Six Sigma

Six Sigma

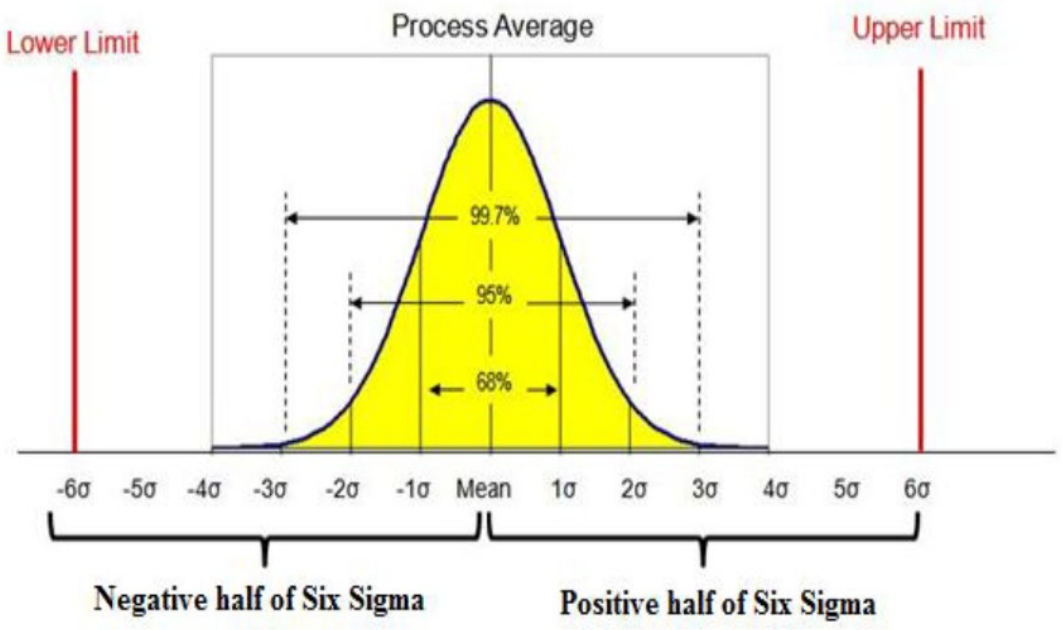
- A method that provides organizations tools to improve the capability of their business processes.
- This increase in performance and decrease in process variation lead to defect reduction and improvement in profits, employee morale, and quality of products or services.
- Six Sigma quality is a term generally used to indicate a process is well controlled

What is Six Sigma?

- Six Sigma is a statistical measure of quality:
  - It is based on rigourous process based performance measures.
- A Process for Continuous Improvement:
  - Six Sigma is a "generic" structured methodology for continuous improvement, that can be used to improve any process in any business.
- An Enabler of Cultural Change:
  - Six Sigma changes the way organisations work and the way they think.
- A disciplined process focussed on delivering near perfect products and services.

What does Six Sigma mean?

- In statistical terms “sigma” = standard deviation (measure of variability in a process)
- The term “Six Sigma” refers to a process that has a deviation of **six standard deviations from the mean**
- Produces results with a defect rate of only 3.4 defects per million opportunities.



Six Sigma

- A process operating at a 6-Sigma level
  – So little variation, that the process outcomes are 99.9997% defect free
  • Six Sigma = 6 , 6 Sigma, or 6s
    • 6 sigma is equivalent to 3.4 defects or errors per million.

Six Sigma

- Methodology aimed at
  - Error reduction
  - Eliminating variation
- Goal
  - Design/improve processes so it is impossible to make an error
  - Reliance on performance measurements and statistical analysis

Six Sigma Concepts

- Critical to Quality (CTQ)
- – How the customer judges our products/services
- Y = The outcome measure of the process
- X's = Inputs or variables that affect the Y
- Defect - Failure to deliver what the customer expects
- DPMO – Defects per million opportunities
- Variation
  - – The enemy of predictable output and customer satisfaction
- Sigma

– An expression of process yield, based on the number of defects per million opportunities (DPMO)

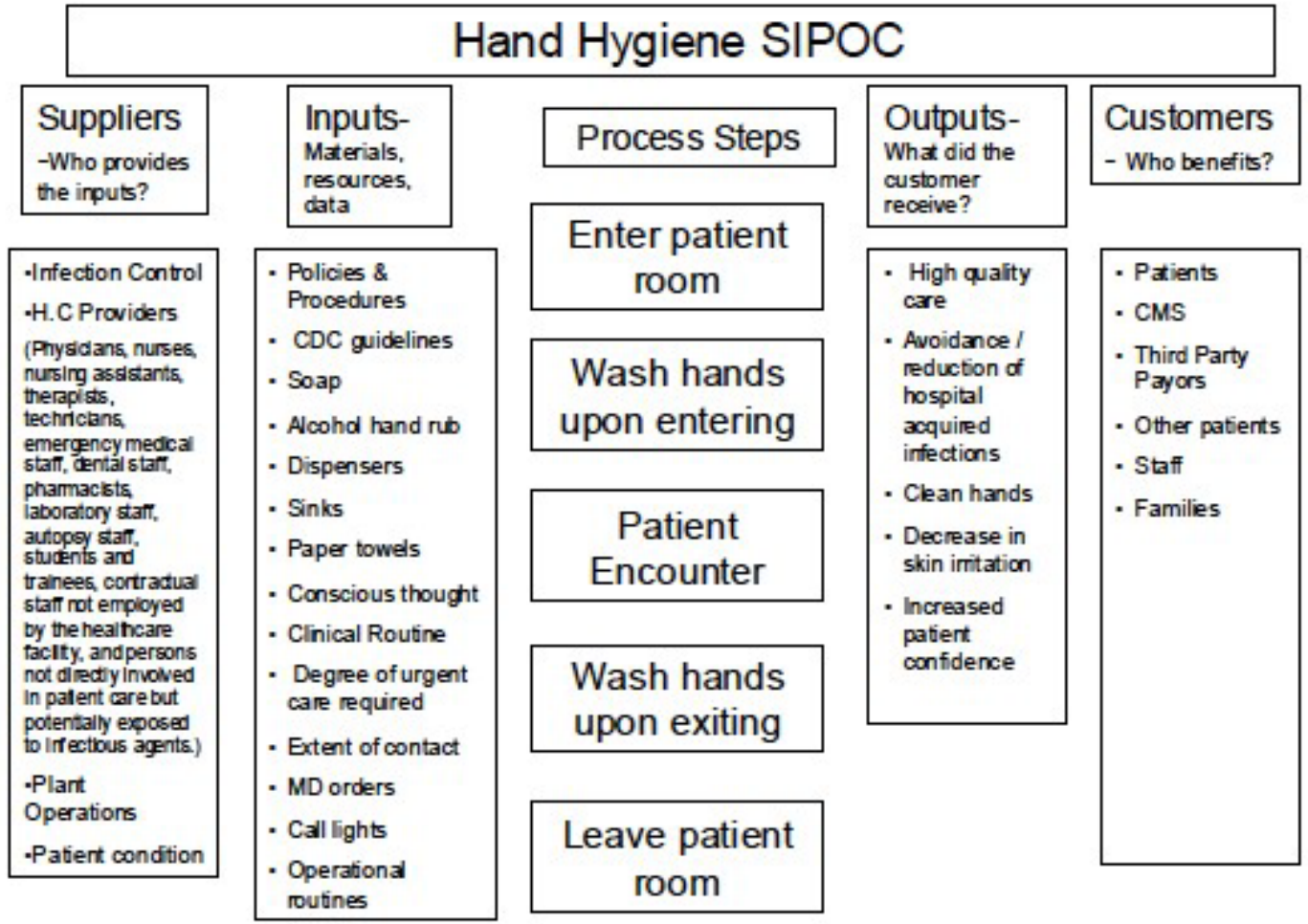
Tools of Six Sigma

- ❑ Y = f(X,x)
- ❑ Process Map
- ❑ FMEA (Failure Mode and Effects Analysis)
- ❑ Cause – Effect Diagram
- ❑ Pareto Diagram
- ❑ Gage R&R
- ❑ Process Capability
- ☐ Multi-Vari Charts
- ☐ Regression
- ☐ Hypothesis Test
- ☐ 95% Confidence Interval
- ☐ ANOVA
- ☐ DOE (Design of Experiments)
- ☐ Control Plan
- ☐ Statistical Process Control

Six Sigma Model -DMAIC

- Charter project
  - Problem statement - How do we know we have a problem?
  - Goal Statement - How will we know if we have made an improvement?
  - Project Scope and Team
- High Level Process Map
- Identify Customer CTQs
- Stakeholder analysis
- Review historical data

SIPOC Example



Voice of the Customer

Establish Voice of the Customer (VOC)

- Identify and prioritize all customers
  - Who is impacted the most by the process?
  - Who is the most dissatisfied with the current process?
- Solicit feedback
  - How does the customer view the process?
  - What does the customer value from the process?
  - What does the customer expect from the process?

What does the customer want most of the time?

What is the limit the customer is willing to tolerate?

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Stakeholder Analysis form?

- Who will be affected by any changes from this project?
- Begin addressing issues early!
- Not everyone needs to be strongly supportive!

Stakeholder Analysis

Names	Strongly Against	Moderately Against	Neutral (0)	Moderately Supportive	Strongly Supportive

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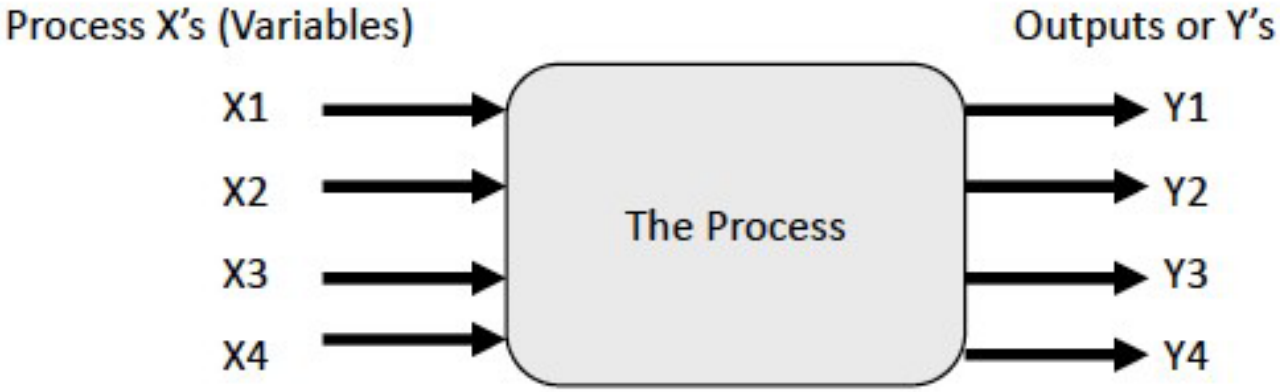
Six Sigma Model -DMAIC

- Select CTQ characteristics
- Define Performance Standards
- Data Collection
- Measurement System Analysis



CTQ characteristics

- Select the main characteristic that the customer uses to judge your performance
  - Six Sigma lingo: The big "Y"
  - How will I know if I have made an improvement?
- How will the "Y" be defined and/or measured?

VOC	CTQ	Y
Expect to be seen within 15 min of appt.	Wait Time	Pt. check-in at front desk to first contact with staff physician.

Define Performance Targets

- Translate the Customer expectations into Metrics
  - Target:
    - What does the customer want most of the time?
  - Specification Limits:
    - What are the limits the patient is willing to tolerate?

VOC	CTQ	Y	Target	Upper Limit
• Expect to be seen within 15 min of appt. •Unhappy if > 30 min	Wait Time	Pt. check-in at front desk to first contact with staff physician.	15 min	30 min

Data Collection/Sampling

- Key considerations
  - Data must be representative of the process
  - Data must be reliable
  - Must capture measurements of importance

OBS #	Role(s)	ENTRY				EXIT			
		Hand Hygiene		Notes		Hand Hygiene		Notes	
1 ☐ Group		☐ Sink ☐ Hand Rub ☐ None ☐ Did Not Observe ☐ Direct Exit to Enter?	Y / N Y / N Y / N Y / N	Gloves On Urgent Full Hands? Blocked Access		☐ Sink ☐ Hand Rub ☐ None ☐ Did Not Observe	Y / N Y / N Y / N Y / N	Gloves On Removed gloves Full Hands? Blocked Access	
2 ☐ Group		☐ Sink ☐ Hand Rub ☐ None ☐ Did Not Observe ☐ Direct Exit to Enter?	Y / N Y / N Y / N Y / N	Gloves On Urgent Full Hands? Blocked Access		☐ Sink ☐ Hand Rub ☐ None ☐ Did Not Observe	Y / N Y / N Y / N Y / N	Gloves On Removed gloves Full Hands? Blocked Access	

Six Sigma Model -DMAIC

- Establish current capability
- Identify key sources of variability
- Define performance objectives

How is the process performing today?

Do we need to “shift the mean” or “reduce variation”?

What are the key X’s that are driving the Y?

How do you know?

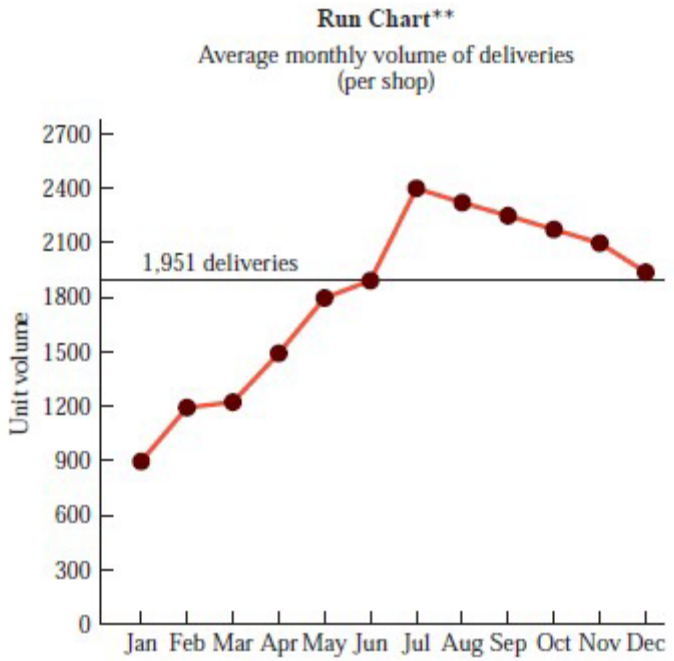
Analyze

- Graphical Tools
  - Flow diagrams, frequency plots, Pareto charts, etc.
- Statistical Testing-
  - Descriptive Statistics, Process Capability Hypothesis testing, Regression Analysis, etc.
- Designed Experiments

Analytical Tools for Six Sigma

- **Run charts.** They depict trends in data over time, and thereby help to understand the magnitude of a problem at the define stage. Typically, they plot the median of a process.

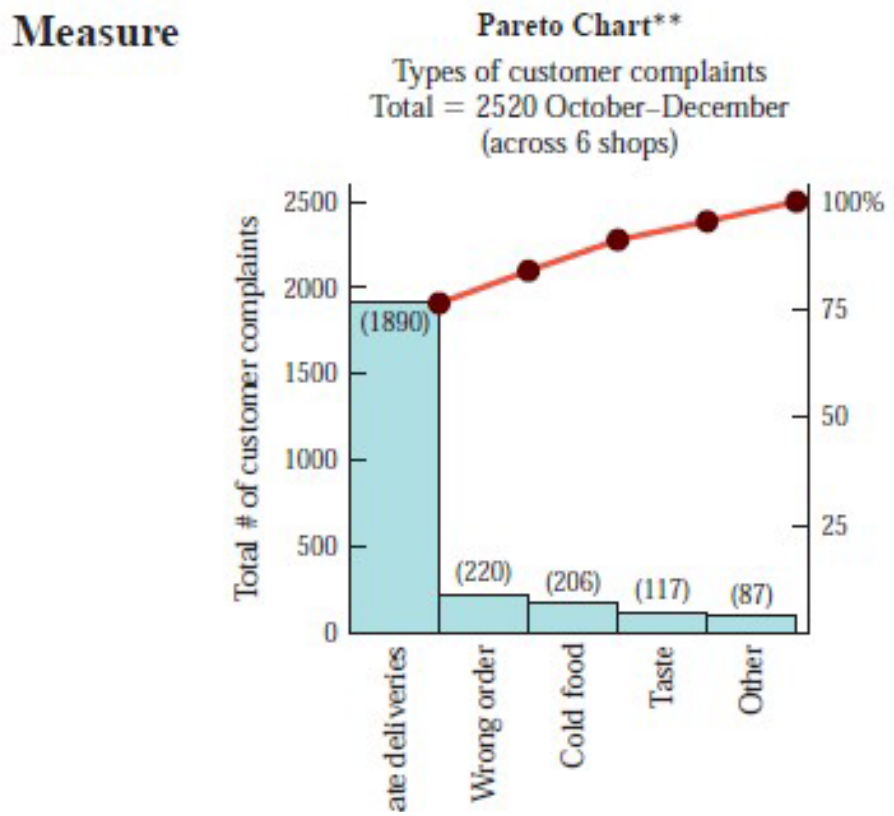
Run charts


Run Chart**
Average monthly volume of deliveries
(per shop)
Unit volume
2700
2400
2100
1800
1500
1200
900
600
300
0
1,951 deliveries
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Analytical Tools for Six Sigma

- **Pareto charts.** These charts help to break down a problem into the relative contributions of its components.
- They are based on the common empirical finding that a large percentage of problems are due to a small percentage of causes.

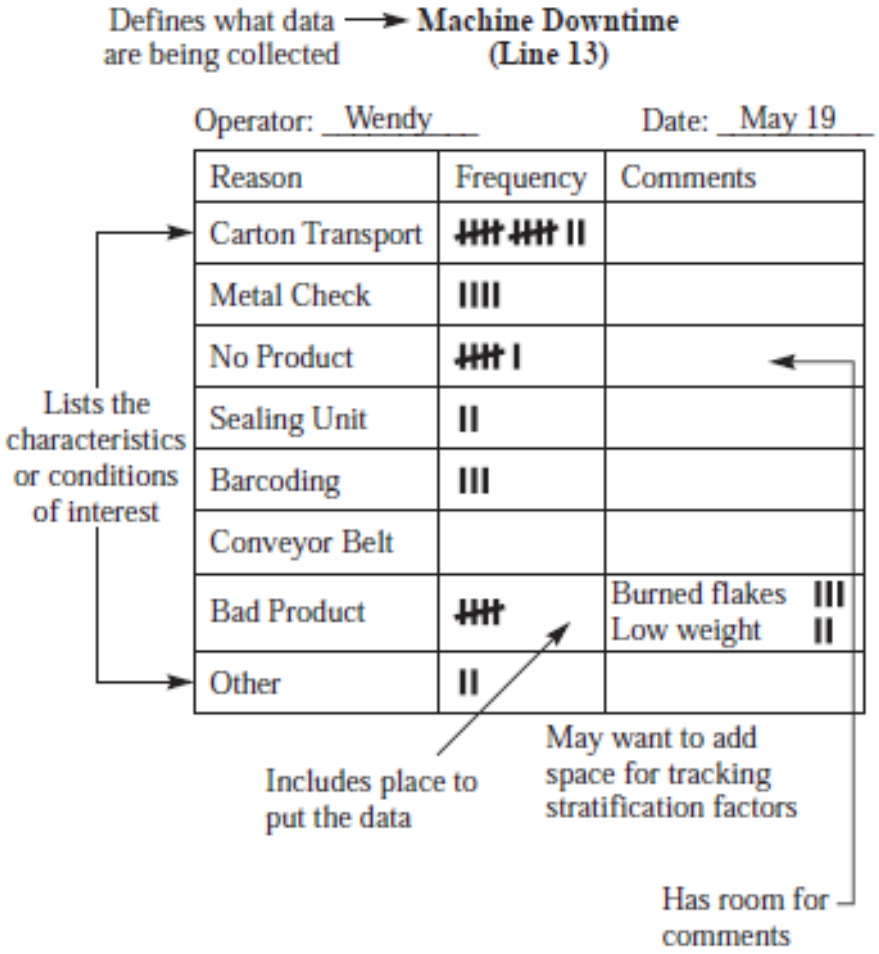
Pareto Chart



Analytical Tools for Six Sigma

- **Check sheets.** These are basic forms that help standardize data collection. They are used to create histograms such as shown on the Pareto chart.

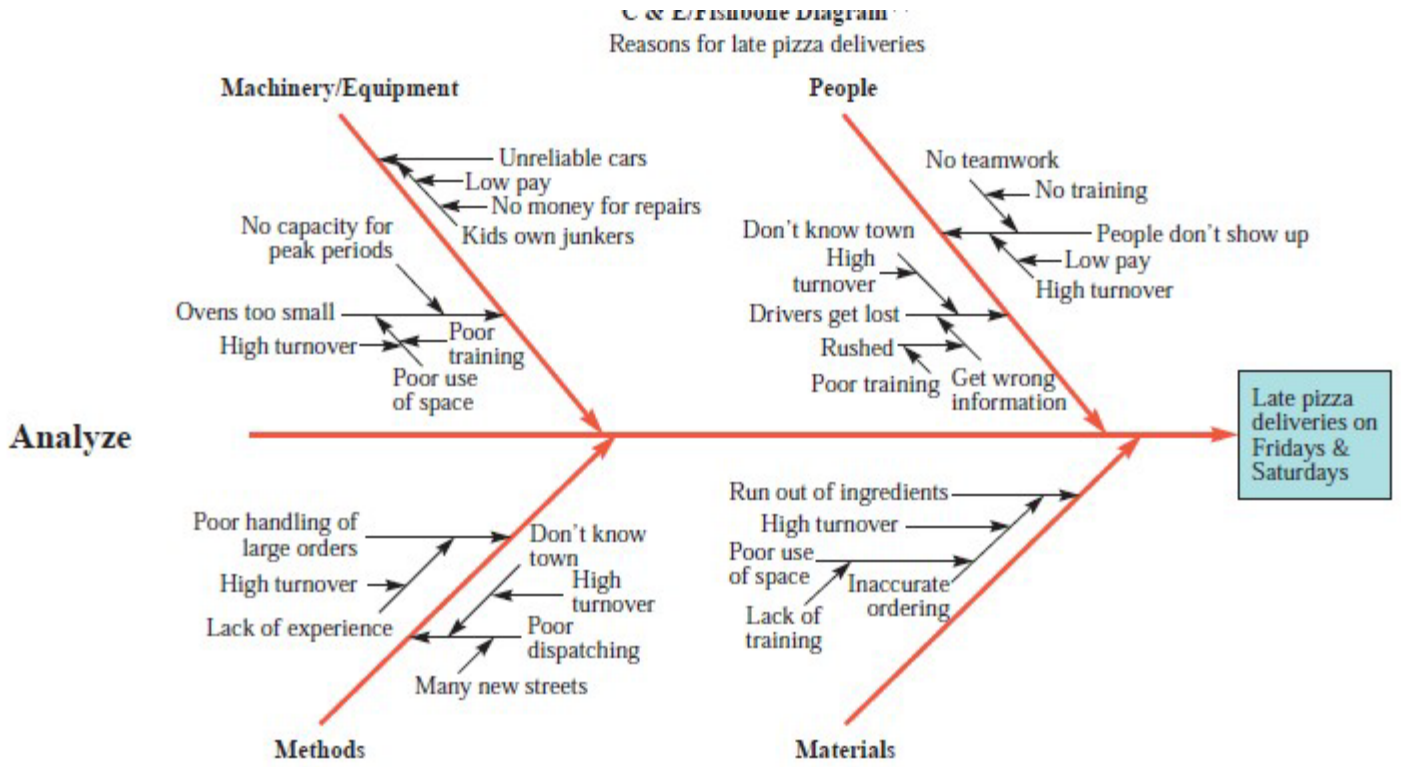
Check sheets



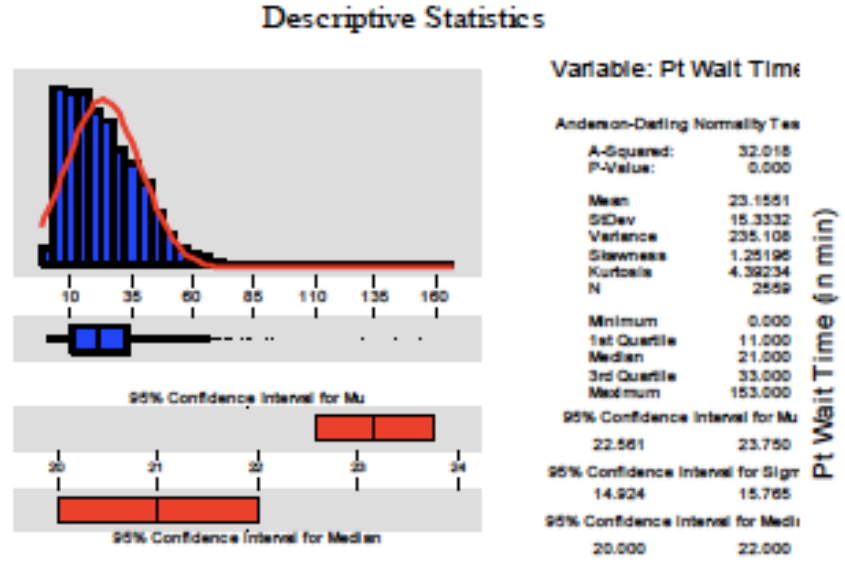
Analytical Tools for Six Sigma

- **Cause-and-effect diagrams.** Also called *fishbone diagrams,* they show hypothesized relationships between potential causes and the problem under study.
- Once the C&E diagram is constructed, the analysis would proceed to find out which of the potential causes were in fact contributing to the problem.

Fishbone diagram



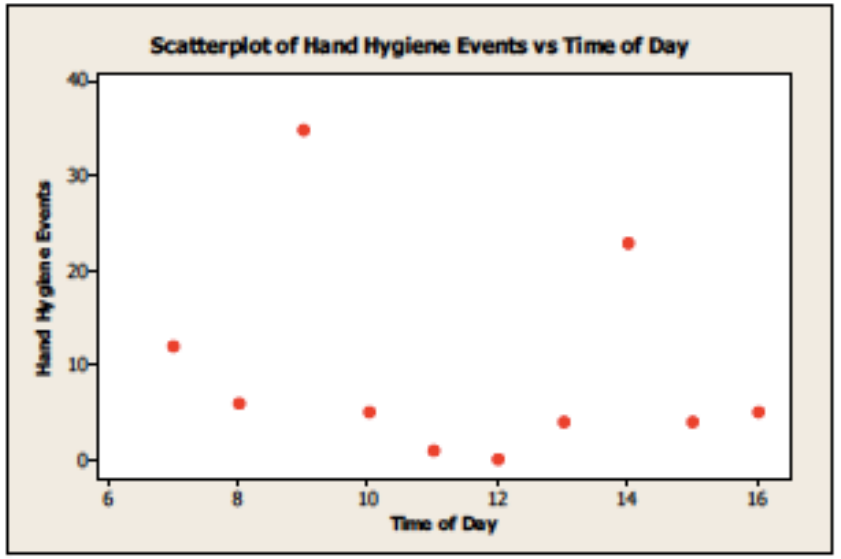
Displaying the Data

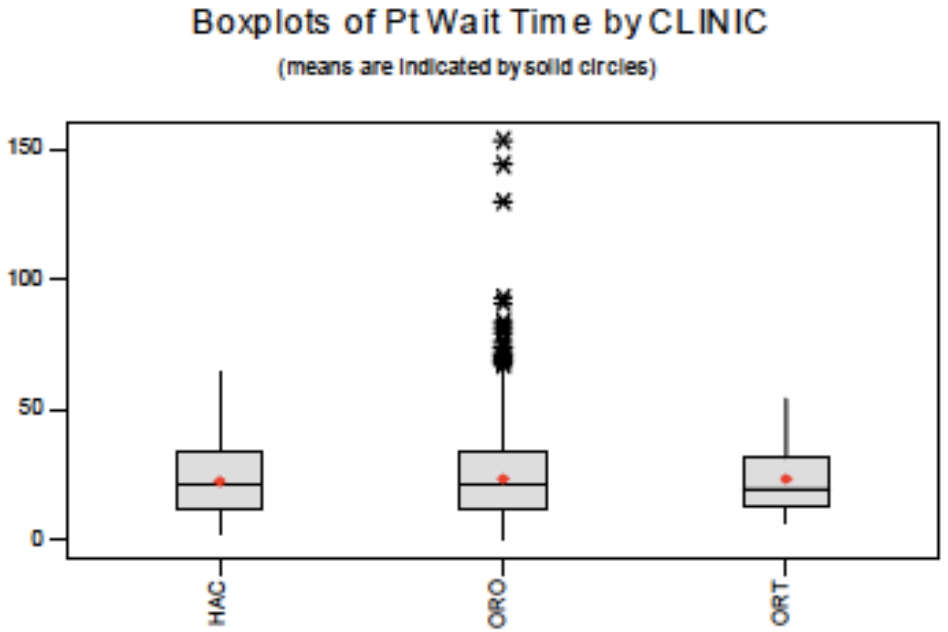


Variable: Pt Wait Time

Anderson-Darling Normality Test

A-Squared:	32.018
P-Value:	0.000
Mean	23.1551
StDev	15.3332
Variance	235.108
Skewness	1.25196
Kurtosis	4.39234
N	2559
Minimum	0.000
1st Quartile	11.000
Median	21.000
3rd Quartile	33.000
Maximum	153.000
95% Confidence Interval for Mu	
22.561	23.750
95% Confidence Interval for Sigm	
14.924	15.765
95% Confidence Interval for Medi	
20.000	22.000





Overall Statistics By Patient:

Metric	Wait Time	Exam Time	Total Time
Mean	23.16	18.94	42.10
Median	21	16	40
Std Deviation	15.33	11.54	19.76
Sample Size	2559	2559	2559
Min	0	0	3
Max	153	99	183

Six Sigma Model -DMAIC

Define → **Measure** → **Analyze** → **Improve** → **Control**

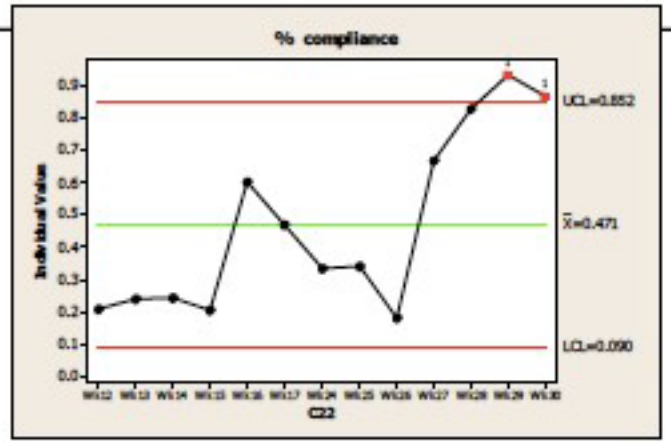
- Optimization of Y (Cycle time, Variability, Cost/LOS)
- Validation of Improvements
- Implementation
- Control Plan

Generate alternatives

Assess the risks

Test the alternative

Select the best alternative



Evaluating solutions

Generate multiple options!

Evaluate how each option meets CTQs

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Pugh Matrix

Key Criteria	Importance Rating	Alternatives: Tele tech on floor with continuous central monitoring	Tele tech on floor and deletion of central monitoring	Shift coordinator with restructured position- no patients	Flawline call light system installed in tele room
RN accountable for patient		⇔	↑	↑	⇔
Efficient trouble shooting		↑	↑	↑	⇔
Utilizes RN critical Thinking		⇔	↑	↑	⇔
FTE neutral		↓	↓	↓	⇔
Good judgement regarding whether to take patient off tele when off unit		↑	↑	↑	⇔
RN knowledge of when patient leaves unit		⇔	⇔	↑	⇔
RN knowledge of when patient returns		⇔	⇔	↑	⇔
Assurance that patient placed back on tele when returned to floor		↑	↑	↑	⇔
30 Second response to sustained lethal rhythms or rate alarms		↑	↑	↑	⇔
Documentation of rate/rhythm changes		↑	↑	↑	⇔
Consistent/accurate interpretation of rate/rhythm		⇔	⇔	↑	⇔
Timely recognition of rate/rhythm changes		↑	↑	↑	↑
Overall high standard of care maintained		⇔	⇔	↑	⇔
Continuous observation		⇔	↓	↓	⇔
Misc. benefits					
enhance current shift coor. Responsibilities		⇔	⇔	↑	⇔
Increased awareness of unit "big" picture		⇔	⇔	↑	⇔
Increase resources avail. to unit RNs		⇔	⇔	↑	⇔
Increase unit teamwork		↑	↑	↑	⇔
Increase staff satisfaction		↑	↑	↑	⇔
Increase coordination of care		⇔	⇔	↑	⇔
Sum of Positives		8	10	18	1
Sum of Negatives		1	2	2	0
Sum of Sames		11	8	0	19

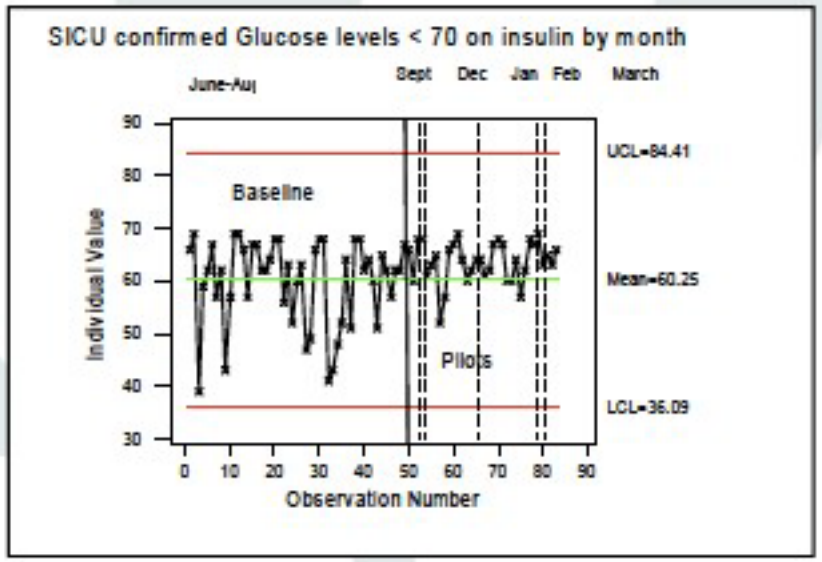
Key
Better ↑
Same ⇔
Worse ↓

↑ = 10
↑⇔= 8
⇔ = 5
⇔↓= 3
↓ = 1

Pilot/Validate Results

Pilot Planning

- Failure Mode and Effects Analysis
- Assure adequate sample size
- Validate improvements through data and statistical analysis



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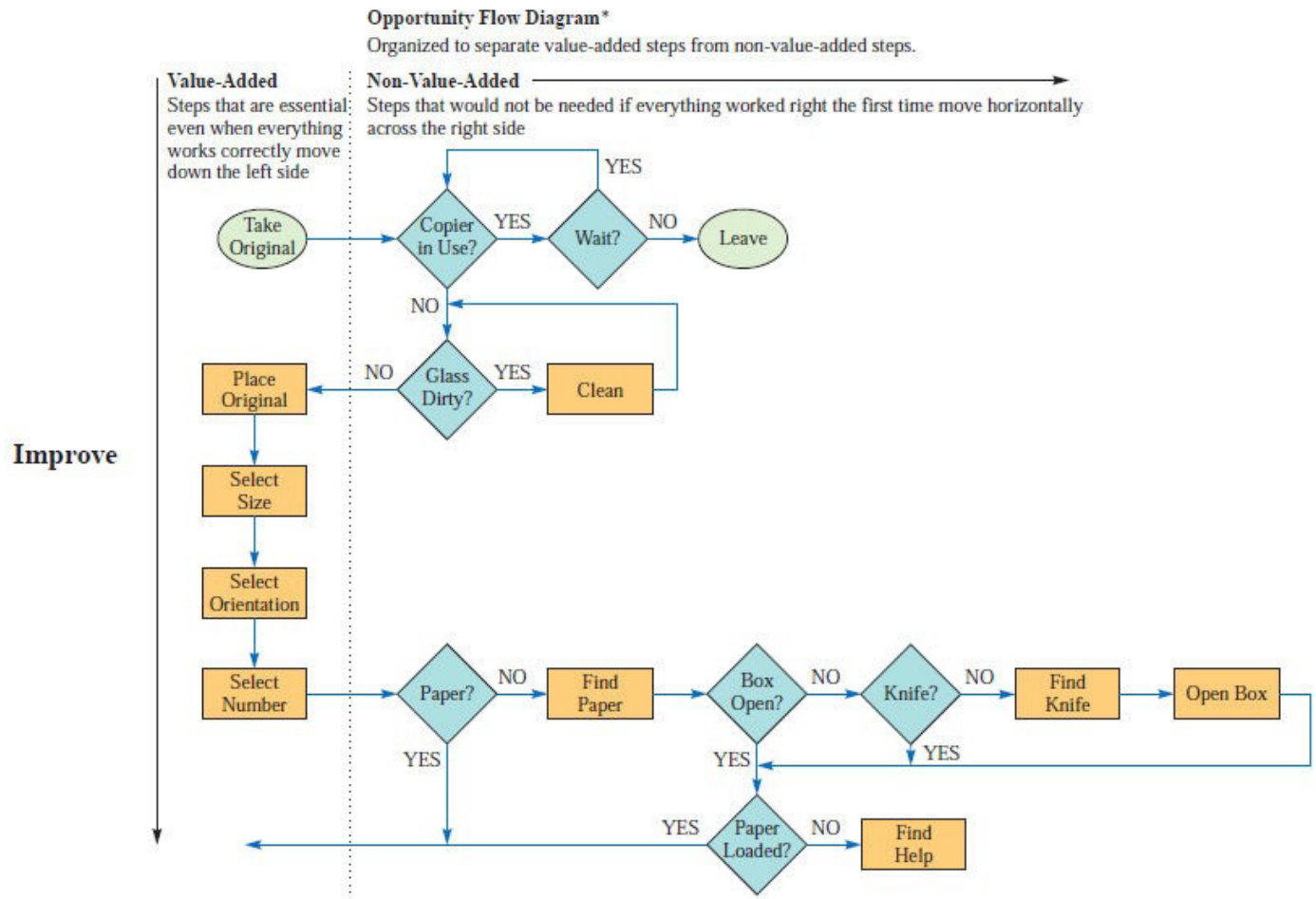
Opportunity Flow Diagram

- **Opportunity flow diagram.** This is used to separate value-added from non-value added steps in a process.

Opportunity Flow Diagram



Failure mode and effect analysis.

- This is a structured approach to identify, estimate, prioritize, and evaluate risk of possible failures at each stage of a process.
  - identifying each element,
  - assembly, or part of the process and listing the potential failure modes,
  - potential causes,
  - and effects of each failure.
- A risk priority number (RPN) is calculated for each failure mode.
- It is an index used to measure the rank importance of the items listed in the FMEA chart.
- These conditions include the probability that the failure takes place (occurrence), the damage resulting from the failure (severity), and the probability of detecting the failure in-house (detection).
- High RPN items should be targeted for improvement first.

FMEA Analysis

Project: _____ Date: _____(original)

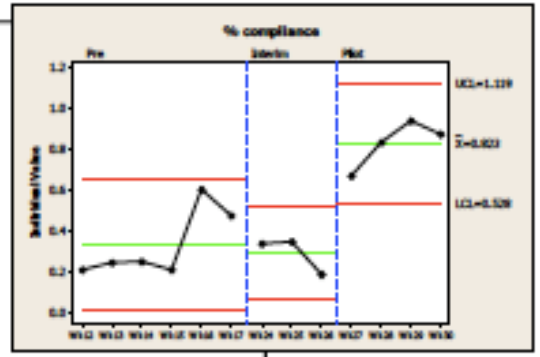
Team: _____ _____ (revised)

Item or Process Step	Potential Failure Mode	Potential Effects of Failure	Severity	Potential Cause(s)	Occurrence	Current Controls	Detection	RPN	Recommended Action	Responsibility and Target Date	"After" → Action Taken	Severity	Occurrence	Detection	RPN
Total Risk Priority Number:									"After" Risk Priority Number:						

Six Sigma Model -DMAIC

Define → **Measure** → **Analyze** → **Improve** → **Control**

- Determine capability of new process
- Implement process controls
- Ensure Gains are Sustained
- Close the project



Is the new measurement system measure what it is suppose to measure?
Does the new process meet the goal?
How can you sustain the gains?
Mistake proofing, Robust design, Process Monitoring
Celebrate successes!

Control

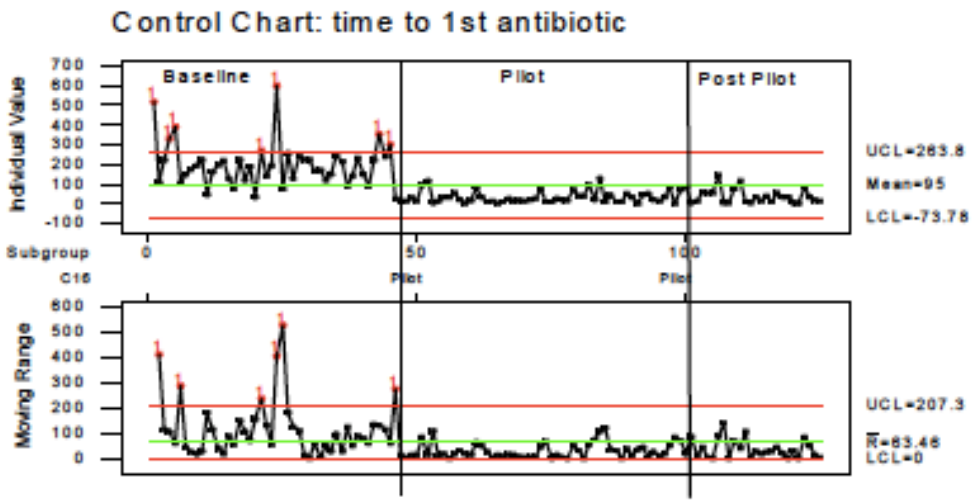
Determine new process capability

Develop control plan

- Monitor Inputs and Outputs (Y's and Xs)
- Ensure that Gains are Sustained

Share Best Practices

Maintain the gains!



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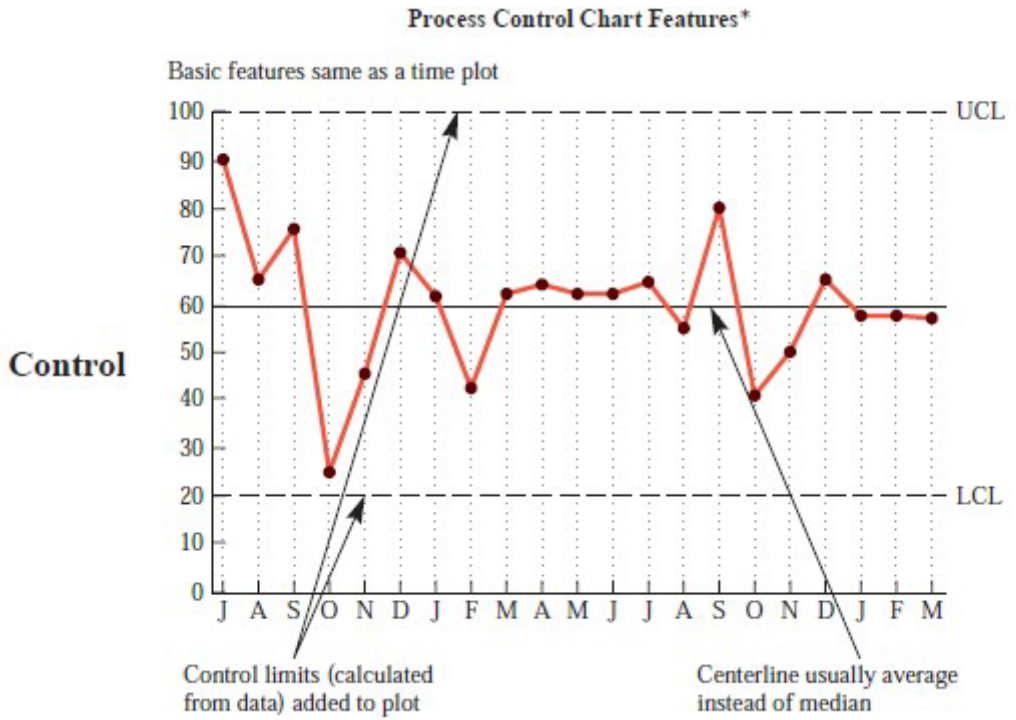
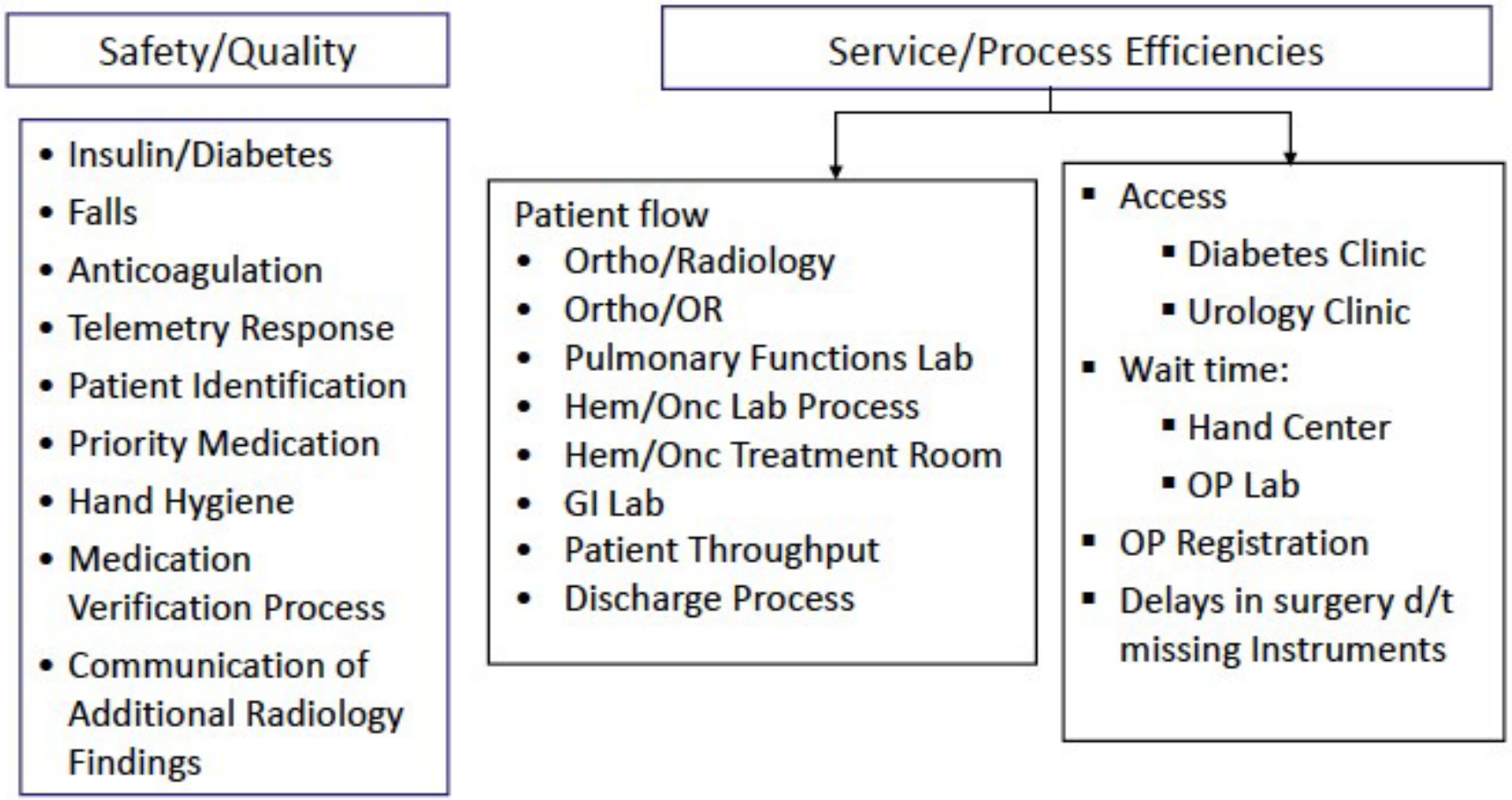
Analytical Tools for Six Sigma

- **Process control charts.** These are time-sequenced charts showing plotted values of a statistic including a centerline average and one or more control limits.
- It is used to assure that processes are in statistical control

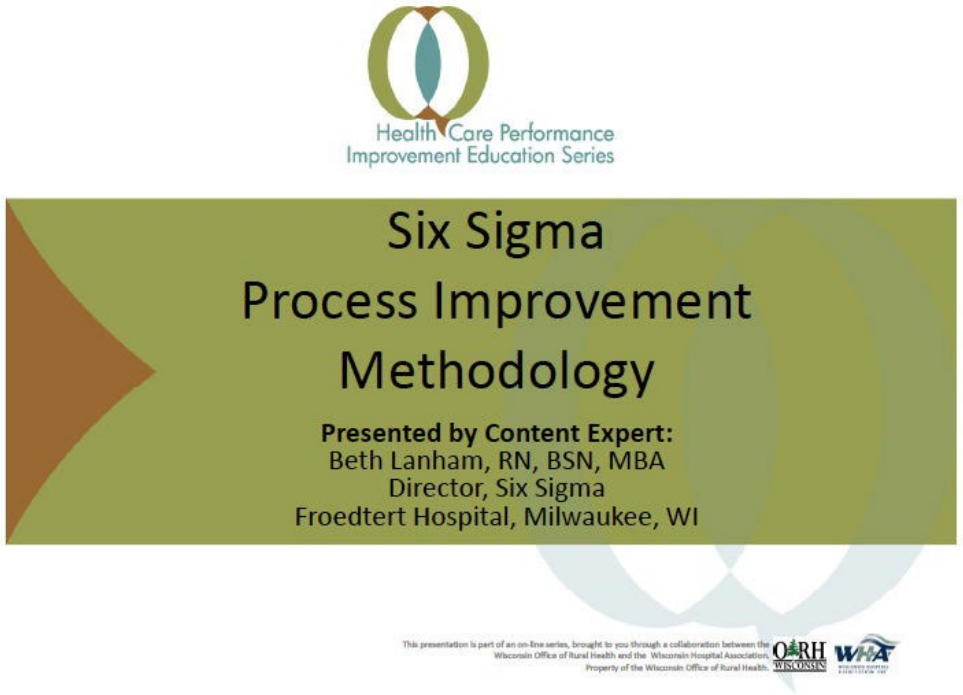
Process Control Charts



Example Six Sigma Projects



Resources


Health Care Performance
Improvement Education Series
Six Sigma
Process Improvement
Methodology
Presented by Content Expert:
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