

## Experience with Lean/Six Sigma

Todd Pawlicki




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## What is Six Sigma?

- A methodology
- Focuses on process variation and defects
- Tools and methods to improve process quality and process costs




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## What is Lean?

- A methodology that focuses on process speed, flow, and agility

### **The Application of Lean Thinking to the Care of Patients With Bone and Brain Metastasis With Radiation Therapy**

*By Christopher S. Kim, MD, MBA, James A. Hayman, MD, MBA, John E. Billi, MD, Katly Lash, BS, RT, and Theodore S. Lawrence, MD, PhD*

Departments of Internal Medicine, Pediatrics and Communicable Diseases, and Radiation Oncology, Division of General Internal Medicine, University of Michigan Medical School, Ann Arbor, MI

Journal of Oncology Practice 3(4):189-193, 2007.




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## What is Lean/Six-Sigma?

- An integrated quality, speed, and cost methodology and toolset
- Use more lean tools if trying to improve process speed or reduce process costs,
- Use more Six-Sigma tools if trying to improve process quality



## Lean/Six-Sigma Demystified

- The scientific process applied to quality improvement



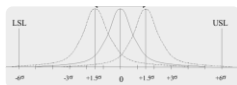
Not quite...also includes many new tools, change management, and sustaining change strategies.



## Six-Sigma Excellence

- Defective parts per million (ppm) opportunities

Limits in sigma around the mean	Probability of having a product outside the limits (Centered distribution)	Probability of having a product outside the limits (distribution shifted by $1.5\sigma$ )
3 sigma	2700 ppm	66,810 ppm
4 sigma	63.4 ppm	6,210 ppm
5 sigma	0.34 ppm	233 ppm
6 sigma	2 ppb	3.4 ppm



## Creator of Six-Sigma

- Bill Smith
  - TQM spinoff; a better mousetrap
- 1952 Naval Academy graduate
  - 35 years engineering and QA
- Joined Motorola in 1987
  - Using 6 $\sigma$ , Motorola was the 1988 Baldrige winner
- Died at work of a heart attack in 1994



## DMAIC



## UCSD Six-Sigma Experience

- Support obtained (~\$20k)
  - May 2010
- June – December 2010
- 5 members / 5 projects
  - Clin Ops Manager, Physics, IT, Dosimetry, Therapy
  - Example
    - Reduce the time for patients to start SRS treatment



## Six Sigma – Project Scorecard

Define	Measure	Analyze	Improve	Control
<b>Charter</b>	<b>Process map</b>	Analyze process flow and identify waste	<b>Prioritize</b>	Create a Control Plan for solution
Form an improvement team including key stakeholders	<b>Data plan</b>	<b>Find variation</b>	Identify, evaluate, and select best solution	<b>Control charts</b>
Validate prob.	Determine process performance capability	Analyze data collected for trends, patterns, and relationships	Develop, optimize and implement pilot solution	<b>SOPs</b>
<b>Communicate</b>	Validate the measurement system	<b>RCA</b>	<b>"to be" VSM</b>	Transition project to process owner
Form a Value Stream Map of "as is" VSM	<b>Collect data</b>	Analyze test samples using statistical tools	Validate pilot solution for potential improvements with feedback from key stakeholders	<b>Communicate</b>
Develop a Value Stream Map (VSM)		<b>ANOVA</b>	<b>FMEA</b>	Facilitate change management
Collect baseline data if applicable		<b>Regression</b>	<b>DOE</b>	
<b>Verify VOC</b>				
Review with Sponsor	Review with Sponsor	Review with Sponsor	Review with Sponsor	Review with Sponsor

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## Project Charter

Project Charter - Six Sigma Performance Improvement Projects			
<b>Project Name:</b> Reducing the time for identifying and starting cranial SRS patients on treatment <b>Start Date:</b> 6/29/2010 <b>End Date:</b> 9/30/2010			
Responsibility	Name	Project Team Members	
		Department	Title
Team Leader	Todd Pawlicki & Greg White		Physicist & Dosimetrist
Project Sponsor	Josh Lawson, MD		Physician (Rad Onc)
Executive Champion	Al Mundi, MD		Department Chair (Rad Onc)
Process Owner	Mary Collins		Clinical Operations Manager
Stakeholder	John Akana, MD		Physician (Neurosurgery)
Team Member	Grace Kim & Jia-Zhu Wang		Physicists
Team Member	Matt Taylor		Chief Therapist
Team Member	Rich Fletcher		Chief IT
Team Member	Polly Noblenavsky		Chief Nurse

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## Problem Statement and Scope

Problem Statement
Currently, it takes 16.3 work days to get a cranial SRS patient on treatment. This results in stress for the patients in waiting for their treatment as well as deviations from high-quality care, in some cases due to medical conflicts with chemotherapy, for example.
Scope
Starts after consult is completed and ends when the patient's first fraction begins.

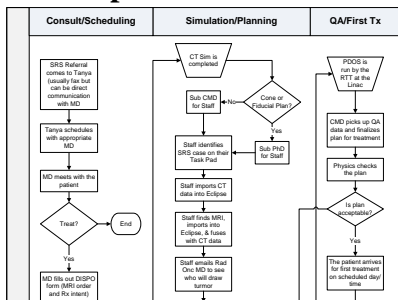
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## Objective and Metrics

Objective	
Decrease the time from consult to first fraction treated by 70%. The goal is to have all SRS patients treated within 5 work days of their consult.	
<b>Primary Metric(s)</b>	Work day hours (7am - 5pm): Consult to first fraction treated.
<b>Secondary Metric(s)</b>	Work day hours: Consult to Sim
	Work day hours: Sim to PDOS started
	Work day hours: PDOS to first fraction treated


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## Process Map



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## Data Collection Plan

Process Owner: Todd Pawlicki			Data Collection Plan					
Process: Reducing the time for identifying and starting cranial SRS patients on treatment								
Data			Operational Definition and Procedures					
What?	Measure Units & Data Type	Sample Size	Stratification Factors	Who will collect data	How Measured?	How will data be collected	Where will data be collected	
Consult	date & time		By case type (cranial SRS)	Schedulers	Entered in Aria	Entered by staff (part of routine procedures)	Aria database	
CT Sim	date & time		Taken from consult case	Schedulers	Entered in Aria	Entered by staff (part of routine procedures)	Aria database	
PDOS	date & time		Taken from CT Sim case	Dosimetrist	Entered in Aria	Entered by staff (part of routine procedures)	Aria database	
First treatment	date & time		Taken from PDOS case	Therapist	Entered in Aria	Entered by staff (part of routine procedures)	Aria database	
Consult to first treatment	duration (7am-5pm weekdays)	41	By case type (cranial SRS)	n/a	calculated from above data	n/a	Aria database	

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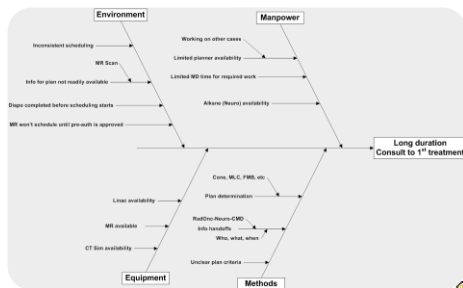
## Baseline Data

### Consult to First Treatment (workdays, 7am - 5pm)

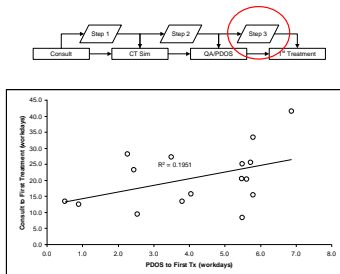
	Raw Data	Outlier Removed
Mean	19.6	16.3
Standard deviation	11.9	6.5
Minimum	8.3	8.3
Maximum	48.7	28.1



## Fishbone Diagram



## Correlation Analysis



## Correlation Analysis – Conclusions

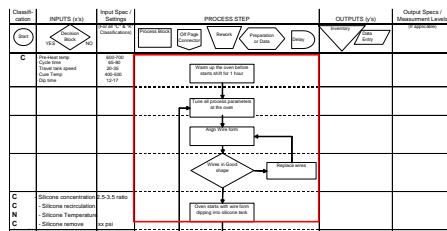


- Strongest correlation for primary metric
  - Consult to CT Sim (Step 1)
- The steps are only weakly correlated
  - Improving one step won't have an effect on the other steps

## Before Change

	Consult to Sim (workdays)	Sim to PDOS (workdays)	PDOS to First Tx (workdays)	Consult to First Tx (workdays)
17.9	5.8	3.5	27.2	
29.3	5.3	6.9	41.5	
3.4	8.2	5.8	16.4	
20.5	5.2	2.3	28.0	
17.3	2.3	5.5	25.1	
13.0	7.7	2.4	23.2	
1.6	1.2	5.5	8.3	
2.6	4.2	2.6	9.4	
5.6	7.2	0.5	13.3	
5.8	5.9	4.1	15.7	
3.6	11.1	5.6	20.3	
9.3	2.3	8.9	12.5	
13.2	14.4	5.8	33.4	
7.4	12.4	5.7	25.5	
1.0	8.6	3.8	13.4	
2.7	12.2	5.5	20.4	
Mean (workdays)	12.37	5.01	3.08	21.26
Stddev (workdays)	9.65	2.14	2.12	10.70
Minimum (workdays)	1.60	1.20	0.51	8.30
Maximum (workdays)	29.30	7.70	6.08	41.47

## Process Map: “To-Be” Process

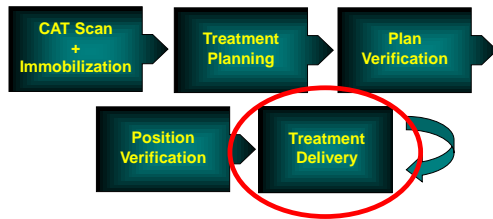


+ Implementation Plan





## Area of focus



- Staff was asked to decrease capture errors
- Staff suggested a focus on treatment delivery

## Value Stream Mapping (VSM)

- Part of Lean Thinking
  - Used to identify and remove waste
- Value stream
  - All the actions required to bring a product or service to a customer
- Steps
  - Establish the process scope
  - Construct a *current* state map
  - Construct a *future* state map
  - Develop a plan to implement changes

## Our VSM Application

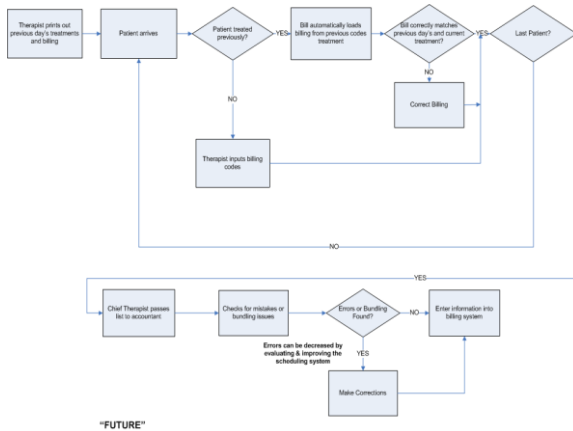
- Step 1
  - Map process by someone not familiar with the process (USD Student)
  - Collect data on accuracy of activity capture
- Step 2
  - Analysis of data ("hard evidence")
- Step 3
  - Create future state
    - Engineering expert + Domain expert = Final recommendations

**21EX**





## Future State Map



## Results – Current State

- Data collected over a two month period

21EX			Trilogy		
#	% tx's		#	% tx's	
20	1.43	Captured incorrectly	11	0.79	Captured incorrectly
17	1.21	Forgot to capture	10	0.71	Forgot to capture
12	0.86	Billed when shouldn't	20	1.43	Billed when shouldn't
8	0.57	Double billed	3	0.21	Double billed

- Total error: ~\$240,500 / month

## Results – *Future State*

- Data collected over a two month period

21EX			Trilogy		
#	% tx's		#	% tx's	
13	0.93	Captured incorrectly	6	0.43	Captured incorrectly
7	0.50	Forgot to capture	5	0.36	Forgot to capture
15	1.07	Billed when shouldn't	2	0.14	Billed when shouldn't
0	0.00	Double billed	4	0.29	Double billed

- Total error: ~\$123,800 / month
- 48.5% improvement



## Lean/Six-Sigma Lessons Learned

- Requirements
  - Direct line of accountability to "senior" management
- Key to success
  - Need protected time for participants
  - Make use the guided problem solving
- Most difficult part
  - Data collection and analysis

