatest waste ... is failure to use the abilities of people”
Dr. Deming

Waste and loss due to not engaging employees, listening to their ideas, or supporting their careers

Graban, 2010

What is Lean?

Value
Value Stream
Flow
Pull
Perfection

Value Stream
Likelihood of success = QS x AS

A3 Problem Solving

Grasp the Situation

Act  Plan

Check  Do

Door-To-Balloon Lean Project

Origins and Scope

• Defining the goal
• Project Scoping
• Identifying the Team
• D2B Value Stream

Door-To-Balloon Lean Project

Grasp the Situation

Current State Analysis

• Define Value
• Map the current state
• Cross-Functional team
• Identify waste and variation
• Go to the Gemba
Door-To-Balloon Lean Project
Grasp the Situation

Data Analysis:
* Stratification
* Box Plots
* Run Chart

Door-To-Balloon Lean Project
Plan/Do/Check/Act

Improvement Projects:
* Pre-Hospital Activation
* ED to Cath Lab Transition
* Activation of STEMI Team
* Quick Hits
Effective Team Selection:
* Avoid Double Digits
* Designate a “Deviant”
* Integrative Thinkers
* Buy-In vs. Ownership
Door-To-Balloon Lean Project
Plan/Do/Check/Act

Pre-Hospital Cath Lab Activation

ED Waste Identified...

<table>
<thead>
<tr>
<th>Type of Waste</th>
<th>Issues</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Defects</strong></td>
<td>• Order Sets not up-to-date</td>
<td>• Up-to-date</td>
</tr>
<tr>
<td></td>
<td>• Cath lab order</td>
<td>• Preselected on STEMI orders</td>
</tr>
<tr>
<td><strong>Overproduction</strong></td>
<td>• X-ray, lab, EKG</td>
<td>• Cancel all pending order</td>
</tr>
<tr>
<td><strong>Transportation</strong></td>
<td>• Monitors</td>
<td>• Only the Zoll accompanies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>patient as appropriate</td>
</tr>
<tr>
<td><strong>Waiting</strong></td>
<td>• Consent</td>
<td>• No consent</td>
</tr>
<tr>
<td></td>
<td>• Registration- In system</td>
<td>• Not required to perform task</td>
</tr>
<tr>
<td><strong>Motion</strong></td>
<td>• IV site</td>
<td>• Education for placement</td>
</tr>
<tr>
<td><strong>Overprocessing</strong></td>
<td>• Consent</td>
<td>• No consent</td>
</tr>
</tbody>
</table>
Door-To-Balloon Lean Project
Plan/Do/Check/Act

Activation of the STEMI Team

* Multiple processes for day and night-waste of variation
* Eliminated dual pathway and waste of variation
* Role delineation
* Waste of waiting, and Human potential

Door-To-Balloon Lean Project
Plan/Do/Check/Act

ED to Cath Lab Transition

Go means GO!!

Cath Lab

* Ready for patient when 2 Cath Lab Team members arrive
* Interventionalist evaluates patients in the Cath Lab
* Medications given and labs obtained in Cath Lab
### Door-To-Balloon Lean Project

#### Plan/Do/Check/Act

### Cath Lab Waste Identified...

<table>
<thead>
<tr>
<th>Type of Waste</th>
<th>Issues</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>• Cath lab Nurse to ED</td>
<td>• Cath Lab calls for patient &amp; ED transports</td>
</tr>
<tr>
<td>Waiting</td>
<td>• Cardiology triage in ED</td>
<td>• Cardiology triage in Cath Lab</td>
</tr>
<tr>
<td></td>
<td>• Medications in ED</td>
<td>• Pharmacist, Meds in Cath Lab</td>
</tr>
<tr>
<td>Variation</td>
<td>• Mult process for paging</td>
<td>• Standardized process</td>
</tr>
<tr>
<td></td>
<td>• Variation in staff roles</td>
<td>• Role delineation</td>
</tr>
<tr>
<td>Motion</td>
<td>• Mult Phone Calls</td>
<td>• Cath Lab calls ED charge only</td>
</tr>
<tr>
<td>Human Potential</td>
<td>• Not engaged, no ownership</td>
<td>• Voice in the process, ownership!</td>
</tr>
</tbody>
</table>

### Door-To-Balloon Lean Project

#### Project mgmt. / Implementation

* FMEA
* Standardized Work Charts
* Communication

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**Potential Failure Mode & Effects Analysis**

<table>
<thead>
<tr>
<th>Row #</th>
<th>Potential Failure Mode</th>
<th>Potential Effects of Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Patient Ineligible for Cath</td>
<td>Patient not seen by Cath Lab</td>
</tr>
</tbody>
</table>

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**Lean Process**

- **Plan**
  - PDCA (Plan-Do-Check-Act)
  - FMEA (Failure Mode and Effects Analysis)
  - Standardized Work Charts
  - Communication

**Door To Balloon Process Map**

- **Triage / Walk in Presentation**
  - Stormont-Vail Health Care
  - Health Connections Process

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**Cath Lab Process**

- **Overview**: Process details and flowchart for Cath Lab operations.
**Results...**

**First Case on May 2\textsuperscript{nd}**

* EMS activated in field
* ED Bypassed
* First Medical Contact to Device 51 min
* Door to Balloon time of 18 min!!!!
  70\% reduction from median

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**Let’s Compare...**

<table>
<thead>
<tr>
<th>Previous Process</th>
<th>New Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>• EMS identified STEMI’s taken directly to ED for pre-cath care</td>
<td>• EMS identified STEMI bypasses ED if cath lab ready</td>
</tr>
<tr>
<td>• EKG repeated</td>
<td>• EMS EKG used</td>
</tr>
<tr>
<td>• Meds given in ED</td>
<td>• Meds given in cath lab</td>
</tr>
<tr>
<td>• Consult / Consent in ED</td>
<td>• Cardiology sees patient in lab / No Consent</td>
</tr>
<tr>
<td>\textbf{D2B = 60 min} \textbf{FMC2B = 115 min}</td>
<td>\textbf{D2B = 18 min} \textbf{FMC2B = 51 min}</td>
</tr>
</tbody>
</table>
Results...  

**Global Reduction in D2B Time**

- **62 min Median**
- **43 min Median**

**31%** Global Reduction in D2B Time

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**EMS Presentation – D2B Process Metrics**

<table>
<thead>
<tr>
<th></th>
<th>Pre-Intervention</th>
<th>Post-Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Hospital Cath Lab Activation</td>
<td>15% (3/20)</td>
<td>80% (12/15)</td>
</tr>
<tr>
<td>ED Bypass</td>
<td>0% (0/3)</td>
<td>75% (9/12)</td>
</tr>
</tbody>
</table>

**EMS Presentation Comparative Data**

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMS D2B Time - Median (Min)</td>
<td>63</td>
<td>24</td>
</tr>
<tr>
<td>EMS D2B Time - Average (Min)</td>
<td>61%</td>
<td>35</td>
</tr>
<tr>
<td>ED Dwell Time - Average (Min)</td>
<td>66%</td>
<td>12</td>
</tr>
</tbody>
</table>
Results...

Door-To-Balloon Lean Project

AMI Case Review

Performance Measures:

<table>
<thead>
<tr>
<th>Intervals Measured</th>
<th>Goal</th>
<th>Actual</th>
<th>ACTION Registry® 50th %ile</th>
<th>ACTION Registry® 90th %ile</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMC (to)ECG Interpretation</td>
<td>10</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EKG (to)ECG team activation</td>
<td>10</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team activation (to) team arrival</td>
<td>30</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team arrival (to) pt. cath lab arrival</td>
<td>10</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-pump arrival (to) case start</td>
<td>10</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case start (to) device</td>
<td>20</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Door (to) Device</td>
<td>90</td>
<td>24</td>
<td>59.9</td>
<td>47.4</td>
</tr>
<tr>
<td>FMC (to) Device</td>
<td>90</td>
<td>47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Based on most recent quarterly report from ACTION Registry®

Name: ********
MRIN: ********
DOS: ********

Summary:
Onset of symptoms: 9:11 AM
24 mins
Overview:
Timeline:
1355: AMR arrives at pt side
1400: EKG obtained/interrogated, STEMI identified
1404: AMR departs, begins transport to SV
1405: EKG transmission received in ED
1408: AMR contacts SV ED with STEMI alert
1408: Health Connections receives request from RN. ED to activate AMR paging
1412: AMR team paged, arrives in house
1418: Pt arrives in cath lab, AMR report to MD and cath lab staff.
1423: Case start
1442: Interventional 1st device
Comments: Successful balloon angioplasty and thrombectomy performed. No stent deployed.
Where from here...

- Community Education
- Continued outreach to EMS and referral hospitals
- STEMI Activation/Process Maintenance
References:  

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Presentation Definitions/Notes:

General Lean Terms:

Value: what a patient would be willing to pay for and/or need to meet their requirements

Value Stream: All processes (and individual steps within processes), both value-creating and nonvalue-creating, required to complete a service or product from beginning to end

Flow: the extent to which work progresses smoothly through the processes and through the value stream

Standard work: Standards or specifications for performing the work in a process, process step, or procedure according to the currently documented best method, this to ensure that work is done correctly and with the least amount of waste, regardless of who is doing the work.

Continuous Improvement: continuous, incremental improvement of standard work on the front line of Lean healthcare operations

8 Types of Lean Waste:

Defects / Rework: Time Spent doing something incorrectly, inspecting for errors, or fixing errors

Overproduction: Doing more than what is needed by the customer or doing it sooner than needed

Transportation: Unnecessary movement of the “product” (patients, specimens, materials) in a system

Waiting: Waiting for the next event to occur or next work activity

Inventory: Excess inventory cost through financial costs, storage and movement costs, spoilage, and wastage

Motion: Unnecessary movement by employees in the system

Overprocessing: Doing work that is not valued by the customer or caused by definitions of quality that are not aligned with patient needs

Human Potential: Waste and loss due to not engaging employees, listening to their ideas or supporting their careers

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