EMC 445 EMC Systems Management

Using Data to Make Decisions for Emergency Medical Services Systems

Presented by…
Todd Hatley

Session Objectives

- The "assumptions" they never tell you about
- Old Habits Die Hard
- Variation
- Dealing with percentages
- Putting it all together
- Summary

Data Inventory

- What is the objective of the data?
- Is there an unambiguous way to obtain a numerical value for the process being measured? Is it appropriate for the objective of the data?
- How are the data accumulated/collected? Is the collection process appropriate?
- How are the data currently being analyzed/displayed? Is the analysis/display appropriate, given the way the data were collected?
- What action, if any, is currently being taken with these data?

Quality Improvement in Healthcare by Davis Balestracci

Operational Definitions

- A specific definition of what is included in the data and how the data will be analyzed.

Cardiac Arrest Survival Performance Indicator
http://www.mhf.net/OpenSource/Indicators/survival.htm

Process Oriented Thinking

Research vs. Improvement

Research

- Data is collected under highly controlled conditions.
- Control conditions are created to keep variation at a minimum.
- Patients are screened and assigned to a control or treatment group.
- Treatment is very detailed.
- Measurement criteria is well-defined and strict criteria are used.

What happens when treatment is placed in regular use?

- Patients are not screened
- Variation will present itself as each care provider performs the task slightly different.
- The practice environment may be slightly different than the study environment

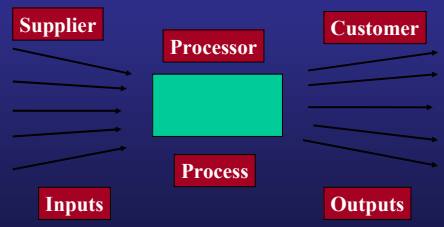
Mental Models

- Inspection (comparison/finger pointing)
- Micromanagement (“From high on the mountain”)
- Results (compared to numerical goal)
- Improvement

Improvement

- Involves the realization that there's variation in processes
- Is aimed at improving process that produce outcomes.
- By improving processes there should be a improvement in outcomes and reliability.

Process



Macro EMS Processes

- Unit Hour Production
- Recruitment & Pre-Service Orientation
- Personnel Scheduling and Labor Relations
- Clinical CQI and Training
- Fleet Operations
- Materials Management and Make-Ready
- Field Operations
- UHP Management and Supervision

Macro EMS Process

- Unit Hour Distribution
- Patient Accounts Management
- 1st Responder Support Services
- Subscription Membership Program
- Strategic Investments
- Operating Unit Management and Admin.
- Management Development
- Core Business Pricing

Micro EMS Processes

- Starting an IV
- Intubating patients
- Deploying unit (response times)
- Billing
- Documentation
- Cardiac resuscitation (all clinical and non-clinical protocols)
- Other clinical and managerial functions

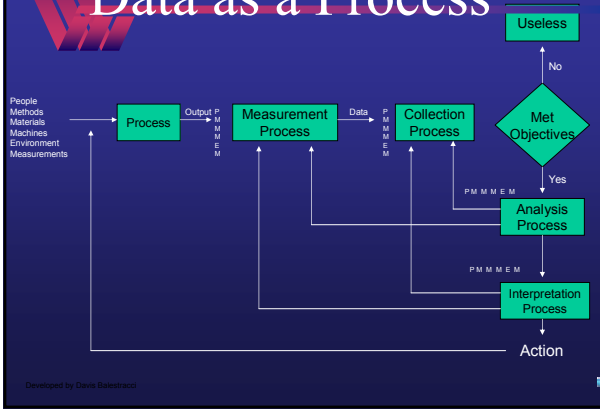
Process-oriented Thinking

- Understanding that all work is accomplished through a series of processes, each of which is potentially measurable
- Understanding data collection and analysis in order to establish consistent, predictable work processes
- Reducing inappropriate and unintended variation by eliminating work procedures that do not add value

Data as a process

- Chose and define the problem in a process/systems context.
- Design and manage a series of simple, efficient data collections.
- Use comprehensible methods presentable and understandable across all layers of the organization, virtually all graphical and no raw data or bar graphs (with the exception of Pareto analysis, and
- Numerically assess the current state of an undesirable situation, assess the effects of interventions, and hold gains of any improvements made.

Data as a Process



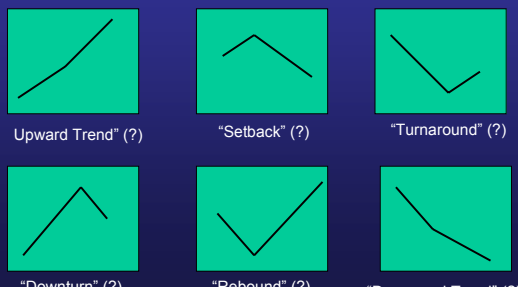
Enumerative Statistics vs Analytic Statistics

Eight Common Statistical Traps

Trap 1: Treating all Observed Variation in Time Series as Special Cause

- Two point trend trap
- It's always something…
- Is the process produced the second number different from the process that produced the first number?
- Coin toss exercise

Six Possible Sequences of Three Distinct Data Values

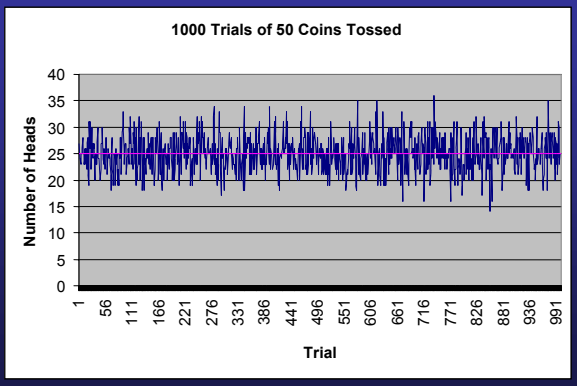


Coin Toss Example

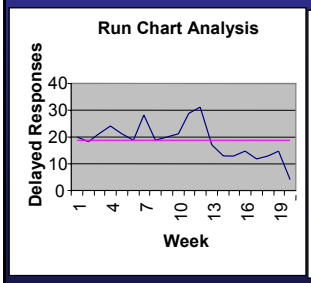
Random Number	Coin Flip
0.174084638	Tails
0.896561396	Heads
0.340793285	Tails
0.142175357	Tails
0.515506612	Heads
0.00176713	Tails
0.566311432	Heads
0.955904951	Heads
0.153851994	Tails
0.191760303	Tails
0.489261651	Tails
0.249998721	Tails
0.448763441	Tails
0.517079738	Heads
0.451438339	Tails
0.787250043	Heads
0.793994475	Heads
0.031062741	Tails
0.278501508	Tails
0.374636166	Tails
0.513118087	Heads
0.544060908	Heads
0.433501182	Tails
0.626430921	Heads
0.389404079	Tails
0.548791441	Heads
0.892069419	Heads
0.22508723	Tails

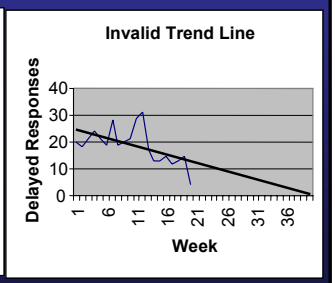
Number of Heads	SimTable	25
1	0.0	28
2	0.0	23
3	0.1	27
4	0.1	25
5	0.1	21
6	0.2	26
7	0.2	28
8	0.2	24
9	0.3	28
10	0.3	30
11	0.3	28
12	0.4	30
13	0.4	32
14	0.4	16
15	0.5	20
16	0.5	23
17	0.5	26
18	0.6	27
19	0.6	27
20	0.6	23
21	0.7	24
22	0.7	24
23	0.7	25
24	0.8	23
25	0.8	22
26	0.8	25

Upper Natural Limit	32
Lower Natural Limit	16



Trap 2: Fitting Inappropriate "Trend" Lines to a Time Series





Variation

- Common Cause / Inherent
- Special cause / assignable

Run Chart Trend & Run Analysis

- Trend consist of 7 contiguous points headed in one direction.
- Runs are a group or contiguous points located above or below the median. Runs of 8 identify a special cause situation.
- To many or to few runs can also justify a special cause situation.

Runs Analysis

Number of data points	Lower Limit for # of Runs	Upper Limits for # of Runs
10	3	8
11	3	9
12	3	10
13	4	11
14	4	12

Trap 3: Unnecessary Obsession with Incorrect Application of Normal Distribution

- The concept of normal distributions does not have universal applicability that is perceived and retrofitted to every situation.

Time to Dispatch Data

Variable	N	Mean	Median	Tr Mean	StDev	SE Mean	Min	Max	Q1	Q3
TTD_1	30	3.027	2.900	3.046	0.978	0.178	1.00	4.80	2.30	3.825
TTD_2	30	3.073	3.100	3.069	0.668	0.122	1.90	4.30	2.575	3.50
TTD_3	30	3.127	3.250	3.169	0.817	1.249	1.10	4.50	.272	3.750

Variance Analysis

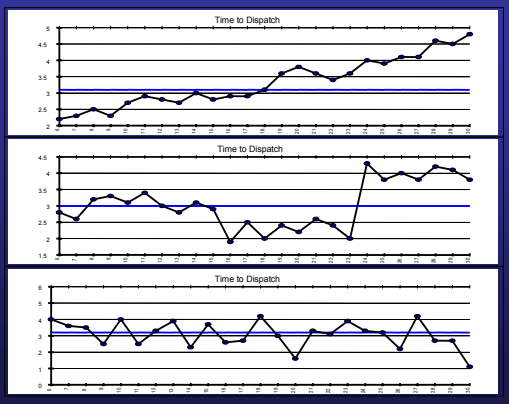
One-Way Analysis of Variance

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
TTD-1	30	90.8	3.027	0.956
TTD-2	30	92.2	3.073	0.446
TTD-3	30	93.8	3.127	0.668

ANOVA

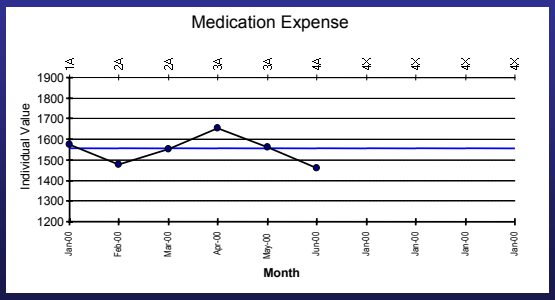
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Hospitals	0.150	2	0.075	0.11	0.897	3.101
Error	60.036	87	0.690			
Total	60.186	89				



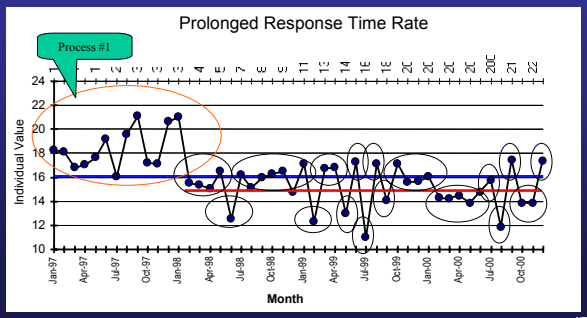
Plot the Dots!

Run Chart Examples

Run Chart Example



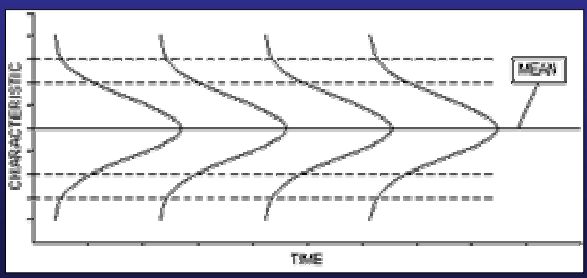
Run Chart Example



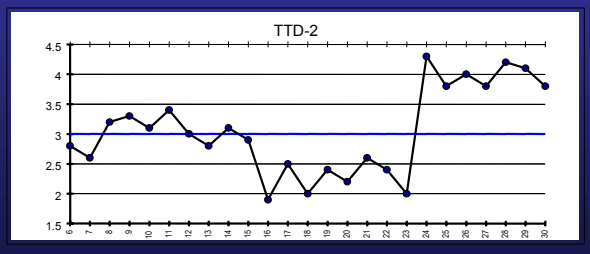
Trap 4: Inappropriate Calculation of Standard Deviation and "Sigma" Limits

- In process statistics 3 standard deviations should always be used.
- 3 StDev produces varying confidence levels based on the type control chart that is used.
- Most of the time under 95%

Control Charts



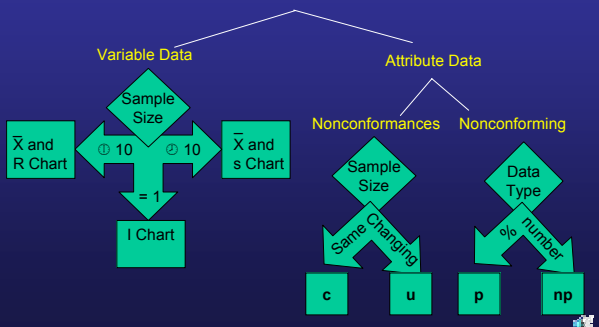
Run Chart vs Control Chart



Types of Control Charts

- I Charts
- P Charts
- X Charts
- U Charts
- C Chart
- S Chart

Control Chart - Determine type of Data



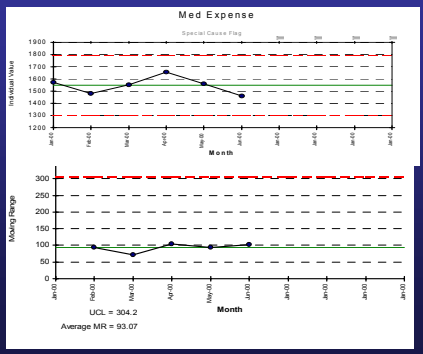
Calculating Control Limits

- **WRONG** *Three standard deviations from the mean (average) of the data*
- **CORRECT** Standard deviation calculated correctly for the type data and based on the variation of the data.

Individuals Chart

- Plot run chart
- Determine the median
- Plot range
- Determine the median range
- Multiple median range by factor 0.3865 to determine the ranges upper control limit
- To determine process limits: Median ± 0.314 MedMR (consider AvgMR if < 20 points)

I Chart Example

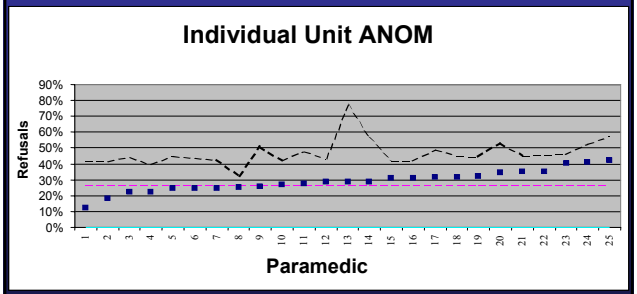


P Chart

- Used to compare individuals, units, etc…
- Determine total number of observations
- Determine total percentage or proportion
- Determine standard deviation for each individual, unit etc…by

$$Mean \pm 3 \times \sqrt{Mean \times (100 - Mean)/\#each}$$

P Chart Example

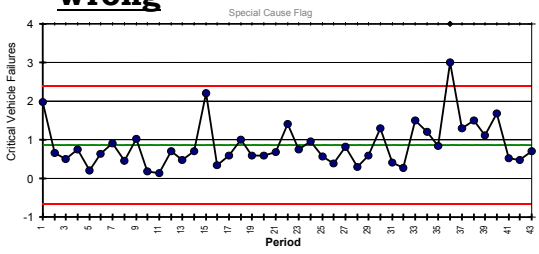


Trap 5 Misleading Special Cause Signals on a Control Chart

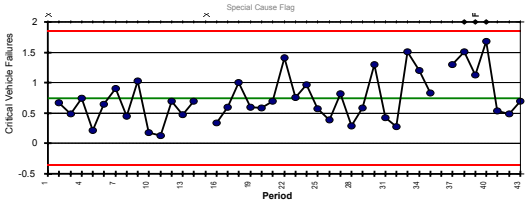
- It is premature to do control charts of all data. It may just add to the confusion.
- Always evaluate a run chart first
- If there's data that you know is representing a different process create a run chart/control chart for the separate process

Critical Vehicle Failure Example

Wrong



Critical Vehicle Failure Example



Special Cause(s) Detected

Chart Type: Chart for Individuals

Centerline: 0.7431 Process Limits: Lower: -0.3682 Upper: 1.854

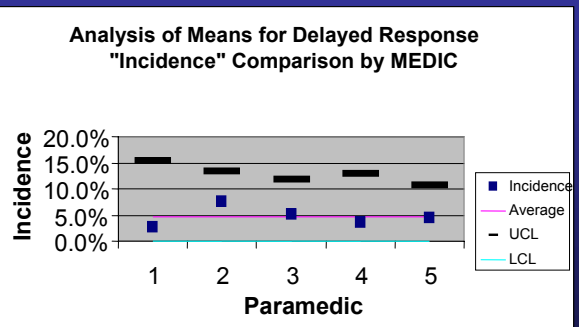
Avg of Data Shown 0.7431	A.1 Beyond Control Limit	E. 2 of 3 Beyond 2 Sigma
Median Data Shown 0.68	B.9 On One Side of Average	F. 4 of 5 Beyond 1 Sigma
Sigma for Limits 0.3704	C.6 Trending Up or Down	G. 15 Within 1 Sigma
Base for Limits Average MR	D.14 Alternating Up & Down	H. 8 Outside 1 Sigma
		X. Excluded or Missing Data

Trap 6 - Choose Arbitrary Cuttoffs for "Above" Average and "Below" Average

- Process limits are defined by the process. They are not something that you can create.
- Process limits help you determine how to approach an issue while arbitrary limits lead to poor approaches to improvement and commonly lead to worsening of the process (tampering)
- Specification limits and process limits are not the same thing.

Delayed Response Data

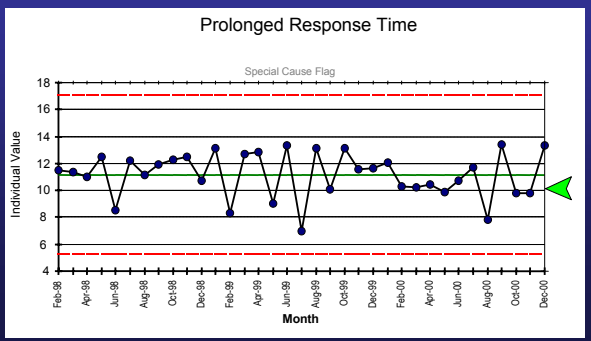
Paramedic	Delayed Response	Calls	% Delayed Response
1	1	36	2.78
2	4	53	7.55
3	4	79	5.06
4	2	58	3.45
5	5	110	4.55
	16	336	4.678



Trap 7 - Improving Processes Through the Use of Arbitrary Numerical Goals and Standards

- **"Insanity" - "Doing things the way we've always done them, yet expecting different results" Dr. Deming**
- Measured numbers vs actual process
- "A goal without a method is nonsense"
- What about imposed goals (JCAHO)
- Determine where you are and if there is common cause or special cause is the culprit and precede as with any other improvement effort.

Arbitrary Limits

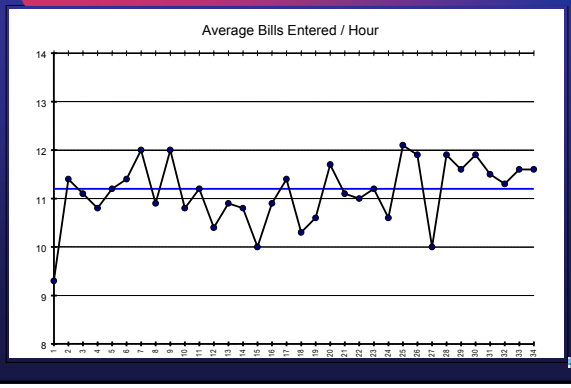


Trap 8 - Using Statistical Techniques on “Rolling” or “Moving” Averages

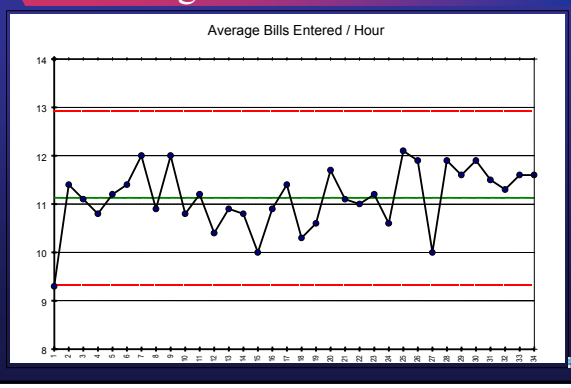
- There are many techniques that try to reduce the amount of variation that is represented on charts.
  - Rolling average of
    - 4 month
    - 12 month
    - 52 month
- Making variation not visible does not make it go away.
- Understanding statistical thinking and the difference between common and special cause is the best option

More Examples

Billing Time

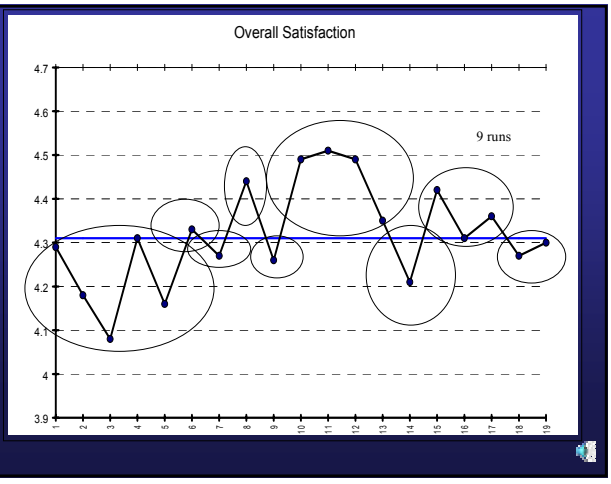


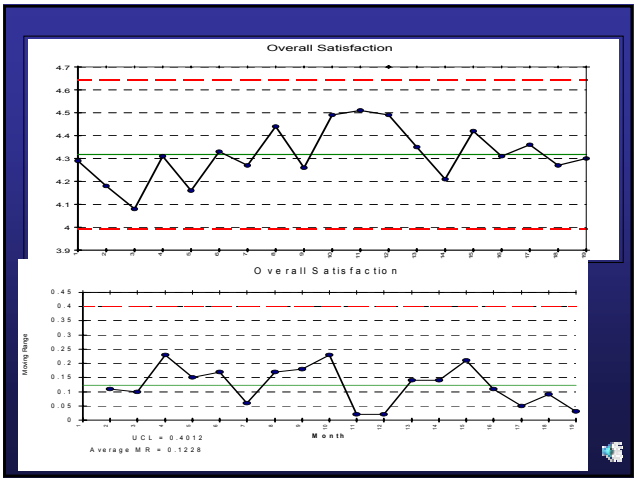
Billing Time Control Chart



Patient Satisfaction

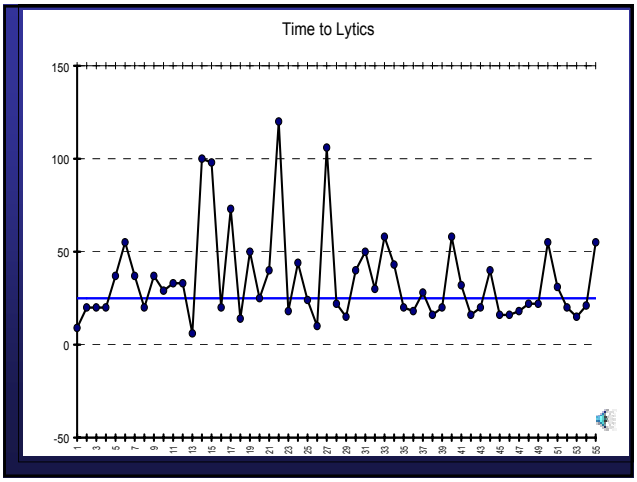
Month	Overall Satisfaction
1	4.29
2	4.18
3	4.08
4	4.31
5	4.16
6	4.33
7	4.27
8	4.44
9	4.26
10	4.49
11	4.51
12	4.49
13	4.35
14	4.21
15	4.42
16	4.31
17	4.36
18	4.27
19	4.3

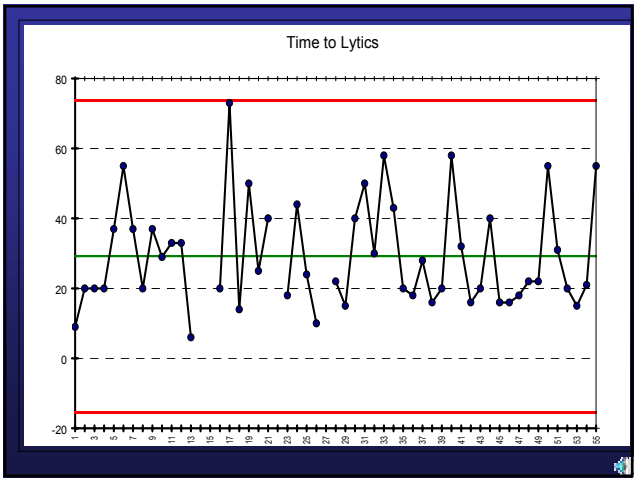




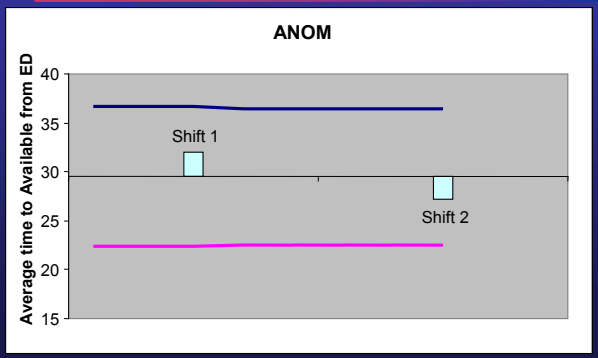
Time to Fibrolytics

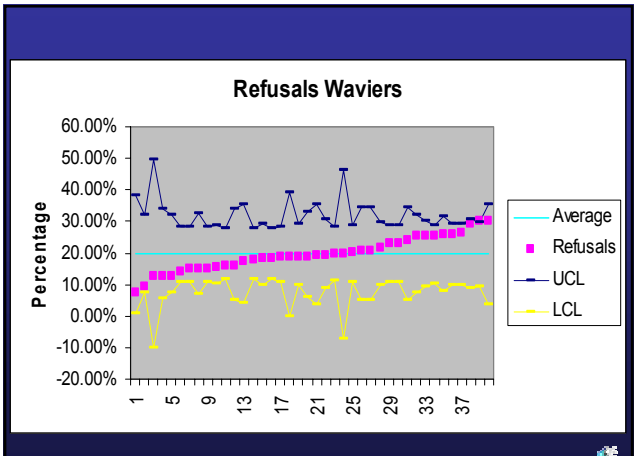
Order	Time to Lytics
1	9
2	20
3	20
4	20
5	37
6	55
7	37
8	20
9	37
10	29
11	33
12	33
13	6
14	100
15	98
16	20
17	73
18	14
19	50
20	25
21	40
22	120
23	18
24	44
25	24
26	10
27	106
28	22
29	15
30	40
31	50
32	30
33	58
34	43
35	20
36	18
37	28
38	16
39	20
40	58
41	32
42	16
43	20
44	40
45	16
46	16
47	18
48	22
49	22
50	55
51	31
52	20
53	15
54	21
55	55





Time to Clear ED



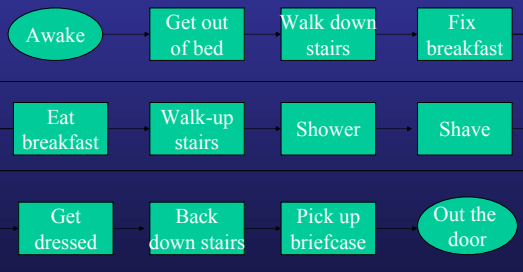


Flowcharting

Flowcharting

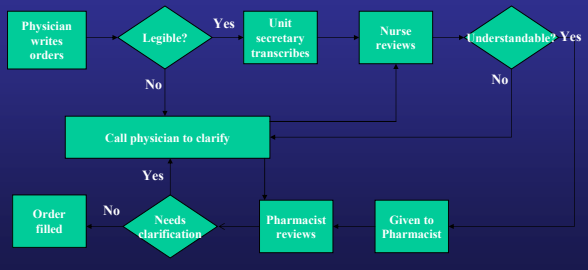
- Start / Finish
- Process
- Decision

Flowchart of Process



Planning Tool

Flowcharts

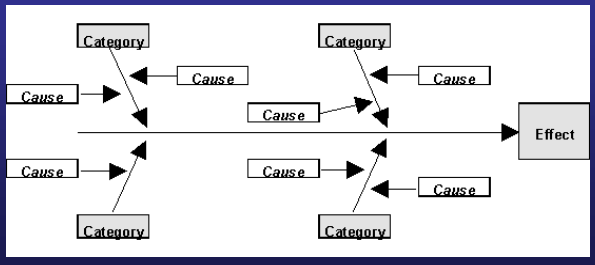


Cause and Effect Diagram
(Fish Bone)

Used to help identify all potential causes of a problem or issue

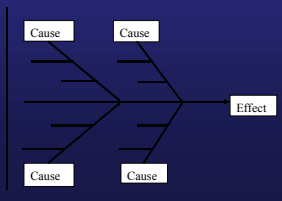
Planning Tool

Cause and Effect Diagram



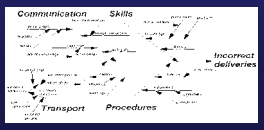
Areas of Questioning

- People
- Equipment
- Policy
- Suppliers
- Method
- Staff
- Patients

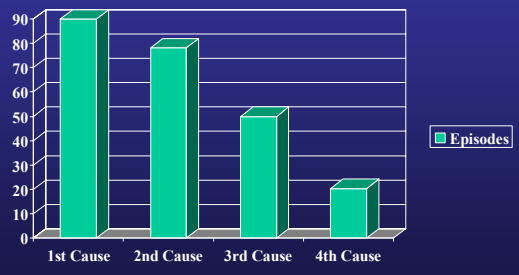


The Five Why's

- Why did this happen?
- And, why did that happen?
- But why did that happen?
- And that happen because?
- And this happened as a result of?



Pareto Analysis



80-20 Rule

- 80 of problems are caused by only 20% of the categorical causes.

Brainstorming

- To gather ideas from all participants without criticism or judgement

Brainstorming

- Encourage everyone to freewheel; don't hold back on any ideas, even if they seem silly at the time; the more ideas the better.
- No discussion during the brainstorm. That will come later.
- No judgement. No one is allowed to criticize another's ideas, not even with a groan or grimace!
- Let people hitchhike-build upon ideas generated by other in the group.
- Write ALL ideas on a flipchart so the whole group can easily scan them.

Brainstorming

- Review topic
- Give everyone a minute or two of silence to think about the question
- Invite everyone to call out their ideas. The facilitator should enforce the ground rules
- Record the ideas such that they are visible to the group

What is Consensus?

- Finding a idea, proposal, potential solution, etc… that all members of the team can support; no member opposes it.

Reaching Consensus

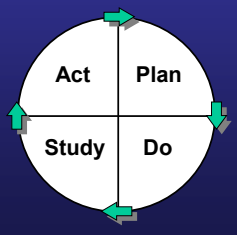
- Takes time
- Requires a commitment to decide by consensus
- Requires skills in communication and conflict resolution
- Requires creative thinking and open-mindedness
- Each element of the consensus reaching process should be facilitated.

Brainstorming Potential Solutions

Planning Tool

- Groupthink
- Concensus building
  - open space technology (Harrison Owen *"Open Space Technology"*)
  - dialogue (William Issiacs *"Dialogue and the Art of Thinking Together"*

PDSA Cycle



- What is the current status of the process. Run Chart
- Flow chart the process
- How can these areas be improved? Cause /effect, 5 Why's,
- Determine the areas of concern (bottleneck) 80-20 rule or pareto analysis
- Brainstorm solutions
- Implement
- Reevaluate

References

- Data "Sanity":Statistical Thinking for Everyday Data by Davis Balestracci
  http://deming.eng.clemson.edu/pub/den/data_sanity.pdf
- Understanding Variation by Donald Wheeler
* Quality Improvement by Davis Balestracci
- Fourth Generation Management by Brian Joiner

Questions

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