RHP 9 Process Improvement Cohort

August 27, 2014

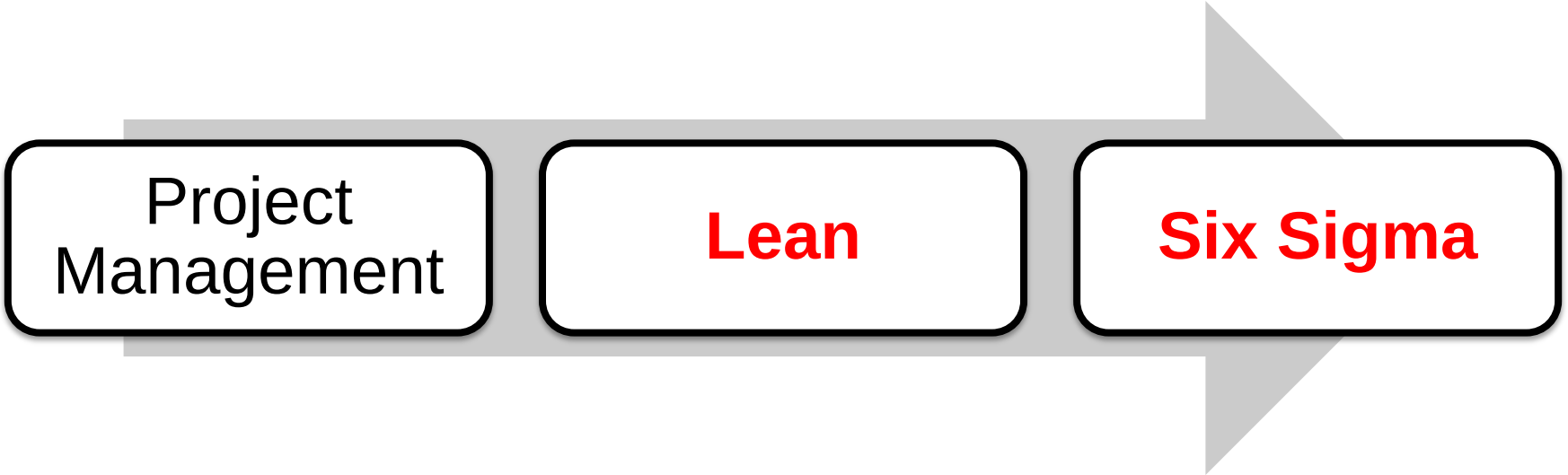
RHP 9 PI Cohort

Agenda

Agenda Item	Time
Purpose and Objectives	9:00 AM
Lean Methodology Overview	9:10 AM
Lean Tools	9:35 AM
Break	*9:45 AM*
Lean Group Activity	9:55 AM
Lean Project Case Study	10:15 AM
Break	*10:25 AM*
Six Sigma Methodology Overview	10:35 AM
Six Sigma Tools	10:55 AM
Six Sigma Group Activity	11:05 AM
Break	*11:20 AM*
Six Sigma Project Case Study	11:30 AM
Group Discussion and Feedback	11:40 AM

What's the Difference?

Relationship between Project Management, Lean and Six Sigma



- Lean and Six Sigma are problem solving methodologies that focus on eliminating waste, variation and adding value
- Project management is the foundation used to execute Lean and Six Sigma projects

What is Lean?

Organizational Habits

Consider the old adage:

Sow a thought, reap an act.

Sow an act, reap a habit.

Sow a habit, reap a character.

Sow a character, reap a destiny.

What is Lean?

The Toyota Triangle

- Lean is an integrated system of human development, technical tools management approaches and philosophy that creates a lean organizational culture

"In short, Lean thinking is Lean, because it provides a way to do more and more with less and less – less human effort, less equipment, less time, and less space – while coming closer and closer to providing customers with exactly what they want." [1]

Womack, James P., and Daniel T. Jones, *Lean Thinking* (New York: Free Press, 2003), 15.

What is Lean?

The Toyota Way

1. Continuous improvement
   - *Kaizen* (improvement)
   - *Muda* (waste)
2. Respect for people
   - Frequent verification on how work is being done
   - Challenging people to perform better but not overworking them

"The most important objective of the Toyota system has been to increase production efficiency by consistently and thoroughly eliminating waste. The concept and the equally important respect for humanity that has passed down form the venerable Sakichi Toyoda… are the foundation of the Toyota production system."

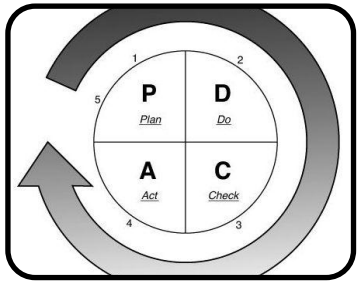
- Taiichi Ohno

What is Lean?

Four Organizational Capabilities[1]

Capability 1: Work is designed as a series of ongoing experiments that immediately reveal problems

- Work is not supposed to take place is a random or inconsistent manner
- Standardizing work should not mean that procedures are final
- Work should be structured so problems are made readily apparent so they can be fixed as quickly as possible



Capability 2: Problems are addressed immediately through rapid experimentation

- When a problem is discovered, this focus should be on solving that problem immediately.
- *"No problems is a problem"*
- A healthy culture doesn't expect success 100% of the time; high expectations can lead to a risk-averse culture

[1] Spear, Steven J., *The High-Velocity Edge: How Market Leaders Leverage Operational Excellence to Beat the Competition* (New York: McGraw-Hill, 2010), 22.

What is Lean?

Four Organizational Capabilities[1]

Capability 3: Solutions are disseminated adaptively through collaborative experimentation

- Local improvements made in one area need to be shared with other departments or areas
- Improvements in other units should be considered a starting point for other units before implementation is decided

Capability 4: People at all levels of the organization are taught to become experimentalists

- Continued coaching, training, and mentoring are required
- Internal and external groups are used to facilitate mentorship with a fresh pair of eyes

[1] Spear, Steven J., *The High-Velocity Edge: How Market Leaders Leverage Operational Excellence to Beat the Competition* (New York: McGraw-Hill, 2010), 22.

What is Lean?

Separate Motion From Value[1]

Waste

- Not the same as cost
- Interruptions, miscommunications, wasted motion and workarounds

Value

Start with the customer

1. The customer must be willing to pay for the activity
2. The activity must transform the product or service in some way
3. The activity must be done correctly the first time

[1] Sayer, Natalie J., and Bruce Williams, Lean for Dummies (Hoboken, NJ: Wiley, 2007), 51.

What is Lean?

Value vs. Waste[1]

Example for Different Roles in Hospital Departments

Department	*Role*	*VA Activity Example*	*NVA Activity Example*
Operating room	Surgeon	Operating on patient	Waiting for delayed procedure or performing unnecessary steps
Pharmacy	Pharmacy technician	Creating an intravenous formulation	Reprocessing medications that were returned from patient units
Inpatient unit	Nurse	Administering medications to a patient	Copying information from one computer system into another
Radiology	Radiology technician	Performing magnetic resonance imaging procedure	Performing a medically unnecessary scan
Laboratory	Medical technologist	Interpreting a test result	Fixing a broken instrument

Examples for Different "Products" in Hospital Processes

Department	*"Product"*	*VA Activity*	*NVA Activity*
Emergency room	Patient	Being evaluated or treated	Waiting to be seen
Clinical laboratory	Patient specimen	Being centrifuged or tested	Waiting to be moved as a "batch"
Pharmacy	Prescription	Medication being formulated or prepared	Being inspected multiple times
Perioperative services	Sterilized instruments	Time when instruments are being sterilized	Instruments being sterilized repeatedly without ever being used from a standard kit
Nutrition services	Patient food tray	Time when food is being cooked or tray is being assembled	Being reworked because the tray was made incorrectly

[1] Mark; Graban (2011-12-20). *Lean Hospitals: Improving Quality, Patient Safety, and Employee Engagement*, Second Edition (Kindle Location 1702).

What is Lean?

The Eight Types of Waste[1]

Defects

- Time spent doing something incorrectly
- Example: Surgical case cart missing an item; wrong medicine or wrong dose administered to patient

Overproduction

- Doing more than what is needed by the customer or doing it sooner than needed
- Example: Doing unnecessary diagnostic procedures

Transportation

- Unnecessary movement of the "product" (patients, specimens, materials) in a system
- Example: Poor layout, such as the catheter lab being located a long distance from the ED

Waiting

- Waiting for the next event to occur or next work activity
- Example: Employees waiting because workloads are not level; patients waiting for an appointment.

Inventory

- Excess inventory cost through financial costs, storage and movement costs, spoilage, wastage
- Example: Expired supplies that must be disposed of, such as out-of-date medications

Motion

- Unnecessary movement by employees in the system
- Example: Lab employees walking miles per day due to poor layout

Overprocessing

- Doing work that is not valued by the customer or caused by definitions of quality that are not aligned with patient needs
- Example: Time/date stamps put onto forms, but the data are never used

Human Potential

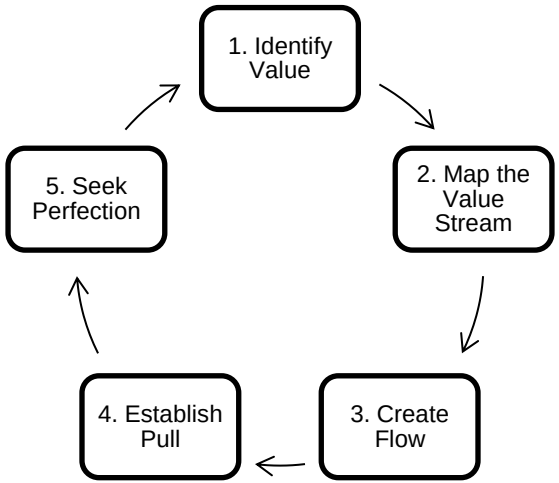
- Waste and loss due to not engaging employees, listening to their ideas, or supporting their careers
- Example: Employees get burned out and quit giving suggestions for improvement

[1] Mark; Graban (2011-12-20). *Lean Hospitals: Improving Quality, Patient Safety, and Employee Engagement*, Second Edition (Kindle Location 1725).

Implementing Lean

Principles of Lean[1]

1. Specify value from the standpoint of the end customer by product family.
2. Identify all the steps in the value stream for each product family, eliminating whenever possible those steps that do not create value.
3. Make the value-creating steps occur in tight sequence so the product will flow smoothly toward the customer.
4. As flow is introduced, let customers pull value from the next upstream activity.
5. As value is specified, value streams are identified, wasted steps are removed, and flow and pull are introduced, begin the process again and continue it until a state of perfection is reached in which perfect value is created with no waste.



[1] Lean Enterprise Institute, Inc. (2009). *Principles of Lean*. Retrieved July 31, 2014, from Lean Enterprise Institute: http://www.lean.org/WhatsLean/Principles.cfm

Lean Tools

Make Waste, Problems or Abnormal Conditions Visually Apparent

Before

After

Lean Tools

Kanban – “Sign” or “Signboard”

How it Works

- A card (the kanban) controls the movement of materials between production processes
- A kanban moves with the same materials all the way through the production process
- When a process needs more materials, it sends the corresponding kanban to the supplier

Benefits

- Purchasing is based on use - no guessing and no overstock
- Can eliminate rush deliveries - Kanban quantities are sized to include lead time and adequate safety stock
- Takes the guesswork out of what, when, and how much to order or re-supply

Lean Tools

6S: Sort, Store, Shine, Standardize, Sustain and Safety

1. Sort - Keep only what is required
2. Store - Arrange and identify for ease of use, organize
3. Shine - Clean regularly
4. Standardize - Eliminate causes to reduce variations, make standards obvious
5. Sustain - Set discipline, plan, schedule, train
6. Safety - Maintain the highest standards of safety

Guidelines for Storing Items[1]

Frequency of Use	***Storage Proximity***
Hourly	Within arm's reach
Every Shift	Within a short walk
Daily	Further away
Monthly	Department storage
Annually	Hospital storage

[1] Mark; Graban (2011-12-20). *Lean Hospitals: Improving Quality, Patient Safety, and Employee Engagement*, Second Edition (Kindle Location 3233).

10 Minute Break

Lean Group Activity

6S Numbers Game

Start

- Don’t begin until you are told to begin
- On your worksheet, cross out the numbers 1 to 49 in the correct sequence
- Complete this task in 30 seconds

Finish

- How many numbers have you crossed out?
- How do you feel about this score?
- What impacted your score?

Lean Group Activity

6S Numbers Game

Sort

- There is too much clutter in our worksheet
- We don’t need the numbers 50-90 so they have been removed
- When told to begin, cross out numbers 1-49 in the correct sequence
- Complete this task in 30 seconds

Team Score:

- How do you feel about this score?
- How might you improve your score?

Lean Group Activity

6S Numbers Game

Set in Order

- Racks (3 x 3) have been installed on the worksheet
- Numbers are organized - 1, lower left, 2 middle left, etc.
- When told to begin, cross out numbers 1-49 in the correct sequence
- Complete this task in 30 seconds

Team Score:

- How do you feel about this score?
- How might you improve your score?

Lean Group Activity

6S Numbers Game

Standardize

- A better rack system has been installed
- Numbers are reorganized
- When told to begin, cross out numbers 1-49 in the correct sequence
- Complete this task in 30 seconds

Team Score:

- How do you feel about this score?
- How might you improve your score?

Lean Group Activity

6S Numbers Game

Benefits of a 6S Workplace

- Two numbers are missing!
- When told to begin, find the missing numbers
- Call out when you've found the missing numbers

Team Score:

- How do you feel about this score?
- How might you improve your score?

Lean Group Activity

6S Numbers Game

Benefits of a 6S Workplace

- Two numbers are missing again!
- When told to begin, find the missing numbers
- Call out when you've found the missing numbers

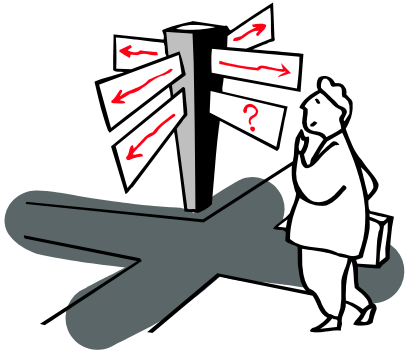
Team Score:

- How do you feel about this score?
- How might you improve your score?

Lean Case Study

UTSW: Electroconvulsive Therapy (ECT)

- Shelley Brown, Director of Neurosciences & Therapy Services, asked Lean Six Sigma Team to conduct an observation of the ECT area and make recommendations to improve Patient and Process Flow



Lean Case Study

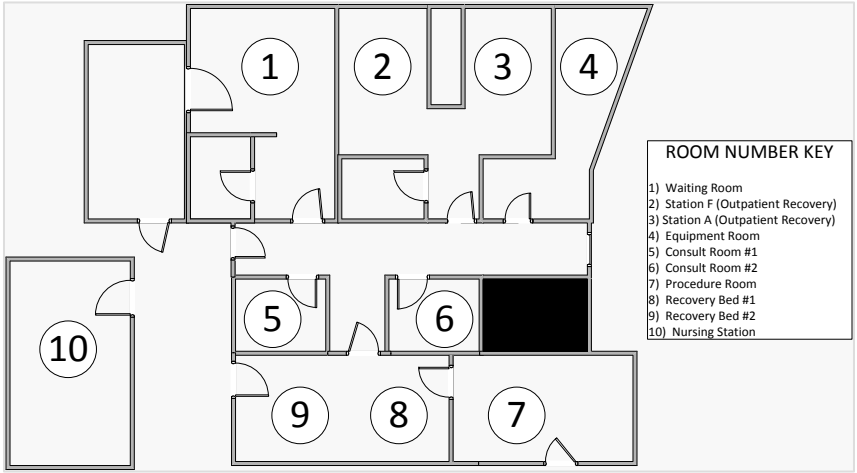
UTSW: Electroconvulsive Therapy (ECT)

- Work Days & Hours
  - Monday, Wednesday, Thursday, Friday (6a - 6p)
  - Anesthesiologists Start & End Times (7a - 3p)
- See only Outpatients on Thursdays
- Staff – 6 Nurses & 3 Anesthesiologists
- Cannot mix Outpatients with Inpatients, Anesthesia with Non-Anesthesia patients
  - Outpatient Recovery Room can be an exception (Separated by Station A & F)

Lean Case Study

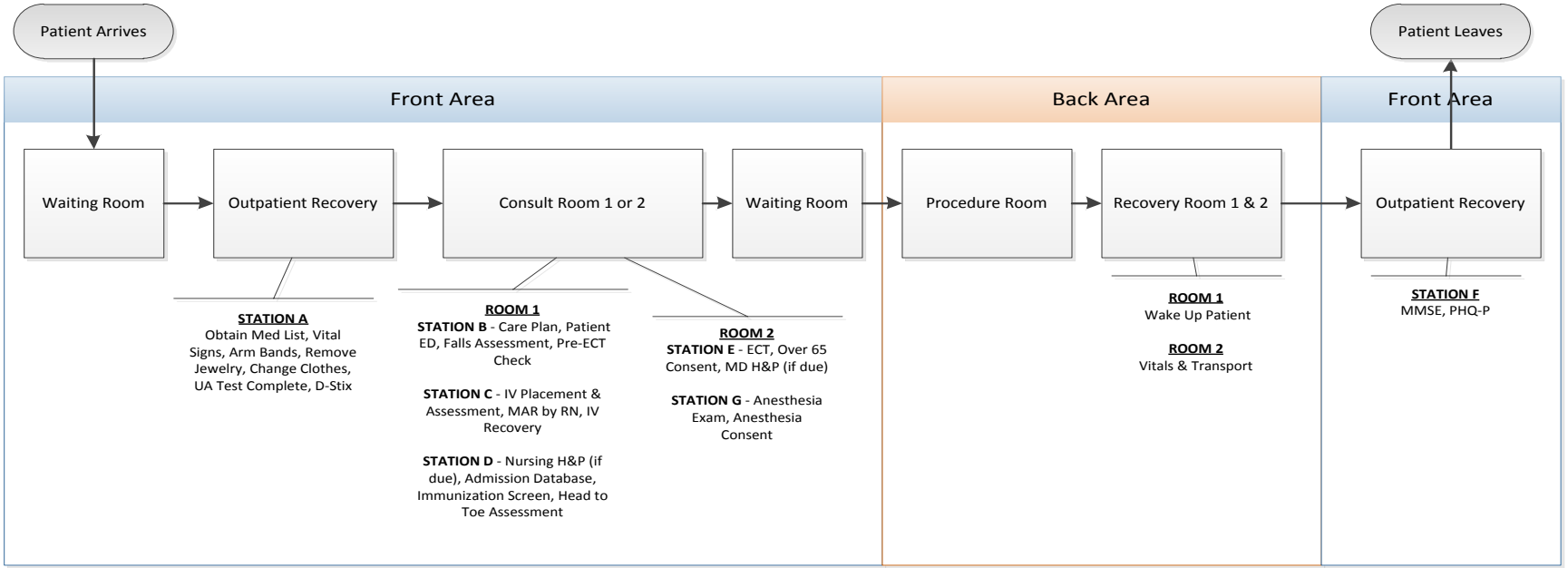
UTSW: Electroconvulsive Therapy (ECT)

- Conduct time studies by tracking patient movement
  - Before Recommendations
    - Thursday, December 13, 2012 (Outpatients Only)
      - Observed 8 Patients
    - Friday, December 21, 2012 (Outpatients & Inpatients)
      - Observed 20 Patients
        - » 13 Outpatients
        - » 7 Inpatients
  - After Recommendations
    - Wednesday, March 27, 2013 (Outpatients & Inpatients)
      - Observed 13 Patients
        - » 7 Outpatients
        - » 6 Inpatients
- Observe front area (Omar R.)
  - Waiting Room (Area 1)
  - Consult Rooms (Area 5 & 6)
  - Outpatient Recovery Rooms (Area 2 & 3)
- Observe back area (Chris S.)
  - Procedure Room (Area 7)
  - Recovery Rooms (Area 8 & 9)



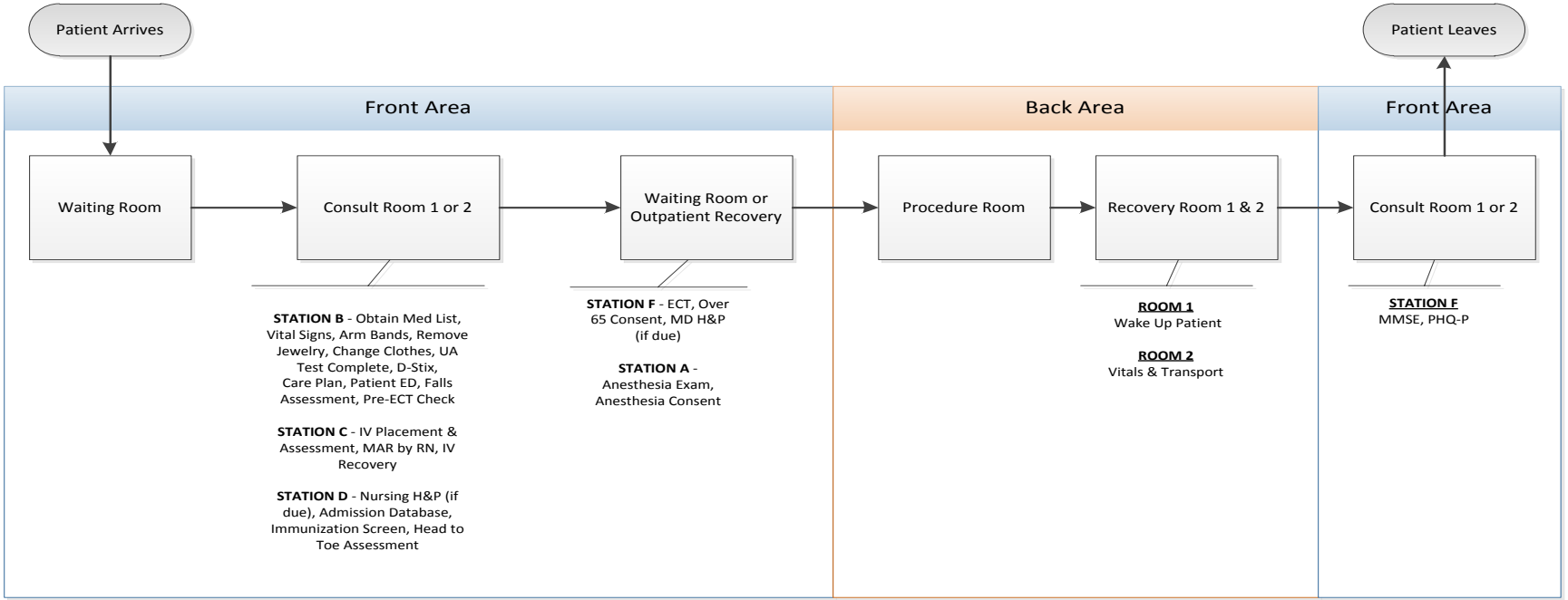
Lean Case Study

UTSW: Electroconvulsive Therapy (ECT)



Lean Case Study

UTSW: Electroconvulsive Therapy (ECT)

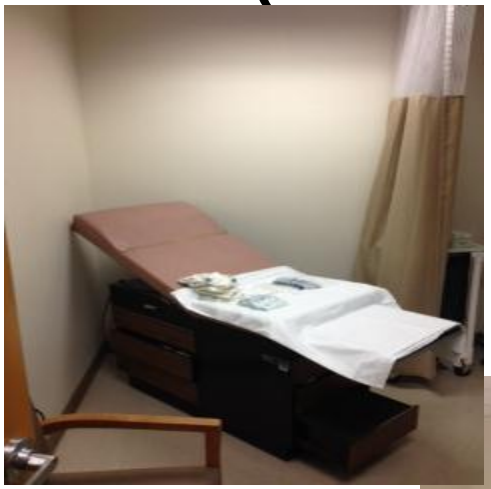


What we learned: The ECT staff modified the rooms and combined certain tasks to increase the Patient Flow.

Consult Room 1

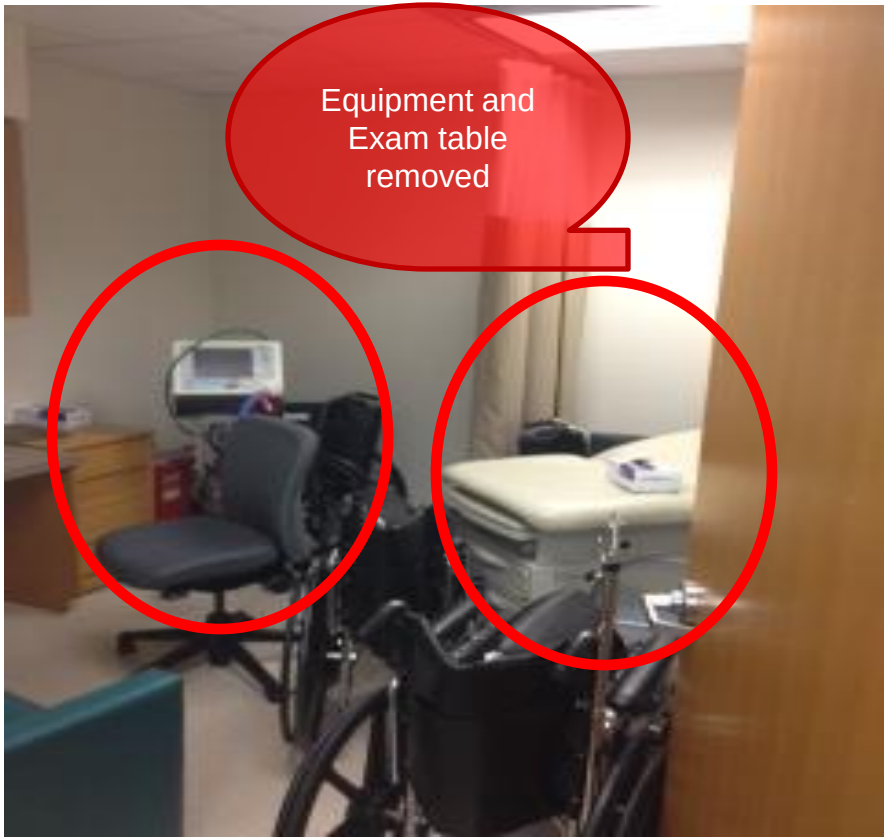
Before

After (March 27th, 2013)



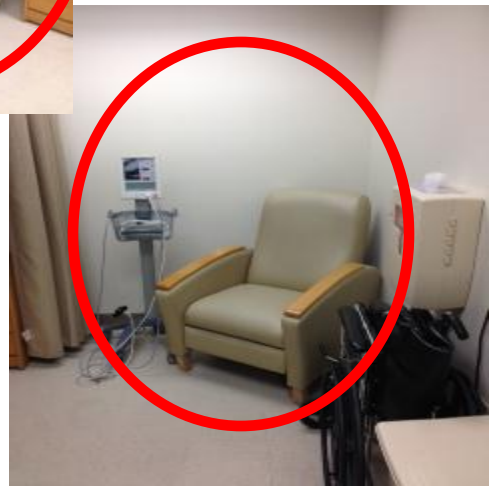
Consult Room 2

Before



After (March 27th, 2013)

Replaced with chairs to create two consult areas



Outpatient Recovery – Station A

Before

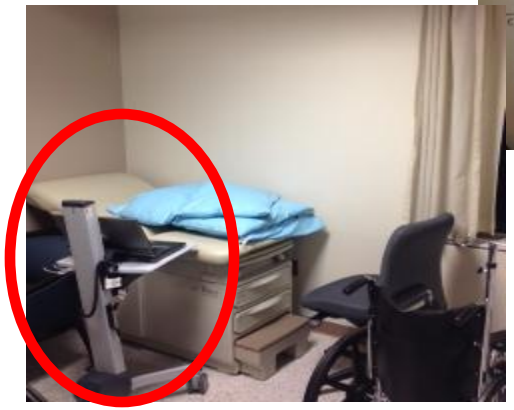
After (March 27th, 2013)

This is now a sub-waiting area

Outpatient Recovery – Station F

Before

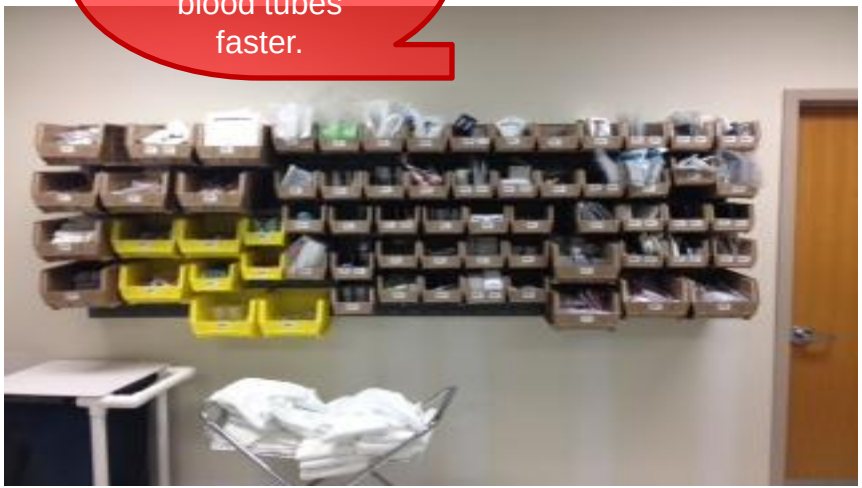
After (March 27th, 2013)



Recovery Room – Supply Wall

Before

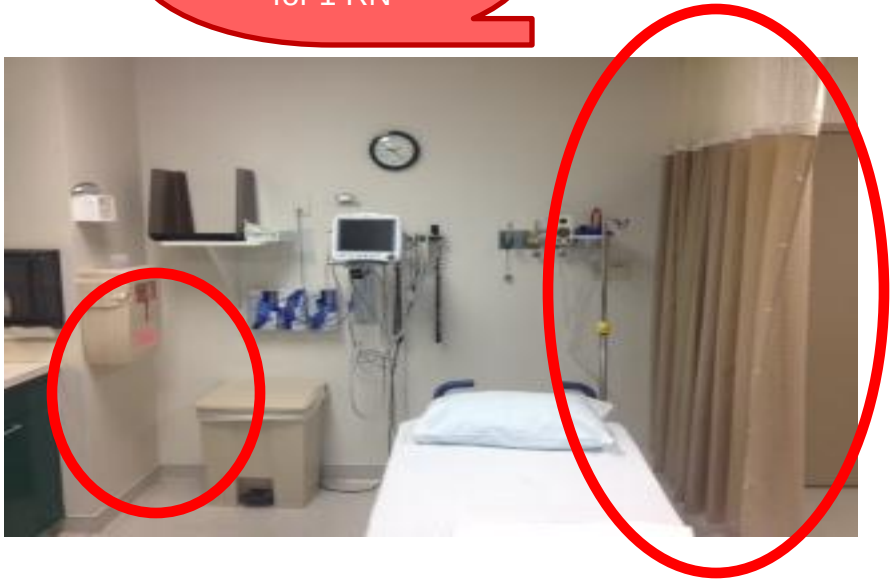
After (March 27th, 2013)



Recovery Room – Bed 1

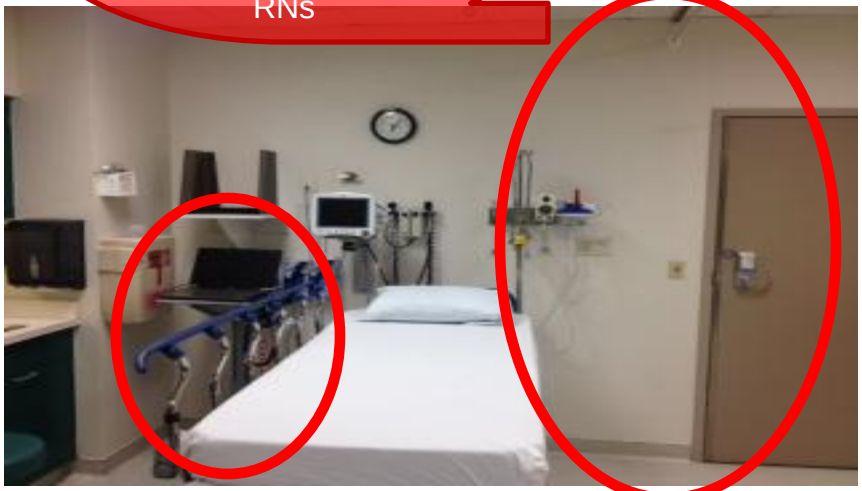
Before

Only one Recovery Area for 1 RN



After (March 27th, 2013)

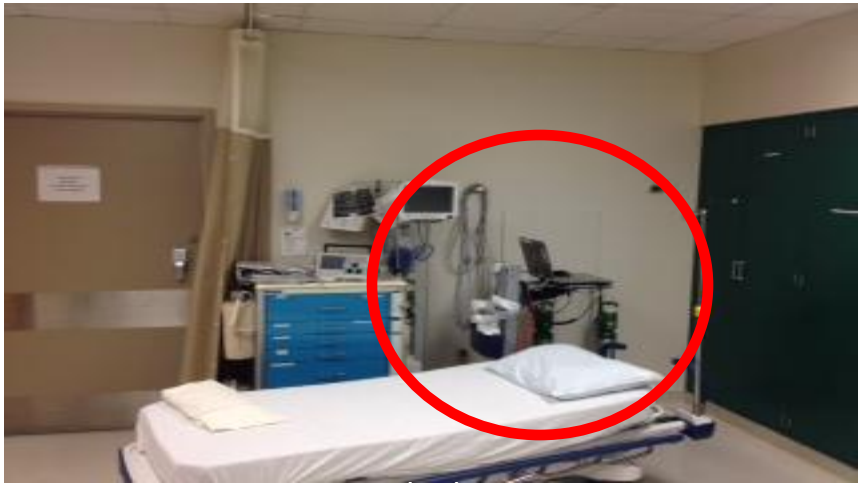
Better stands for the laptops. Curtain is moved to the center of the room to create 2 Recovery Areas for 2 RNs



Recovery Room – Bed 2

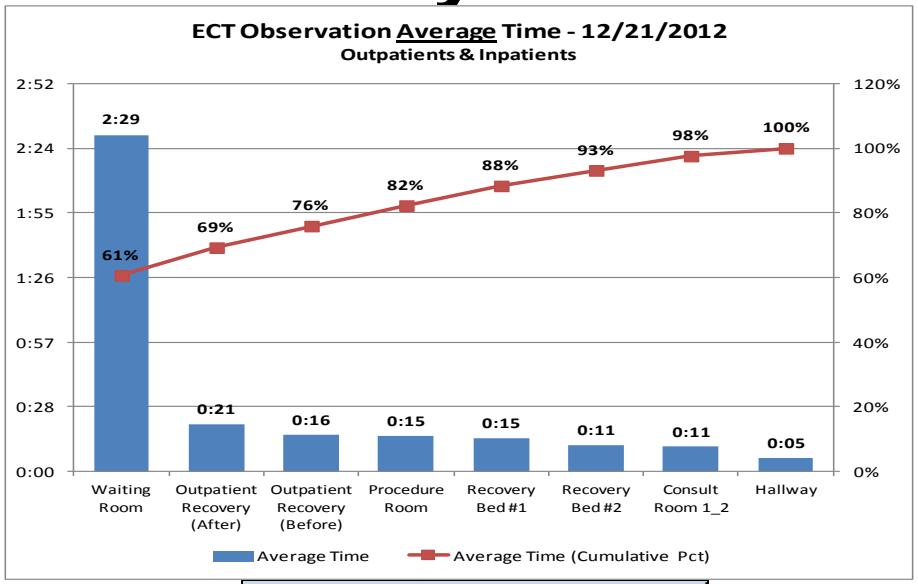
Before

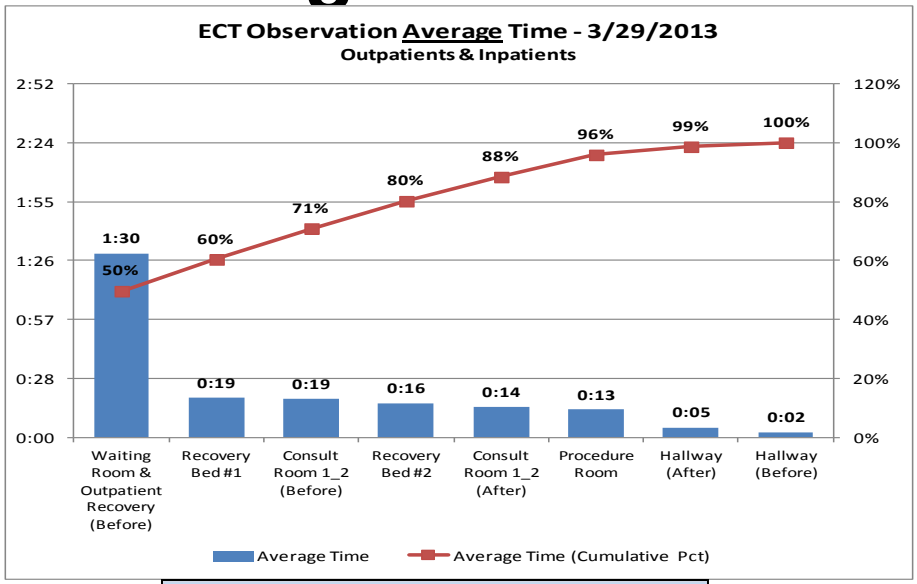
After (March 27th, 2013)



areas so patients receive the same treatment. Bed 2 has oxygen tanks instead of an O2 wall

Analysis – Patient Average Times



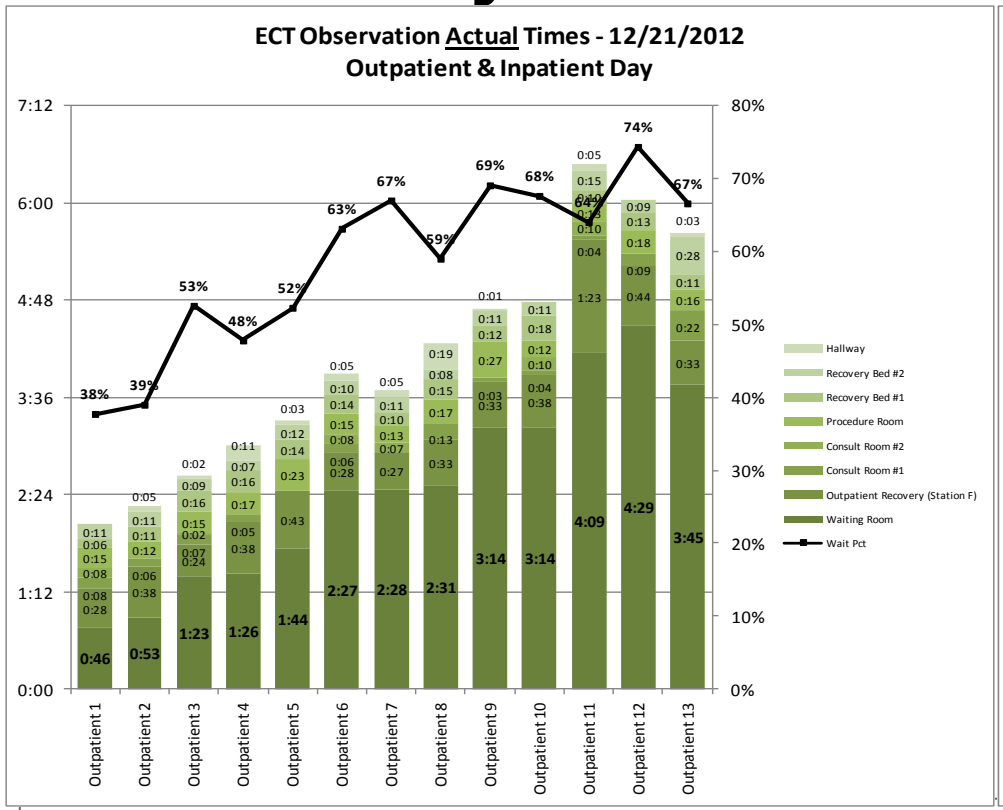


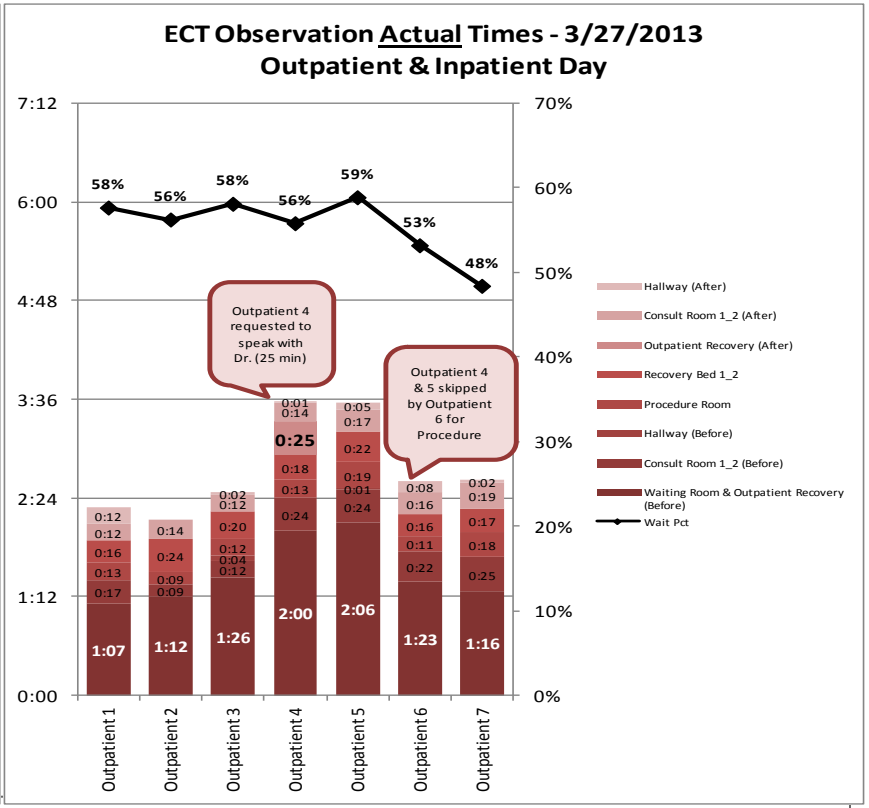
Observation 12/21/2012		
Room	Average Time	Pct
Waiting Room	2:29	61%
Outpatient Recovery (After)	0:21	9%
Outpatient Recovery (Before)	0:16	7%
Procedure Room	0:15	6%
Recovery Bed #1	0:15	6%
Recovery Bed #2	0:11	5%
Consult Room 1_2	0:11	4%
Hallway	0:05	2%
Total	**4:07**	
13 Outpatients & 7 Inpatients		

Observation 3/27/2013		
Room	Average Time	Pct
Waiting Room & Outpatient Recovery (Before)	1:30	50%
Recovery Bed #1	0:19	11%
Consult Room 1_2 (Before)	0:19	10%
Recovery Bed #2	0:16	9%
Consult Room 1_2 (After)	0:14	8%
Procedure Room	0:13	8%
Hallway (After)	0:05	3%
Hallway (Before)	0:02	1%
Total	**3:01**	
7 Outpatients & 6 Inpatients		

What we learned: A Pareto chart is a bar graph. The lengths of the bars represent "Average" time spent in each area, and are arranged with longest bars on the left and the shortest to the right. The chart visually depicts which times are more significant. The line shows the Cumulative Percentage by area (Patient's Time was spent in the Waiting Room went from **61%** to **50%**).

Analysis – Patient Actual Times





What we learned: The Stacked Bar Chart shows each Patient's Actual Times spent in each room. The Line (secondary axis) represents each Patient's Waiting Room time percentage of the Total Time spent in ECT. Notice the Wait Times and Total Times increased from the first patient to the last. Procedures were scheduled to start at 8:00a and Outpatient 1 was ready at 7:30a, so there Wait Time probably would have been shorter had the Patient not arrived early (before 6:45a).

Analysis – Patient Procedure Times

Procedure Room Breakdown (7)							
Date	**Patient**	**Time In**	**MD Start**	**Time Out**	**Meds**	**Proc Start**	**Proc End**
12/13/2012	Outpatient2	7:16	7:23	7:25	7:26	7:30	7:32
12/13/2012	Outpatient3	7:40	7:44	7:45	7:48	7:51	7:52
12/13/2012	Outpatient1	8:00	8:05	8:05	8:05	8:10	8:11
12/13/2012	Outpatient4	8:18	8:34	8:35	8:37	8:39	8:41
12/13/2012	Outpatient5	8:48	8:49	8:52	8:54	8:56	8:57
12/13/2012	Outpatient6	9:06	9:10	9:10	9:11	9:15	9:17
12/13/2012	Outpatient7	9:22	9:27	9:29	9:31	9:33	9:34
12/13/2012	Outpatient8	9:45	9:49	9:50	9:56	9:59	10:00
3/27/2012	**Outpatient1**	**8:09**	**8:12**	**8:13**	**8:15**	**8:17**	**8:22**

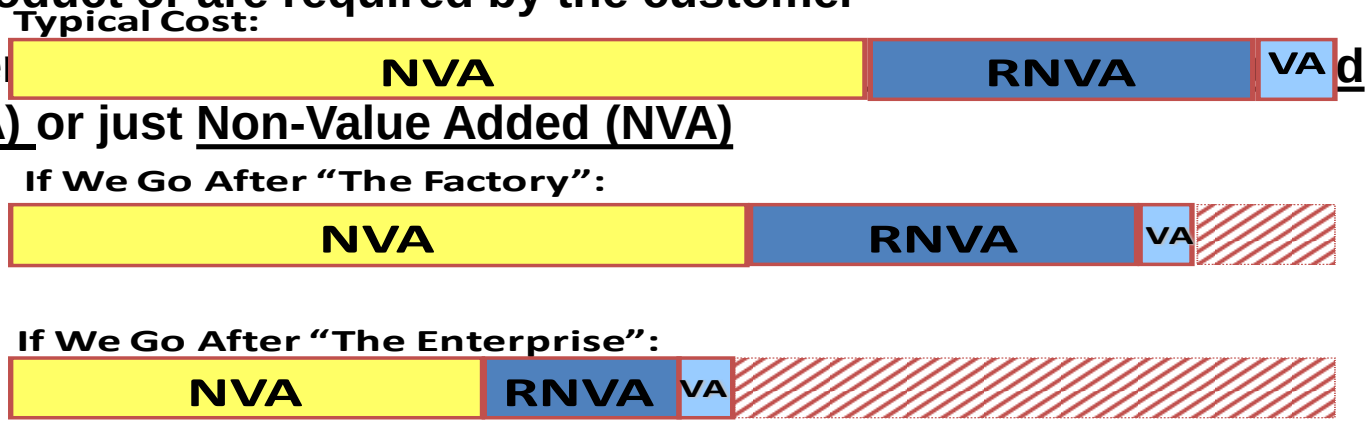
Procedure Room Delta Times						
Date	**Patient**	**TimeIn_MD Start_Delta**	**MD Start_Time Out_Delta**	**TimeOut_Meds _Delta**	**Meds_Proc_Del ta**	**ProcStart_End_ Delta**
12/13/2012	Outpatient2	0:07	0:02	0:01	0:04	0:02
12/13/2012	Outpatient3	0:04	0:01	0:03	0:03	0:01
12/13/2012	Outpatient1	0:05	0:00	0:00	0:05	0:01
12/13/2012	Outpatient4	0:16	0:01	0:02	0:02	0:02
12/13/2012	Outpatient5	0:01	0:03	0:02	0:02	0:01
12/13/2012	Outpatient6	0:04	0:00	0:01	0:04	0:02
12/13/2012	Outpatient7	0:05	0:02	0:02	0:02	0:01
12/13/2012	Outpatient8	0:04	0:01	0:06	0:03	0:01
12/13/2012	Mean	0:05	0:01	0:02	0:03	0:01
12/13/2012	Median	0:04	0:01	0:02	0:03	0:01
3/27/2012	Outpatient1	0:03	0:01	0:02	0:02	0:05

Procedure Room Wheels In - Wheels Out Delta				
12/13/2012	Mean	0:13	Median	0:12
12/21/2012	Mean	0:15	Median	0:14
3/27/2013	Mean	0:14	Median	0:13

What we learned: Mean is the average. Median is the middle observation in the data set. It is less sensitive to extreme values than the mean.

Value Added vs. Non Value Added Analysis

- All actions and activities, both value added (VA) and non-value added (NVA), required by the current state of the process to meet the customer demand
- Value Added (VA): Any activities that change the fit, form, or function of the product or are required by the customer
- The re[illegible]d (RNVA) or just Non-Value Added (NVA)



What we learned: Time spent 'Waiting' would be considered **'Non-Value Added'**. Time spent in the Consult & Recovery Rooms would be **'Required but Non-Value Added'**. Time spent in Procedure Room would be considered **'Value Added'**.

Consider 'Value-Added' tasks as tasks that the Customer is willing to pay for.

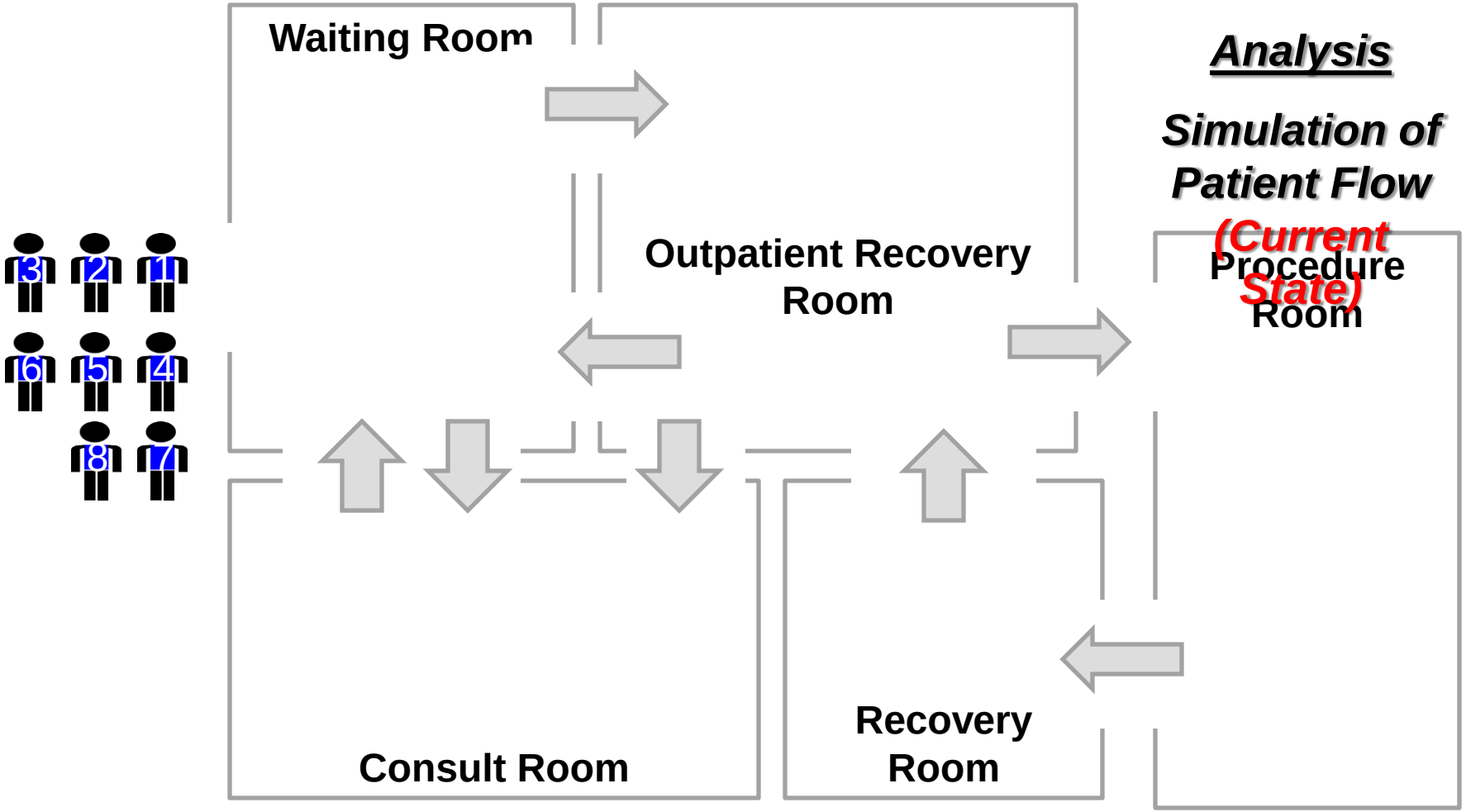
Value Added vs. Non Value Added

Outpatient (12/21/12)	Waiting Room	Outpatient Recovery (Station F)	Consult Room #1	Consult Room #2	Procedure Room	Recovery Bed #1	Recovery Bed #2	Hallway	Order	Value Added Time	Non-Value Added Time	Value Added Pct
Outpatient 1	0:46	0:28	0:08	0:08	0:15	0:06	0:11		1	1:16	0:46	62%
Outpatient 2	0:53	0:38	0:06		0:12	0:11	0:11	0:05	2	1:18	0:58	57%
Outpatient 3	1:23	0:24	0:07	0:02	0:15	0:16	0:09	0:02	3	1:13	1:25	46%
Outpatient 4	1:26	0:38	0:05		0:17	0:16	0:07	0:11	4	1:23	1:37	46%
Outpatient 5	1:44	0:43			0:23	0:14	0:12	0:03	7	1:32	1:47	46%
Outpatient 6	2:27	0:28	0:06	0:08	0:15	0:14	0:10	0:05	8	1:21	2:32	35%
Outpatient 7	2:28	0:27		0:07	0:13	0:10	0:11	0:05	9	1:08	2:33	31%
Outpatient 8	2:31	0:33	0:13		0:17	0:15	0:08	0:19	10	1:26	2:50	34%
Outpatient 9	3:14	0:33	0:03		0:27	0:12	0:11	0:01	11	1:26	3:15	31%
Outpatient 10	3:14	0:38	0:04	0:10	0:12	0:18	0:11		12	1:33	3:14	32%
Outpatient 11	4:09	1:23	0:04	0:10	0:13	0:10	0:15	0:05	15	2:15	4:14	35%
Outpatient 12	4:29	0:44	0:09		0:18	0:13	0:09		16	1:33	4:29	26%
Outpatient 13	3:45	0:33	0:22		0:16	0:11	0:28	0:03	17	1:50	3:48	33%
Average	**2:29**	**0:37**	**0:07**	**0:07**	**0:16**	**0:12**	**0:11**	**0:05**		**19:14**	**33:28**	**36%**

Outpatient (3/27/13)	Waiting Room & Outpatient Recovery (Before)	Consult Room 1_2 (Before)	Hallway (Before)	Procedure Room	Recovery Bed 1_2	Outpatient Recovery (After)	Consult Room 1_2 (After)	Hallway (After)	Order	Value Added Time	Non-Value Added Time	Value Added Pct
Outpatient 1	1:07	0:17		0:13	0:16		0:12	0:12	1	0:58	1:19	42%
Outpatient 2	1:12	0:09		0:09	0:24		0:14		2	0:56	1:12	44%
Outpatient 3	1:26	0:12	0:04	0:12	0:20		0:12	0:02	4	0:56	1:32	38%
Outpatient 4	2:00	0:24		0:13	0:18	0:25	0:14	0:01	5	1:34	2:01	44%
Outpatient 5	2:06	0:24	0:01	0:19	0:22		0:17	0:05	7	1:22	2:12	38%
Outpatient 6	1:23	0:22		0:11	0:16		0:16	0:08	8	1:05	1:31	42%
Outpatient 7	1:16	0:25		0:18	0:17		0:19	0:02	10	1:19	1:18	50%
Average	**1:30**	**0:19**	**0:02**	**0:13**	**0:19**	**0:25**	**0:14**	**0:05**		**8:10**	**11:05**	**42%**

What we learned: Time spent 'Waiting' would be considered **'**Non-Value Added'. Time spent in the Consult & Recovery Rooms would be 'Required but Non-Value Added'. Time spent in Procedure Room would be considered 'Value Added'. Consider 'Value-Added' tasks as tasks that the Customer is willing to pay for.

Value Added Pct increased from **36%** to **42% (16% increase)**. Goal is to have a greater percentage of value added time.

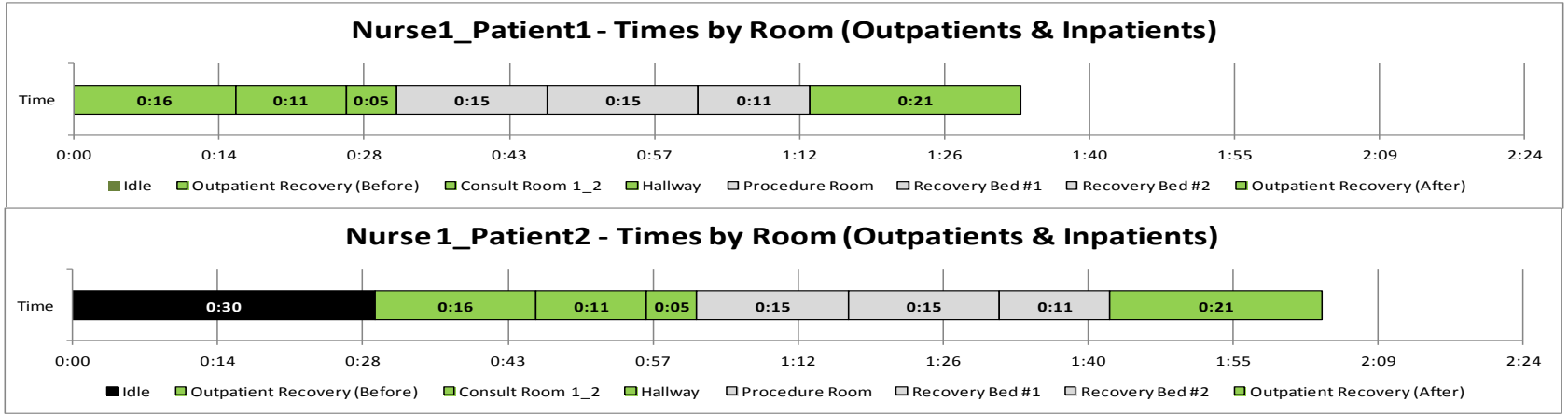


Analysis

Simulation of Patient Flow (Current State)

Work Flow Changes

- **One Piece Flow – 1 Nurse assigned to 1 Patient at a time**
- **Schedule Adjustments**
  - EPIC Training / Access to control Patient Scheduling
  - Stagger Scheduling of Patients (intervals) to reduce/eliminate Wait Times
  - Work Balancing and Level Loading of Tasks
- **6S Opportunities for Rooms & Supplies**



One Piece Flow Overview

- **The movement of products through the process one unit at a time**
- **Contrast to batch processing – having all patients arrive at the same time (1st come, 1st served)**

Advantages

- Focus is on the process
  - ✓ Reduces operating costs by making non-value added work more evident
  - ✓ Facilitates the elimination of waste
- Reduces
  - ✓ Wait time
  - ✓ Transport time
  - ✓ Excess inventory
- Reveals defects or problems early in the process

Recommendations – Simulation Models

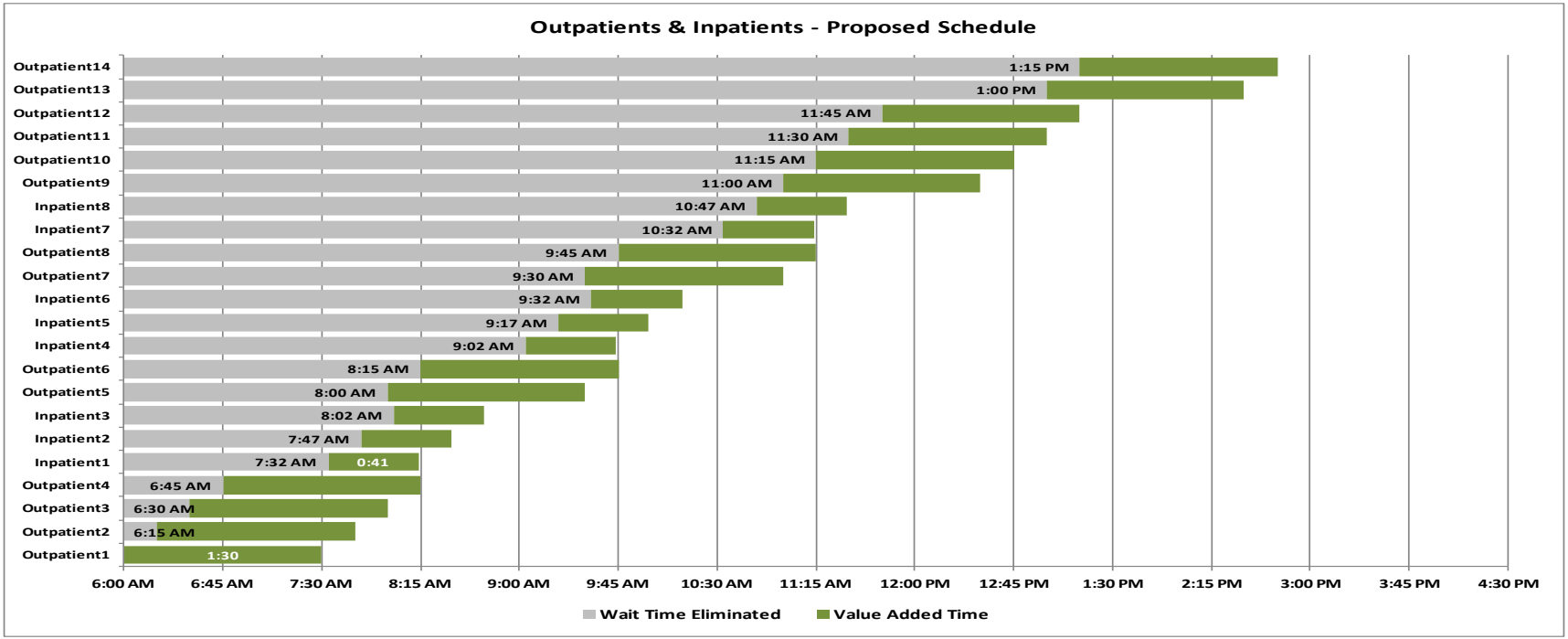
Assumptions

- We know that it takes on average 1 hr and 23 - 30 min to see an Outpatient and 41 min to see an Inpatient (based on observation – excluding Waiting Room time)
- Wanted to reduce/eliminate Patient Wait Times
- Build in times to Chart through out the day and not after all Patients have left
- Models based on One-Piece Flow

Simulation Models

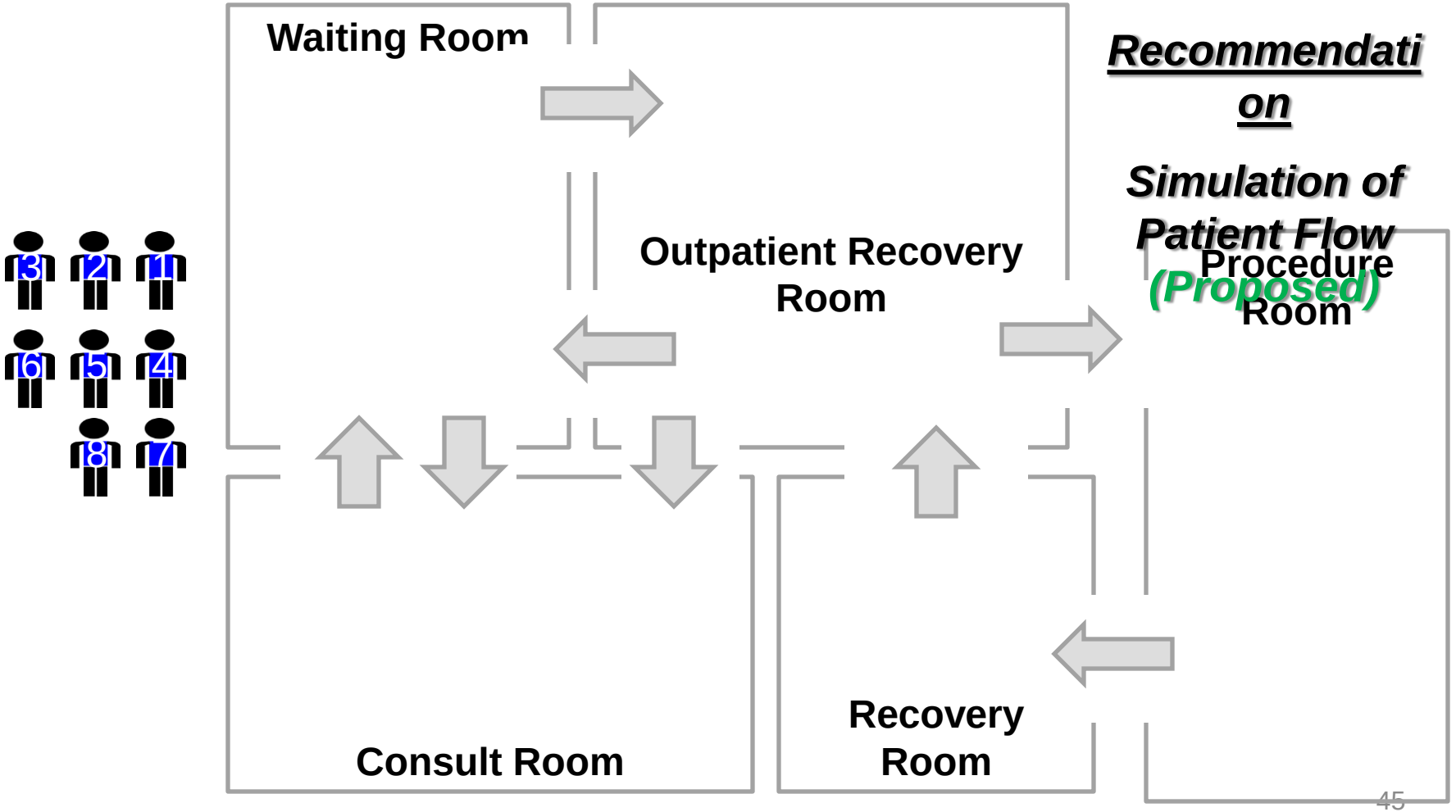
- **15 Minute Intervals**
- **30 Minute Intervals**
- **45 Minute Intervals**

Recommendations – 15 Minute Schedule



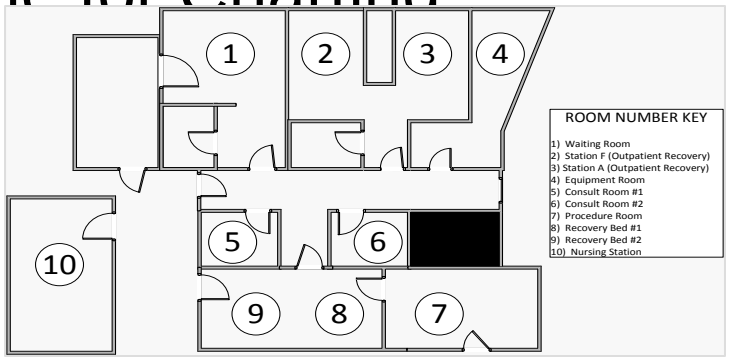
Schedule Adjustments

- Stagger Scheduling of Patients (15 minutes intervals) to reduce/eliminate Wait Times
- Nurse1 would see Outpatients 1, 3, 5, etc. - Nurse2 would see Outpatients 2, 4, 6, etc.
- Charting/Break Time (Front Area) = 5 Hours (spread throughout day)


Waiting Room
Recommendation on
Simulation of Patient Flow
(Proposed)
Outpatient Recovery Room
Procedure Room
3
2
1
6
5
4
8
7
Consult Room
Recovery Room

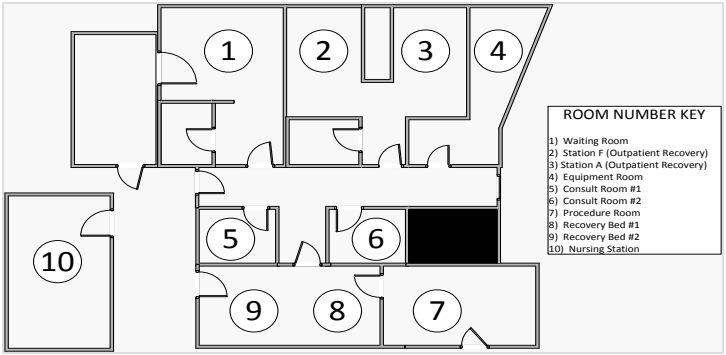
Summary of Changes

- Modified Recovery, Consult and Procedure Rooms
- Work Balancing and Better Patient Flow
- Scheduling Control (More Flexibility with Inpatients)
- Rearranged Staff so the 2 Nurses are in Front Area
  - 1 Nurse to 1 Patient
- Increased Time for Charting



Results

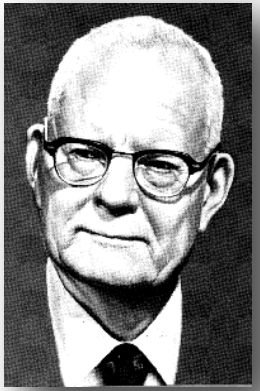
- Patient ‘Wait Time’ decreased on average from **61%** to **50% (18% decrease)**
- ‘Value Added’ Time Percentage increased from **36%** to **42% (16% increase)**
- Patient Movement decreased on average from **12** moves per patient to **11**



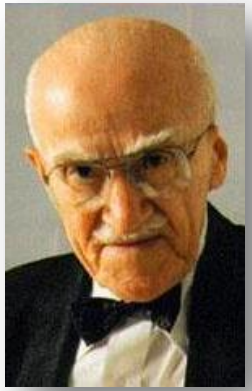
10 Minute Break

What is Six Sigma?

History – Early Pioneers



W. Edwards Deming



Joseph M. Juran

Philip Crosby

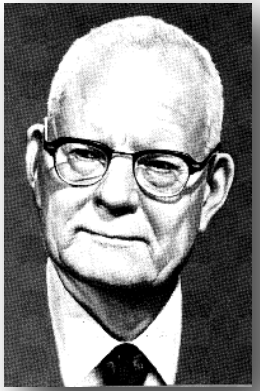
Armand Feigenbaum

Kaoru Ishikawa

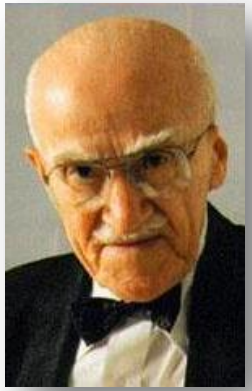
- Father of SPC – Statistical Process Control
- Emphasized the need for changes in management structure and attitudes. He developed a list of "Fourteen Points."

What is Six Sigma?

History – Early Pioneers



W. Edwards Deming



Joseph M. Juran

Philip Crosby

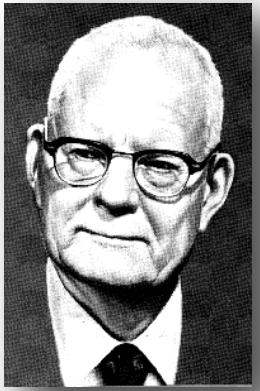
Armand Feigenbaum

Kaoru Ishikawa

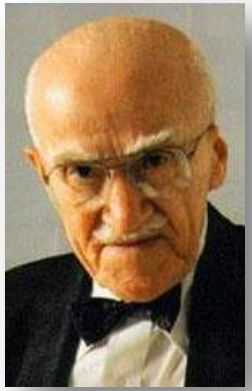
- Developed the Juran trilogy, three managerial processes for use in managing for quality: quality planning, quality control, and quality improvement.

What is Six Sigma?

History – Early Pioneers



W. Edwards Deming



Joseph M. Juran

Philip Crosby

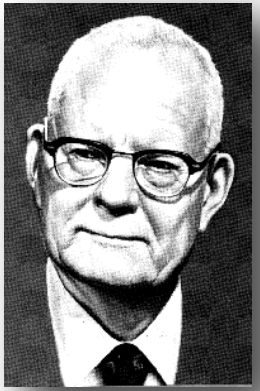
Armand Feigenbaum

Kaoru Ishikawa

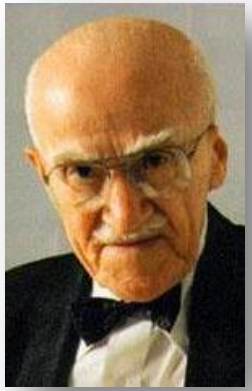
- Wrote many books including Quality Is Free, Quality without Tears, Let's Talk Quality, and Leading: The Art of Becoming an Executive.
- Originated the zero defects concept

What is Six Sigma?

History – Early Pioneers



W. Edwards Deming



Joseph M. Juran

Philip Crosby

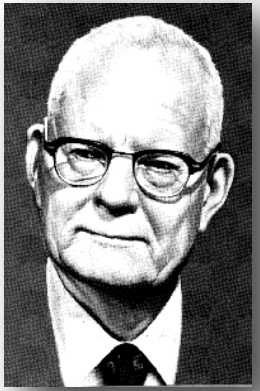
Armand Feigenbaum

Kaoru Ishikawa

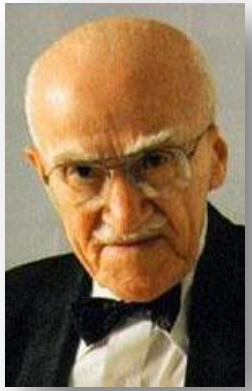
- Originated the concept of total quality control in his book Total Quality Control, published in 1951.

What is Six Sigma?

History – Early Pioneers



W. Edwards Deming



Joseph M. Juran

Philip Crosby

Armand Feigenbaum

Kaoru Ishikawa

- Developed the cause-and-effect diagram.
- He worked with Deming through the Union of Japanese Scientists and Engineers (JUSE).

What is Six Sigma?

Measuring Improvement

"Six Sigma is a fact-based, data-driven philosophy of improvement that values defect prevention over defect detection. It drives customer satisfaction and bottom-line results by reducing variation and waste, thereby promoting a competitive advantage. It applies anywhere variation and waste exist, and every employee should be involved."

- Use of teams that are assigned well-defined projects that have direct impact on the organization's bottom line.
- Training in statistical thinking at all levels and providing key people with extensive training in advanced statistics and project management. These key people are designated "Black Belts."
- Emphasis on the DMAIC approach to problem solving: define, measure, analyze, improve, and control.
- A management environment that supports these initiatives as a business strategy.

LEAN stabilizes a process and Six Sigma optimizes the process!

Kubiak, T. M., & Benbow, D. W. (2009). *The Certified Six Sigma Black Belt Handbook - Second Edition*. Milwaukee, WI: ASQ Quality Press.

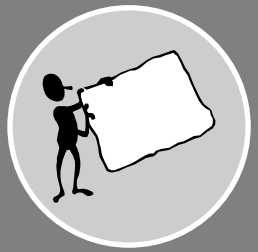
What is Six Sigma?

Six Sigma Process

- The basic strategy of Six Sigma is contained in the acronym DMAIC: Define, Measure, Analyze, Improve and Control
  - Define: identify the issue causing decreased customer satisfaction
  - Measure: collect data from the process
  - Analyze: study the process and data for clues to what is going on
  - Improve: act on the data to change the process for improvement
  - Control: monitor the system to sustain the gains
- Six Sigma was first started at Motorola, Inc. and was then developed more into what we know today at General Electric
- Six Sigma is about collecting data on a process and using that data to analyze and interpret what is happening in that process so that the process can be improved to satisfy the customer

What is Six Sigma?

The DMAIC Process



Define

- Activity Network Diagrams
- Affinity Diagrams
- Benchmarking
- Brainstorming
- Fishbone Diagram
- Failure Mode and Effects Analysis (FMEA)
- Focus Groups
- Force-Field Analysis
- Interrelationship Digraphs
- Interviews
- SIPOC

Measure

- Flowcharts
- Pareto Charts
- Measurement Systems Analysis
- Linearity and Bias Study
- Attribute Agreement Analysis
- Process Capability Study

Analyze

- Multi-Vari Studies
- Hypothesis Testing for means, variances and proportions
- Hypothesis Testing Paired-Comparisons
- Analysis of Variance (ANOVA)
- Chi Square Test

Improve

- Design of Experiments

Control

- Statistical Process Control
- Maintain Controls
- Sustain Improvements

What is Six Sigma?

Linking Projects To Organization Goals

- Organizational goals must be consistent with the long-term strategies of the enterprise.
  - e.g. – Toyota Kata Methodology: repeated iterative PDSA cycle starting with the vision of the long term organizational goal
  - e.g. – Hoshin planning: company develops up to four vision statements that indicate where the company should be in the next five years
- It is common to require that project proposals include precise statements of the problem definition and some preliminary measures of the seriousness of the problem, including its impact on the goals of the enterprise

Six Sigma Tools

Balanced Scorecard

- Many business professionals advocate the use of a balanced scorecard type of approach for the selection of project metrics as a method for ensuring that the project meets both customer and business needs
- The balanced scorecard approach includes both financial and nonfinancial metrics, as well as lagging and leading measures across four areas or perspectives

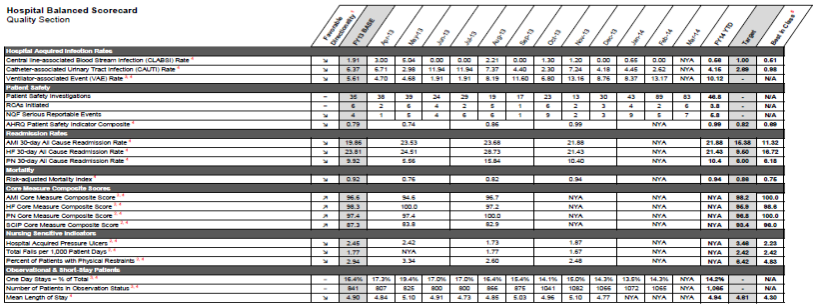
Parkland's BSC

I. Clinical Quality

II. Operations

III. People

IV. Service



Hospital Balanced Scorecard
Quality Section

	Favorable Directionality [1]	FY13 BASE	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	FY14 YTD	Target	Best in Class [2]
Hospital Acquired Infection Rates																	
Central line-associated Blood Stream Infection (CLABSI) Rate [3]	↘	1.91	3.00	6.04	0.00	0.00	2.21	0.00	1.30	1.20	0.00	0.66	0.00	NYA	0.68	1.00	0.61
Catheter-associated Urinary Tract Infection (CAUTI) Rate [3]	↘	6.37	6.71	2.98	11.94	11.94	7.37	4.40	2.30	7.24	4.18	4.46	2.62	NYA	4.16	2.69	0.98
Ventilator-associated Event (VAE) Rate [3, 4]	↘	5.61	4.70	4.68	1.91	1.91	8.19	11.60	6.80	13.16	8.76	8.37	13.17	NYA	10.12	-	N/A
Patient Safety																	
Patient Safety Investigations	–	35	38	39	24	29	19	17	23	13	30	43	89	83	46.8	-	N/A
RCAs Initiated	–	6	2	6	4	2	5	1	6	2	3	4	2	6	3.8	-	N/A
NQF Serious Reportable Events	↘	4	1	5	4	6	6	1	9	2	3	9	5	7	6.8	-	N/A
AHRQ Patient Safety Indicator Composite [3]	↘	0.79		0.74			0.86			0.99			NYA		0.99	0.82	0.69
Readmission Rates																	
AMI 30-day All Cause Readmission Rate [3]	↘	19.86		23.53			23.68			21.88			NYA		21.88	16.38	11.32
HF 30-day All Cause Readmission Rate [3]	↘	23.81		24.51			28.73			21.43			NYA		21.43	9.60	16.72
PN 30-day All Cause Readmission Rate [3]	↘	9.52		5.56			15.84			10.40			NYA		10.4	6.00	6.18
Mortality																	
Risk-adjusted Mortality Index [3]	↘	0.92		0.76			0.82			0.94			NYA		0.94	0.88	0.76
Core Measure Composite Scores																	
AMI Core Measure Composite Score [3, 4]	↗	96.5		94.6			96.7			NYA			NYA		NYA	98.2	100.0
HF Core Measure Composite Score [3, 4]	↗	98.3		100.0			97.2			NYA			NYA		NYA	96.9	98.6
PN Core Measure Composite Score [3, 4]	↗	97.4		97.4			100.0			NYA			NYA		NYA	98.8	100.0
SCIP Core Measure Composite Score [3, 4]	↗	87.3		83.8			82.9			NYA			NYA		NYA	93.4	98.0
Nursing Sensitive Indicators																	
Hospital Acquired Pressure Ulcers [3, 4]	↘	2.46		2.42			1.73			1.67			NYA		NYA	3.48	2.23
Total Falls per 1,000 Patient Days [3, 4]	↘	1.77		NYA			1.77			1.67			NYA		NYA	2.42	2.42
Percent of Patients with Physical Restraints [3, 4]	↘	2.94		3.34			2.60			2.48			NYA		NYA	6.42	4.83
Observational & Short-Stay Patients																	
One Day Stays – % of Total [3, 4]	–	16.4%	17.3%	19.4%	17.0%	17.0%	16.4%	15.4%	14.1%	15.0%	14.3%	13.6%	14.3%	NYA	14.2%	-	N/A
Number of Patients in Observation Status [3, 4]	–	841	807	825	800	800	866	875	1041	1082	1066	1072	1066	NYA	1,066	-	N/A
Mean Length of Stay [3]	↘	4.90	4.84	5.10	4.91	4.73	4.85	5.03	4.96	5.10	4.77	NYA	NYA	NYA	4.94	4.61	4.30

Six Sigma Tools

Process Identification

- Understanding the boundaries of the improvement project and/or process does not prevent outside-of-the-box thinking; it just provides clear guidelines of what to deal with as daily activities and improvement activities are performed.
- Many projects flounder due to the lack of clear boundaries for the project.
- The SIPOC diagram can help in identifying these organizations and functional areas as process suppliers and customers.

Six Sigma Tools

Process Identification

SIPOC Diagram

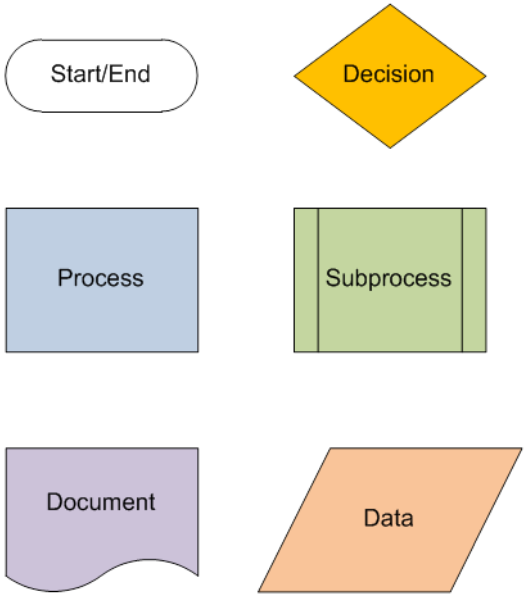
- Working backwards from the customer is ideal

Suppliers	Inputs	Process	Outputs	Customers
Providers of the required inputs/ resources to ensure that the process executes as planned.	Resources required by the process to obtain the intended output.	Top-level description of activity.	Deliverables from the process. Note: deliverables can be hardware, software, systems, services, data, information, and so on.	Any organization that receives an output or deliverable from the process. Note: can also capture systems/ databases that receive outputs, information, data, and so on.

Six Sigma Tools

Flowcharts

- A flowchart is a picture of the separate steps of a process in sequential order, including materials or services entering or leaving the process (inputs and outputs), decisions that must be made, people who become involved, time involved at each step, and/or process measurements.



Munro, R. A., Maio, M. J., Nawaz, M. B., Ramu, G., & Zrymiak, D. J. (2008). *The Certified Six Sigma Green Belt Handbook*. Milwaukee, WI: ASQ Quality Press.

Six Sigma Tools

Flowcharts

1. Define the process to be diagrammed. Write its title at the top of the work surface.
2. Discuss and decide on the boundaries of your process: Where or when does the process start? Where or when does it end? Discuss and decide on the level of detail to be included in the diagram.
3. Brainstorm the activities that take place. Write each on a card or sticky note. Sequence is not important at this point, although thinking in sequence may help people remember all the steps.
4. Arrange the activities in proper sequence.
5. When all activities are included and everyone agrees that the sequence is correct, draw arrows to show the flow of the process.
6. Review the flowchart with others involved in the process (workers, supervisors, suppliers, customers) to see if they agree that the process is drawn accurately

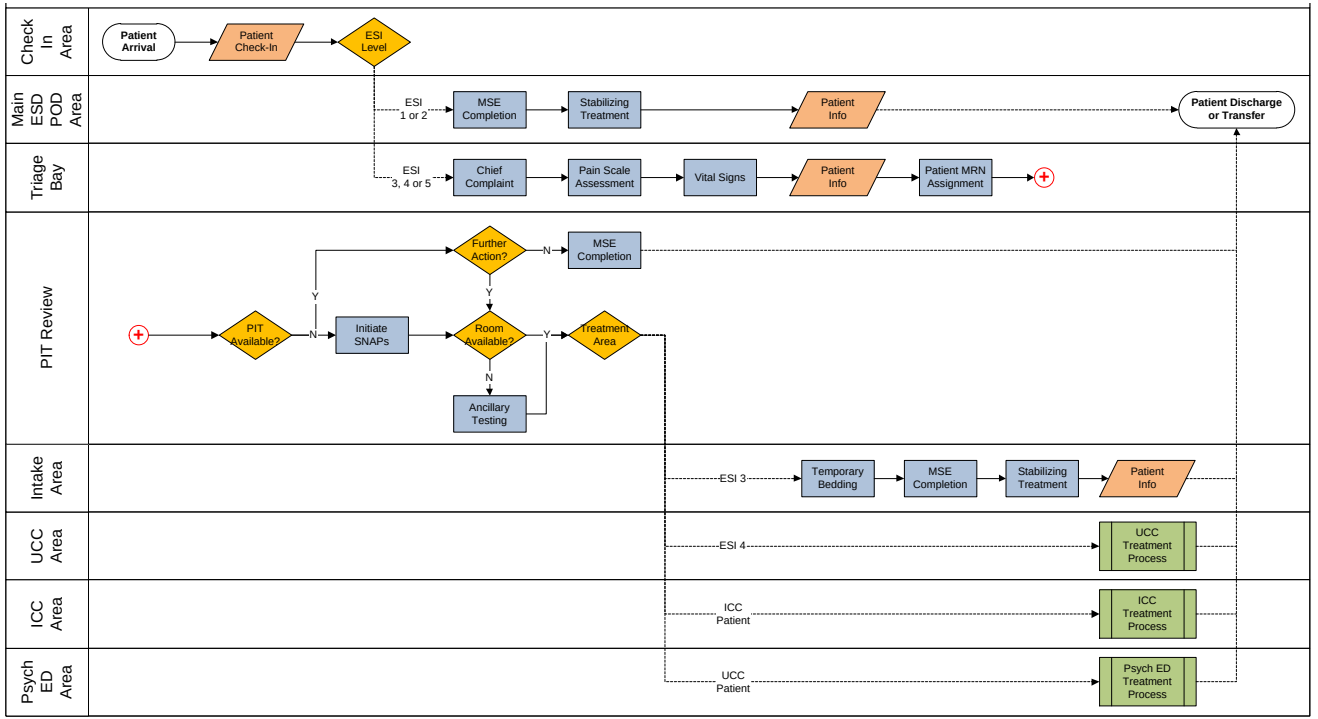
Munro, R. A., Maio, M. J., Nawaz, M. B., Ramu, G., & Zrymiak, D. J. (2008). *The Certified Six Sigma Green Belt Handbook*. Milwaukee, WI: ASQ Quality Press.

Six Sigma Tools

Flowcharts

Flowcharts

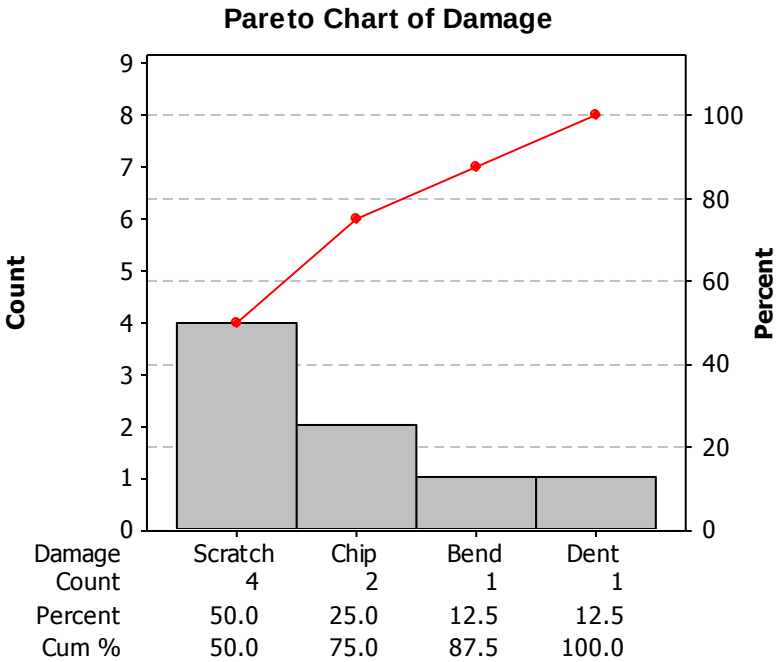
- Swim lanes can show handoffs between departments, people, physical locations, etc.



Six Sigma Tools

Pareto Charts: Vital Few vs. Trivial Many

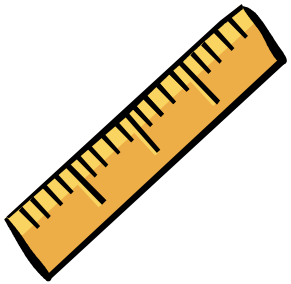
- Pareto charts are a type of bar chart in which the horizontal axis represents attributes of interest, rather than a continuous scale. These attributes are often "defects."
- By ordering the bars from largest to smallest, a Pareto chart can help you determine which of the defects comprise the "vital few" and which are the "trivial many."
- A cumulative percentage line helps you judge the added contribution of each category.
- Pareto charts can help to focus improvement efforts on areas where the largest gains can be made.



Six Sigma Tools

Process Capability

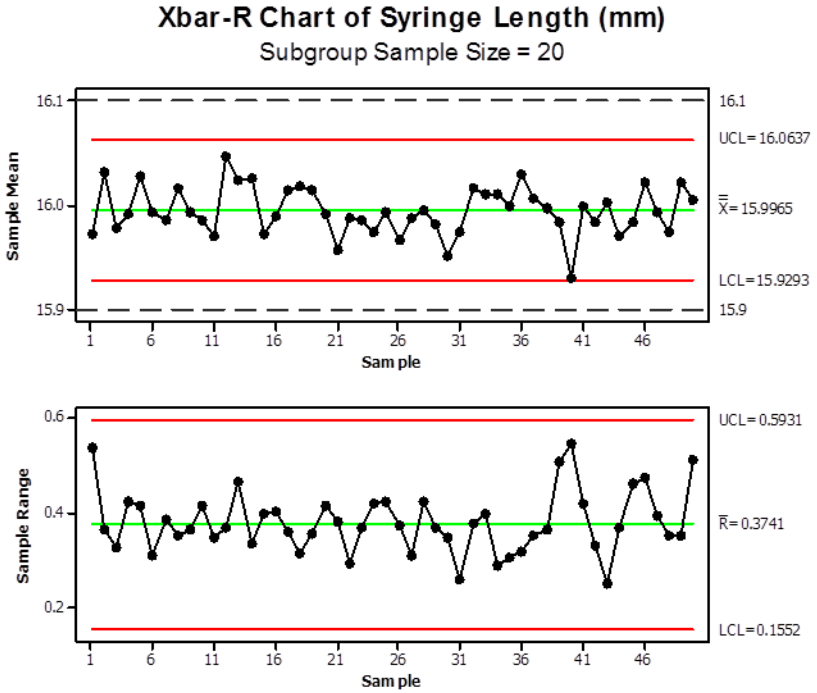
- Many businesses have specifications to ensure the quality of their products and services
  - A pizza parlor can guarantee delivery within 30 minutes
  - A cookie company can produce cookies of a certain weight
  - A golf club manufacturer can produce clubs of a certain length



Six Sigma Tools

Process Capability Example

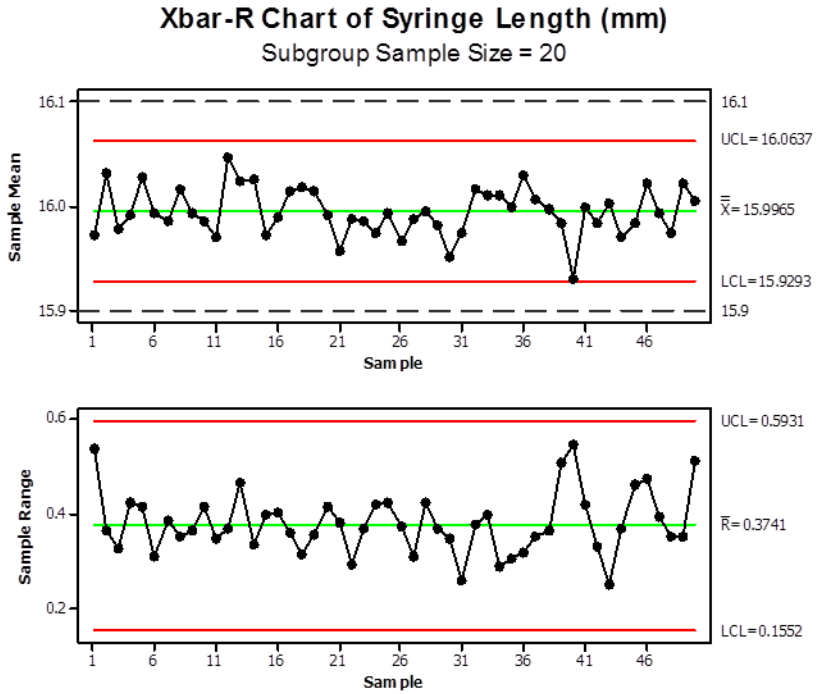
- Consider ABC syringe company, they have to manufacture syringes with a length between 15.9 and 16.1 mm to ensure safe application for their customers
- If these syringes do not comply with the specification limits, patient safety, customer satisfaction and sales will suffer
- We need the process to be **stable** and **meet specifications**



Six Sigma Tools

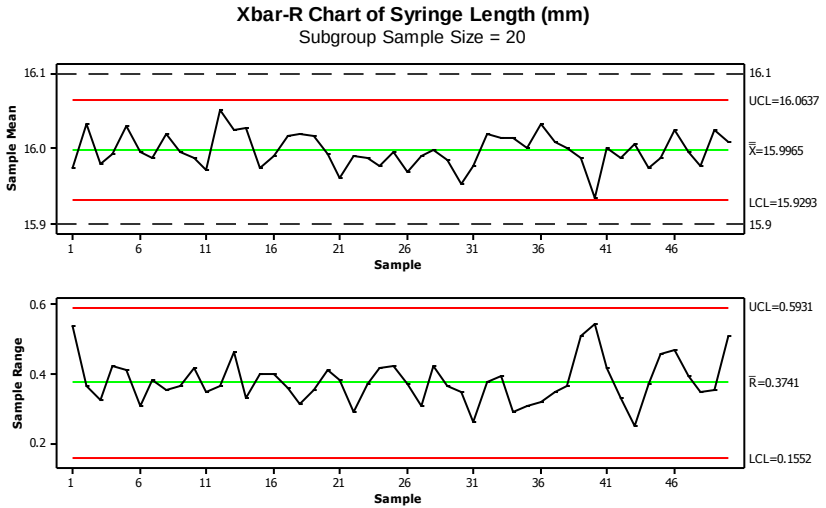
Process Capability Example

The process is stable, but is it meeting specifications?



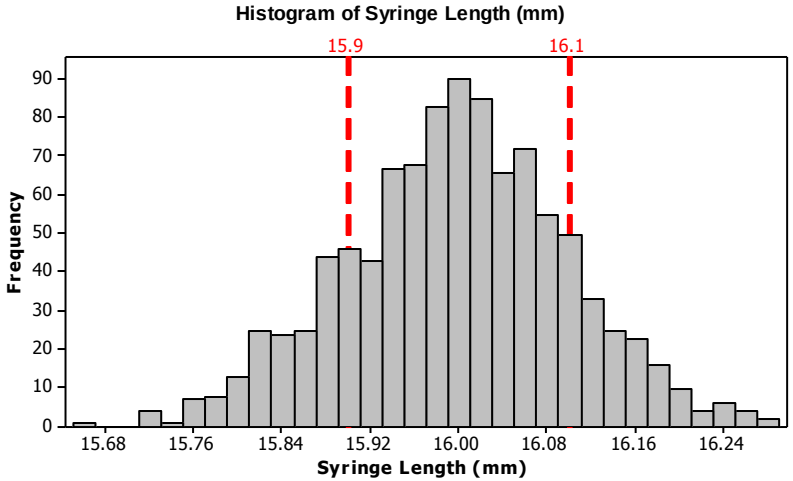
Six Sigma Tools

Process Capability: Control vs. Specification Limits



Control Charts

(Process Stability)



???

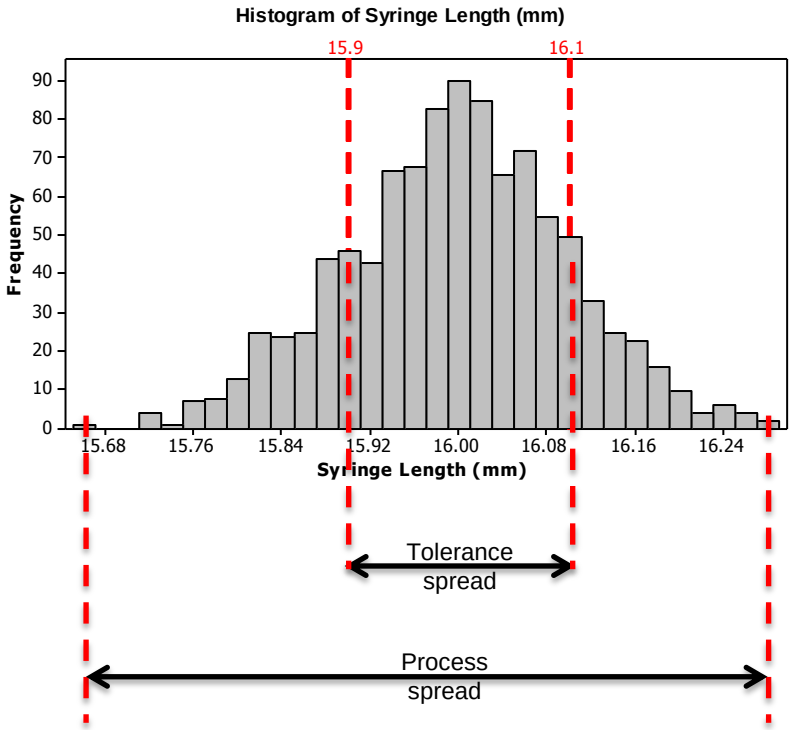
(Process Specifications)

- Control limits are not the same as the specification limits
- Control limits are determined by the process and specification limits are determined by management

Six Sigma Tools

Process Capability: Control vs. Specification Limits

- To assess the performance of a process relative to specifications, we can calculate capability indices.
- A capability index incorporates the process spread and the specification spread
- If a process is able to meet specifications, the process spread is smaller than and within the specification spread (i.e. tolerance)



Six Sigma Tools

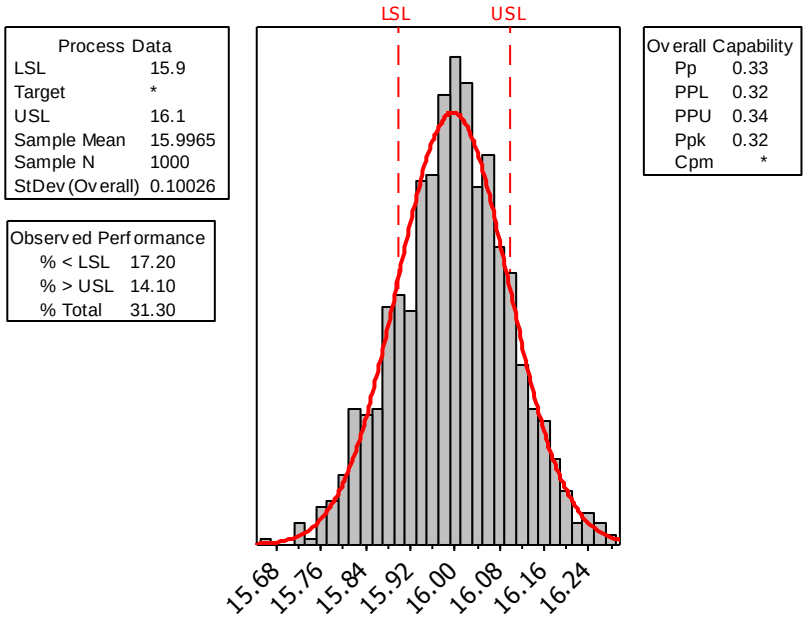
Process Capability: Control vs. Specification Limits

Process Performance: P_p and P_{pk}

$$P_p = \frac{USL - LSL}{6\sigma_{overall}} = \frac{16.1 - 15.9}{6(0.10026)} = 0.33$$

Our syringe manufacturing process produces about 33% of syringes within tolerance limits

Process Capability of Syringe Length (mm)



Six Sigma Tools

Hypothesis Testing

- A hypothesis is an assumption about a **population** parameter, for example:
  - The average adult drinks 1.7 cups of coffee per day
  - No more than two percent of our products that we sell to customers are defective
- The above statements about a population may or may not be true.
- The purpose of hypothesis testing is to make a statistical conclusion about accepting or not accepting such statements.

Munro, R. A., Maio, M. J., Nawaz, M. B., Ramu, G., & Zrymiak, D. J. (2008). *The Certified Six Sigma Green Belt Handbook*. Milwaukee, WI: ASQ Quality Press.

Six Sigma Group Activity

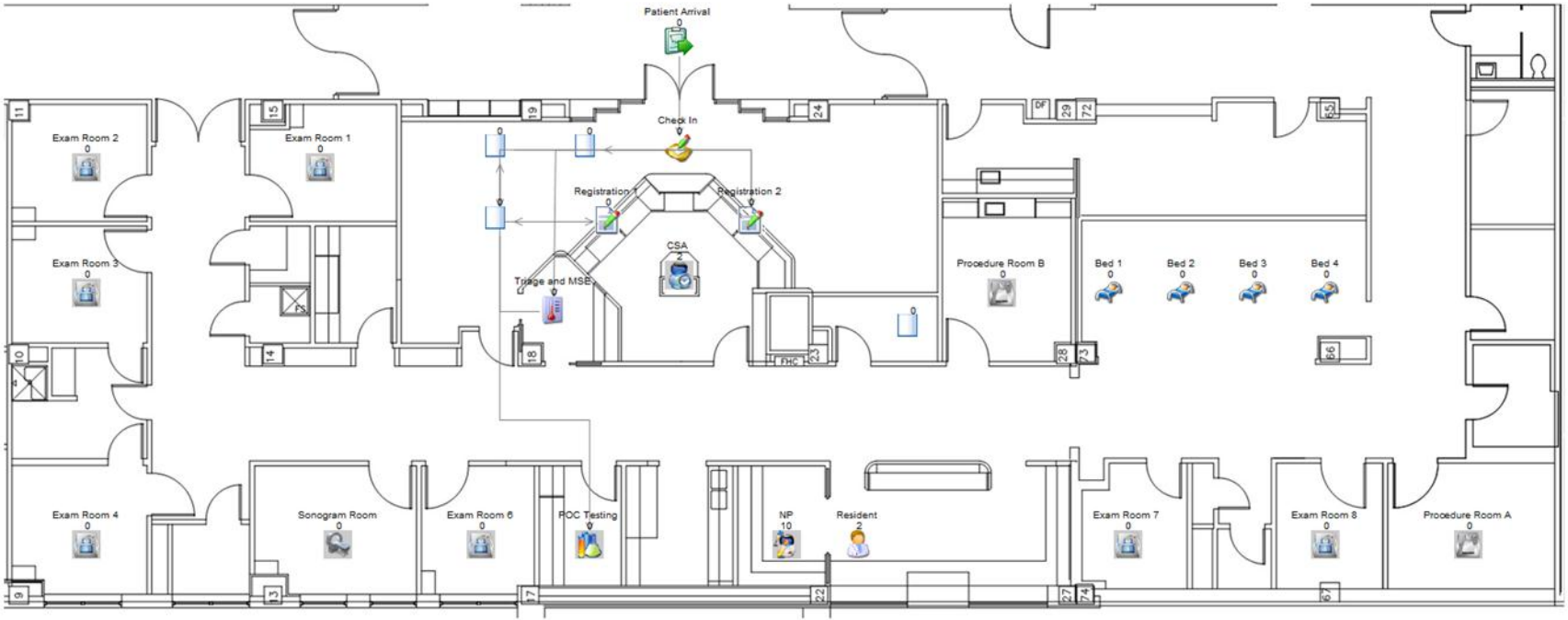
Making Peanut Butter and Jelly Sandwiches

- We have been tasked to make peanut butter and jelly sandwiches for a school bake sale
  - These will be served during lunch to student and teaching staff
  - Financial records will be needed for tax purposes
  - The start of the process start with a customer order and finishes with delivery of the sandwich
- Break off into teams and develop your SIPOC with flowchart of the process

10 Minute Break

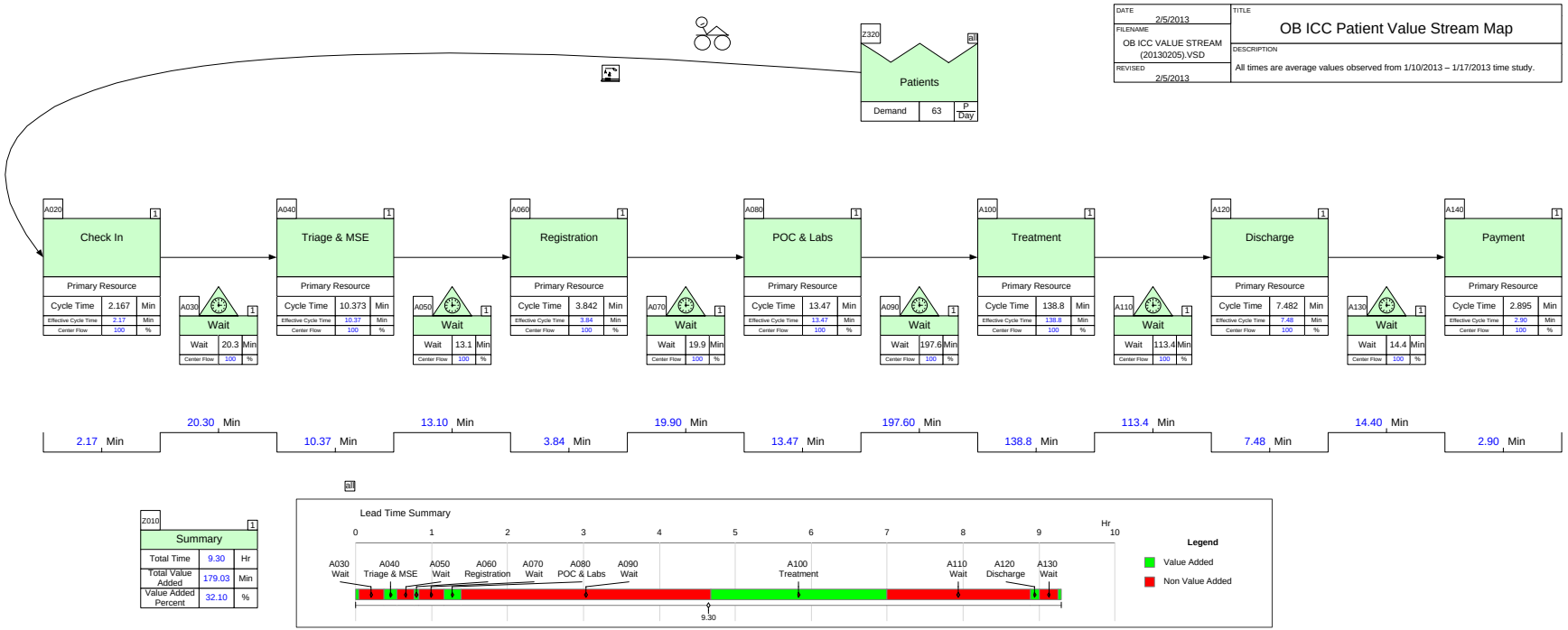
Six Sigma Case Study

Parkland: Women's Emergency Room



Six Sigma Case Study

Parkland: Women's Emergency Room



Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Six Sigma Case Study

Parkland: Women's Emergency Room

Group Discussion

Future Cohorts

- What percentage of leadership time is spent expediting, firefighting, or working around problems?
- How can Lean efforts be oriented around the mission and purpose of our organization and our people?
- If asked “What is Lean?” what is your best 30-second answer?
- Why do some hospital employees get burned out or cynical over time?
- What methods or practices have just evolved in your area, rather than being designed?