Experience with Lean/Six Sigma

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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, Kathy 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

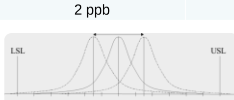
- The scientific process applied to quality improvement

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 1.5σ)
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 6σ, Motorola was the 1988 Baldrige winner
- Died at work of a heart attack in 1994

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DMAIC

Define
What problem to solve?

↓

Measure
What is the process capability?

↓

Analyze
When & where do defects occur?

↓

Improve
Go after root causes.

↓

Control
Control process to sustain gains.

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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

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Six Sigma – Project Scorecard

Define	Measure	Analyze	Improve	Control
Charter	Process map	Analyze process flow and identify waste	Prioritize	Create a Control Plan for solution
Form an improvement team including key stakeholders	Data plan	Find variation	Identify, evaluate, and select, best solution	Control charts
Validate prob.	Determine process performance / capability	Analyze data collected for trends, patterns, and relationships.	Develop, optimize and Implement pilot solution	SOPs
Communicate	Validate the measurement systems	RCA	“to be” VSM	Transition project to process owner
Create a Value Stream Map of “as is” VSM process.	Collect data	Analyze two samples using Hypothesis Tests	Validate pilot solution for portential improvements with feedback from key stakeholders	Communicate adoption.
Develop a high level process map (SIPOC)		ANOVA	FMEA	Facilitate change management
Collect baseline data if exists		Understand relationships in two variables Correlation	DOE	
Verify VOC		Regression		
Review with Sponsor	Review with Sponsor	Review with Sponsor	Review with Sponsor	Review with Sponsor

Project Charter

Project Charter - Six Sigma Performance Improvement Projects

Project Name: Reducing the time for identifying and starting cranial SRS patients on treatment
Start Date: 6/29/2010
End Date: 9/30/2010

Project Team Members

Responsibility	Name	Department	Title
Team Leader	**Todd Pawlicki & Greg White**		**Physicist & Dosimetrist**
Project Sponsor	**Josh Lawson, MD**		**Physician (Rad Onc)**
Executive Champion	**AJ Mundt, MD**		**Department Chair (Rad Onc)**
Process Owner	**Mary Collins**		**Clinical Operations Manager**
Stakeholder	**John Alksne, MD**		**Physician (Neurosurgen)**
Team Member	**Grace Kim & Jia-Zhu Wang**		**Physicists**
Team Member	**Matt Taylor**		**Chief Therapist**
Team Member	**Rich Fletcher**		**Chief IT**
Team Member	**Polly Nobiensky**		**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.
Primary Metric(s)	Work day hours (7am - 5pm): Consult to first fraction treated.
Secondary Metric(s)	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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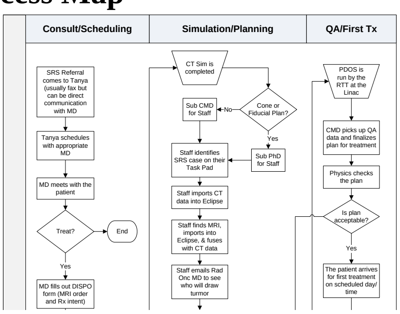
Process Map



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Data Collection Plan

Process Owner: Todd Pawlicki			Data Collection Plan			UC San Diego Radiation Oncology	
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 workdays)	41	By case type (cranial SRS)	n/a	calculated from above data	n/a	Aria database

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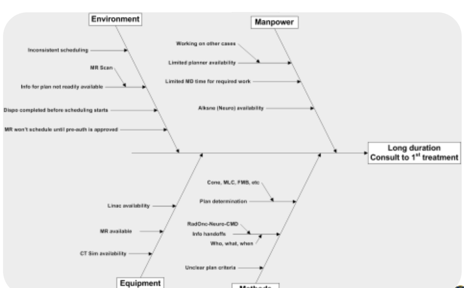
Baseline Data

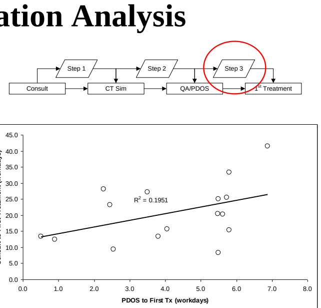
Consult to First Treatment **(workdays, 7am - 5pm)**

	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

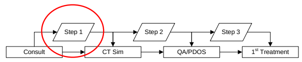
Fishbone Diagram



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

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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	6.2	5.8	15.4
	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	0.9	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	3.88	21.26
Stdev (workdays)	9.66	2.14	2.12	10.70
Minimum (workdays)	1.60	1.20	0.51	8.30
Maximum (workdays)	29.30	7.70	6.88	41.47

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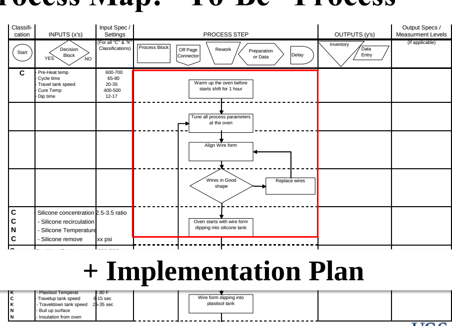
Process Map: "To-Be" Process



+ Implementation Plan

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After Change

	Consult to Sim (workdays)	Sim to PDOS (workdays)	PDOS to First Tx (workdays)	Consult to First Tx (workdays)
	3.0	7.7	1.9	12.6
	0.0	1.9	0.5	2.5
	0.2	4.5	1.0	5.7
	1.1	4.6	0.9	6.5
	1.9	2.8	0.5	5.2
	6.4	1.0	0.9	8.3
	0.1	6.6	1.6	8.3
	0.2	5.9	0.9	7.0
Mean (workdays)	1.62	4.36	1.03	7.01
Stdev (workdays)	2.21	2.34	0.50	2.94
Minimum (workdays)	0.05	1.00	0.53	2.47
Maximum (workdays)	6.40	7.65	1.95	12.60

Cost Benefit Analysis

Cost Benefit Analysis		
Process:		
Project Team:		
Team Leader:		
Expected Costs		
Description	Unit	Cost
	Expected Costs	$ -
Benefits		
Description	Unit	Savings
	Estimated Procurement Savings	$ -
	Projected Project Savings	$ -

VSM IERC 2008

Using Value Stream Map on The Issue of Activity Capture and Billing at an Academic Radiation Oncology Department

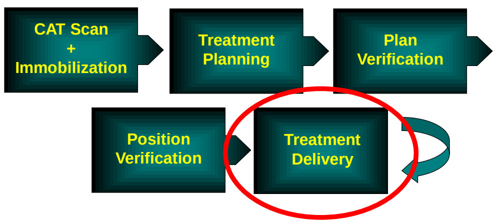
Claribel Bonilla, PhD, CSSBB
Brigitte Wesselink, (Student)
Ashlee Enriquez, (Student)

University of San Diego
Department of Industrial & Systems Engineering

Todd Pawlicki, PhD

University of California, San Diego
Department of Radiation Oncology

Area of focus



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

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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

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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

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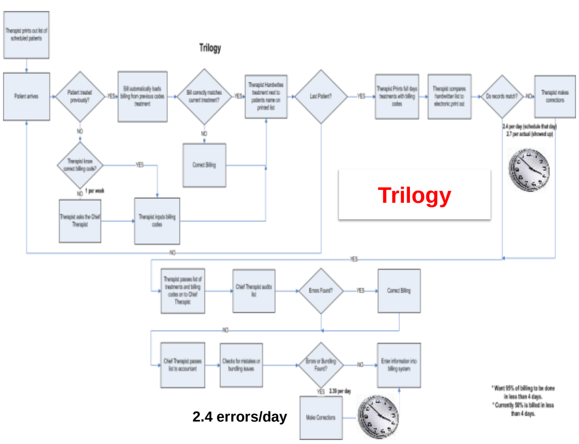
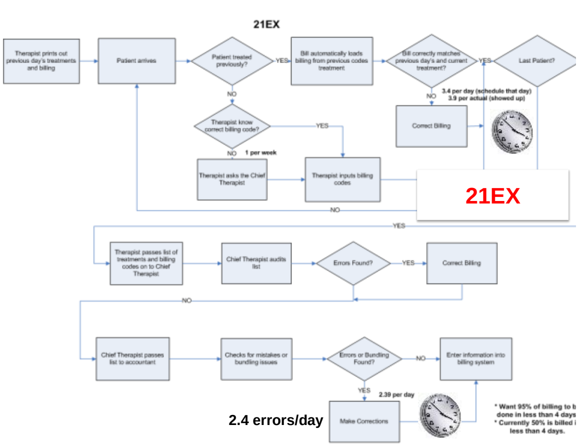
Trilogy **21EX**





Future State Map

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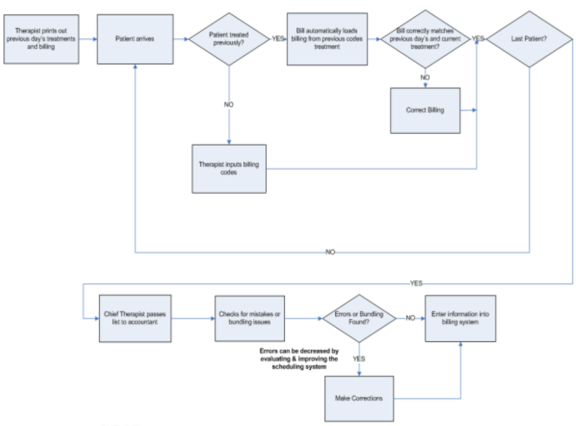

"FUTURE"

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

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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

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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

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