

International Forum on Quality  
and Safety in Healthcare

# Better Quality Through Better Measurement: Worksheets

***Faculty***

*Robert Lloyd, PhD, Vice President  
Institute for Healthcare Improvement*

Kuala Lumpur  
Convention Centre  
24 August 2017

## Measurement Self-Assessment

Source: R. Lloyd, Quality Health Care: A Guide to Developing and Using Indicators. Jones & Bartlett Publishers, 2004: 301-304.

Measurement Topic or Skill	Response Scale				
	1	2	3	4	5
Help people in my organization determine why they are measuring (improvement, judgment or research)					
Move teams from concepts to specific quantifiable measures					
Building clear and unambiguous operational definitions for our measures					
Develop data collection plans (including stratification and sampling strategies)					
Explain why plotting data over time (dynamic display) is preferable to using aggregated data and summary statistics (static display)					
Explain the differences between random and non-random variation					
Construct run charts (including locating the median)					
Explain the reasoning behind the run chart rules					
Interpret run charts by applying the run chart rules					
Explain the statistical theory behind Shewhart control charts (e.g., sigma limits, zones, special cause rules)					
Describe the basic 7 Shewhart charts and when to use each one					
Help teams select the most appropriate Shewhart chart for their measures					
Describe the rules for special cause variation on a Shewhart chart					
Help teams link measurement to their improvement efforts					

1. I'd definitely have to call in an outside expert to explain and apply this topic/method.
2. I'm not sure I could apply this appropriately to a project.
3. I am familiar with this topic but would have to study it further before applying it to a project.
4. I have knowledge about this topic, could apply it to a project but would not want to be asked to teach it to others.
5. I consider myself an expert in this area, could apply it easily to a project and could teach this topic/method to others.



# Aim Statement Worksheet

Can you develop a good Aim Statement?

Project Topic: \_\_\_\_\_

## Aim statement

(What's the problem? Why is it important? What are you going to do about it?)

How good? \_\_\_\_\_

By when? \_\_\_\_\_

3

© 2016 Institute for Healthcare Improvement/R. Lloyd

# Organizing Your Measures Worksheet<sup>©</sup>

Topic for Improvement: \_\_\_\_\_

Concept	Potential Measure(s)	Outcome	Process	Balancing

Source: R. Lloyd. *Quality Health Care: A Guide to Developing and Using Indicators*. Jones and Bartlett, 2004.

© 2016 Institute for Healthcare Improvement/R. Lloyd

# Operational Definition Worksheet

5

## Can you develop a good Operational Definition?

**Measure Name:** \_\_\_\_\_

(Remember this should be specific and quantifiable, e.g., the time it takes to..., the number of..., the percent of... or the rate of...)

### Operational Definition

Define the specific components of this measure. Specify the numerator and denominator if it is a percent or a rate. If it is an average, identify the calculation for deriving the average. Include any special equipment needed to capture the data. If it is a score (such as a patient satisfaction score) describe how the score is derived. When a measure reflects concepts such as accuracy, complete, timely, or an error, describe the criteria to be used to determine "accuracy."

See Appendix D for a detailed Operational Definition worksheet



## Data Collection Plan Worksheet

Project name & location: \_\_\_\_\_

Measure Name	Is Stratification appropriate? If Yes, list the levels of stratification	Will you use sampling? If Yes, describe the sampling method you will use	Frequency of data collection (e.g., hourly, daily, weekly?)	Duration of data collection (i.e., how long do you plan to collect the data?)

## Measurement Dashboard Worksheet<sup>®</sup>

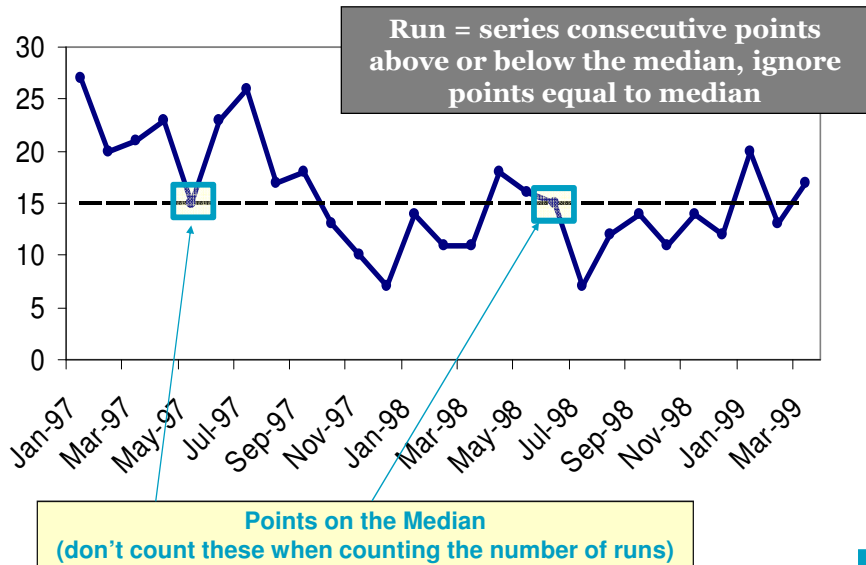
Name of team: \_\_\_\_\_ Date: \_\_\_\_\_

<b><u>Measure Name</u></b> (Be sure to indicate if it is a count, percent, rate, days between, etc.)	<b><u>Operational Definition</u></b> (Define the measure in very specific terms. Provide the numerator and the denominator if a percentage or rate. Be as clear and unambiguous as possible)	<b><u>Data Collection Plan</u></b> (How will the data be collected? Who will do it? Frequency? Duration? What is to be excluded?)

Source: R. Lloyd. *Quality Health Care: A Guide to Developing and Using Indicators*. Jones and Bartlett, 2004.

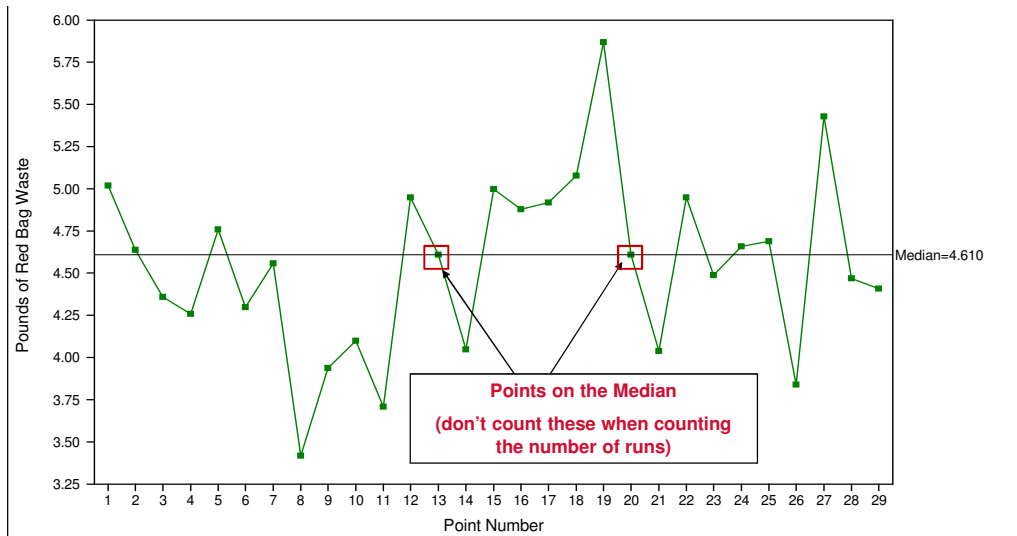
© 2016 Institute for Healthcare Improvement/R. Lloyd

## How many Runs?



## Run Chart: Medical Waste

### Determine the number of runs on this chart



© 2015 Institute for Healthcare Improvement/R. Lloyd

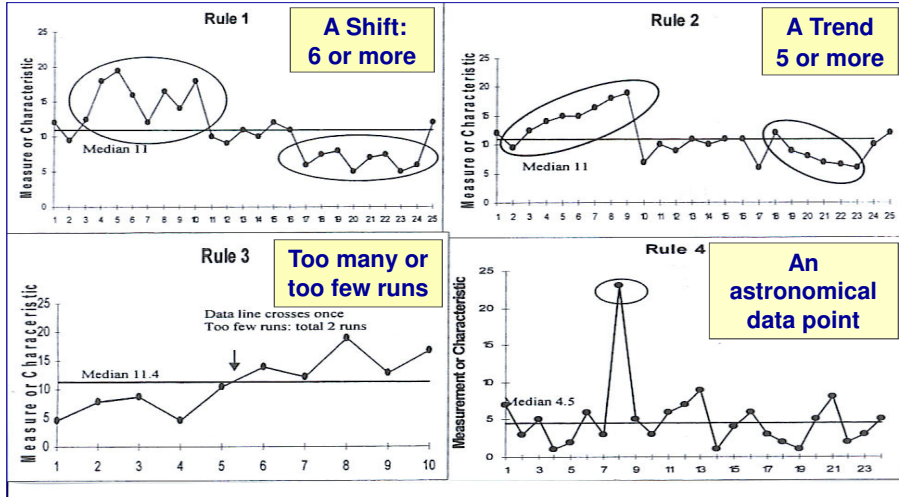
## Rule #3: Too few or too many runs

Use this table by first calculating the number of "useful observations" in your data set. This is done by subtracting the number of data points on the median from the total number of data points. Then, find this number in the first column. The lower number of runs is found in the second column. The upper number of runs can be found in the third column. If the number of runs in your data falls below the lower limit or above the upper limit then this is a signal of a special cause.

# of Useful Observations	Lower Number of Runs	Upper Number of Runs
15	5	12
16	5	13
17	5	13
18	6	14
19	6	15
20	6	16
21	7	16
22	7	17
23	7	17
24	8	18
25	8	18
26	9	19
27 <b>Total useful observations</b>	10	19
28	10	20
29 <b>Total data points</b>	10	20
30	11	21

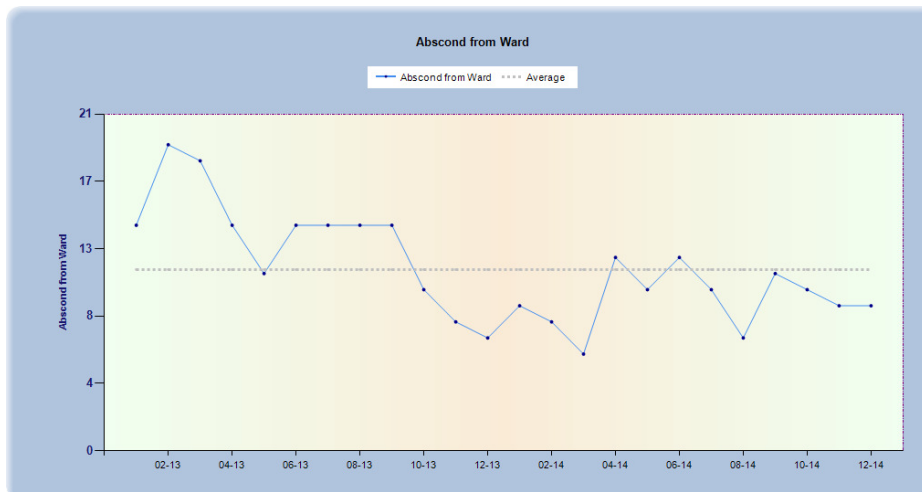
rd

# Non-Random Rules for Run Charts



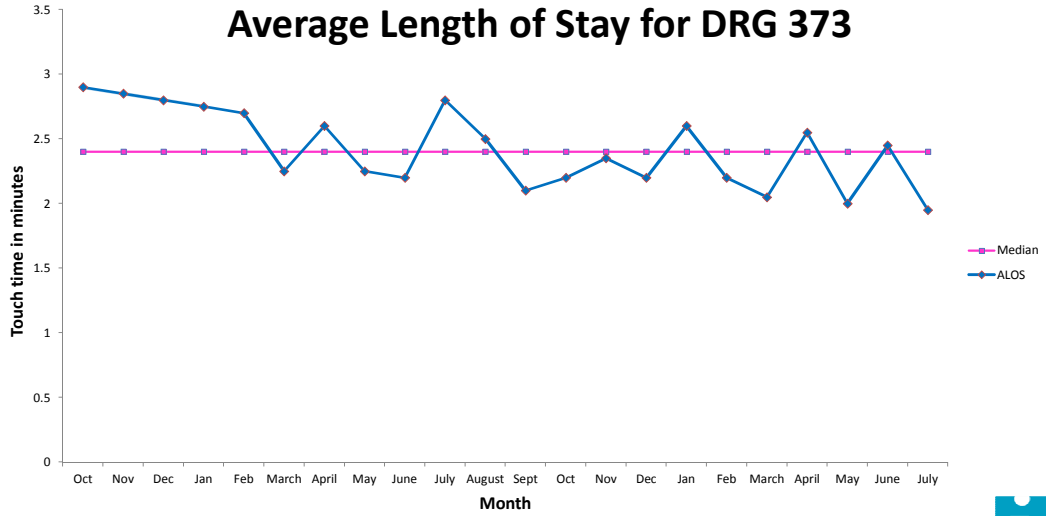
Source: The Data Guide by L. Provost and S. Murray, Jossey-Bass Publishers, 2011.

© 2016 Institute for Healthcare Improvement/R. Lloyd

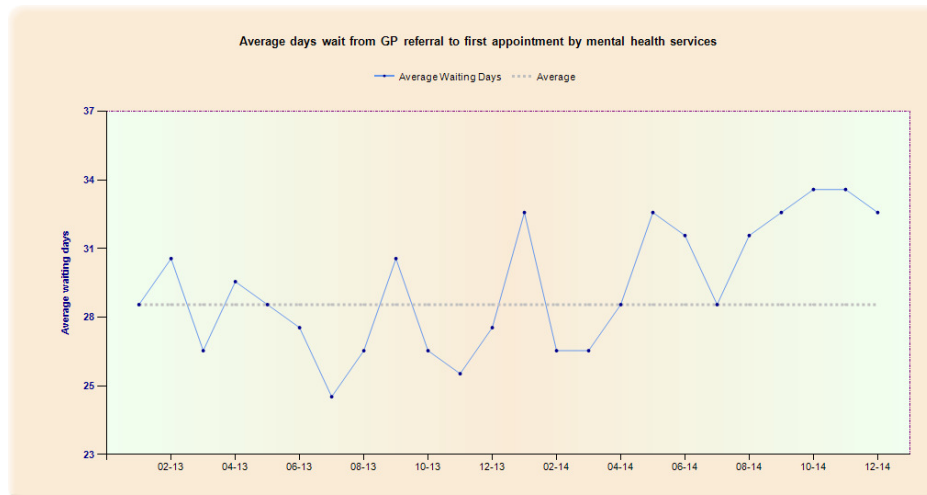


Courtesy of East London Foundation Trust, 2016

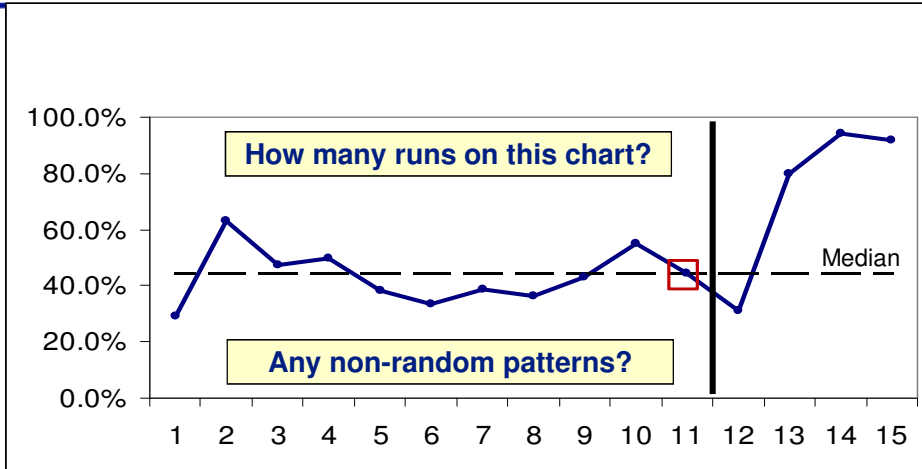
Source: Peter Kammerlind, ([Peter.Kammerlind@lj.se](mailto:Peter.Kammerlind@lj.se)), Project Leader  
 Jönköping County Council, Jonkoping, Sweden.



© 2016 Institute for Healthcare Improvement/R. Lloyd



# Has Anything Really Changed?

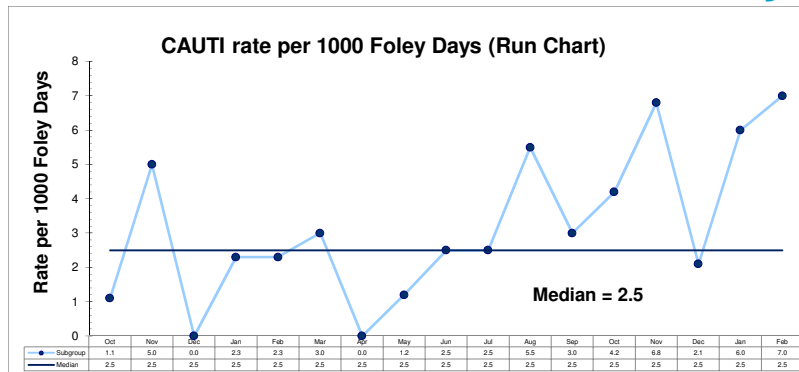


© Richard Scoville & IHI



16

# Run Chart for CAUTI Case Study



- Determine the number of runs
- Apply the Run Chart Rules and interpret the chart
- Any non-random patterns?
- 15 useful data points = 5 to 12 runs

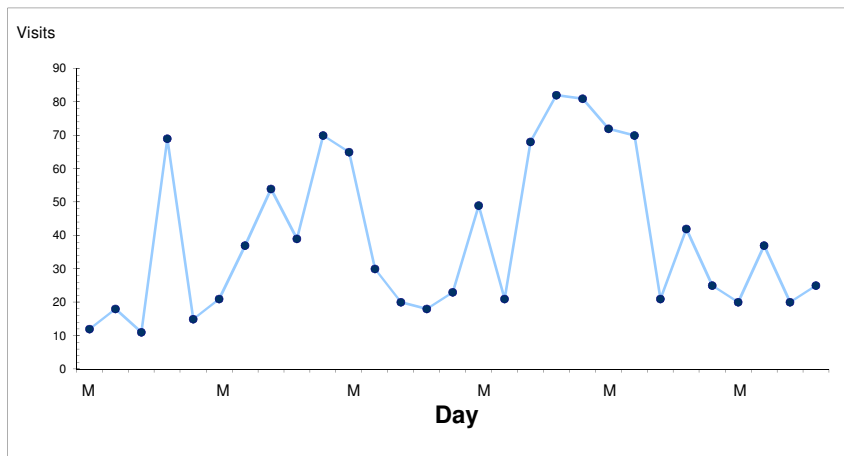


©2015 Institute for Healthcare Improvement/R. C. Lloyd



$$(29 + 1)/2 = 30/2 = 15 = \text{median position}$$

1. Now slide a piece of paper down the page to reveal the dots in descending order.
2. At the 15<sup>th</sup> data point strike a line which will be the median.
3. Determine where the median line intersects the Y axis and find the median value.
4. What is it?



© 2016 Institute for Healthcare Improvement/R. Lloyd

Week	Percent Compliance
1	79
2	82
3	86
4	84
5	85
6	79
7	77
8	86
9	82
10	74
11	85
12	74
13	78
14	83
15	81
16	81
17	74
18	84
19	78
20	75
21	74
22	68
23	81
24	84
25	70
26	85
27	77

Measure is the percent compliance with proper hand hygiene by week.

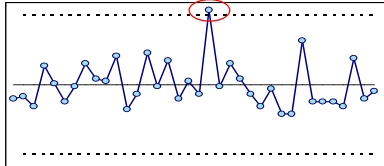
Numerator = number of properly completed hand washings

Denominator = total number of hand washing observations

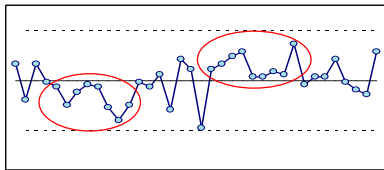
- Make a run chart with the data shown in the table to the left.
- Decide how you want to lay out the X (horizontal) axis and Y (vertical) axis.
  - Plot the data points.
- Calculate the median. Hint: use the  $(n + 1)/2$  formula to find the median position first.
- Then determine the median value.
- Determine the number of runs on the chart.
  - Apply the run chart rules and interpret the results
- **DO NOT use your calculator or Excel!!!**

## Rules for Detecting Special Causes

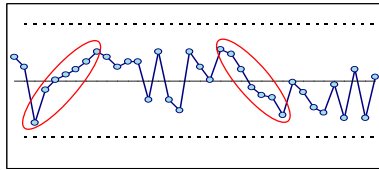
A single point outside the control limits



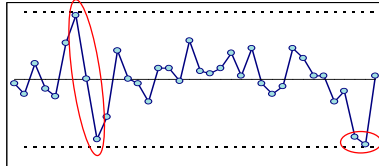
Eight or more consecutive points above or below the centerline



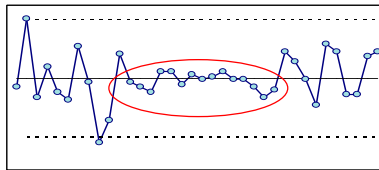
Six consecutive points increasing (trend up) or decreasing (trend down)



Two out of three consecutive points near a control limit (outer one-third)



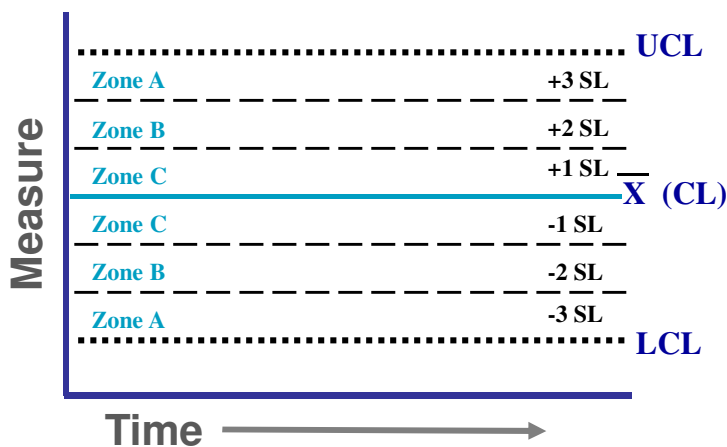
Fifteen consecutive points close to the centerline (inner one-third)



©Copyright 2016 IHI/R. Lloyd



## How do I use the Zones on a Shewhart chart?



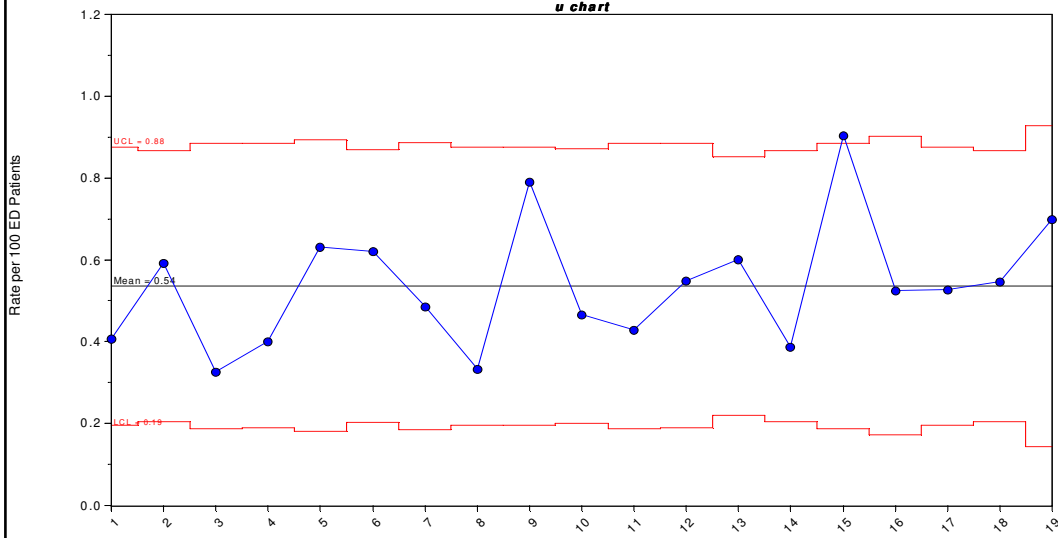
**NOTE:**  
Each zone is equal to 1 sigma

20



# Is there a Special Cause on this chart?

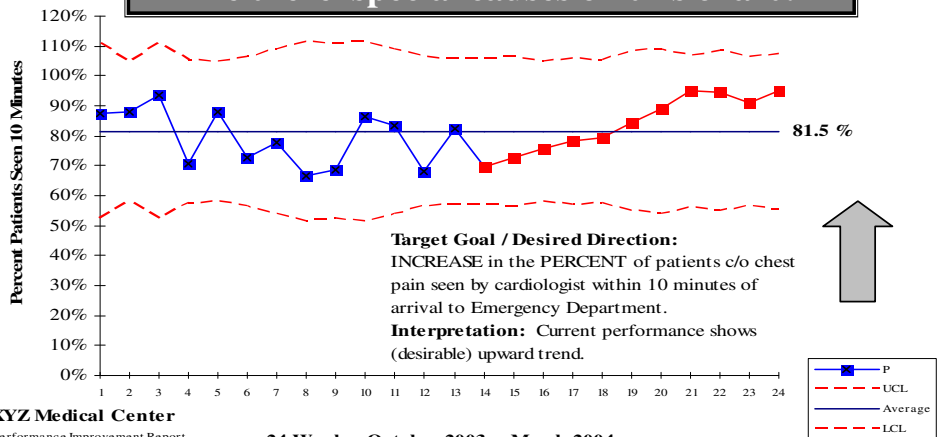
		Unplanned Returns to Ed w/in 72 Hours																			
Month		M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	
ED/100	Returns	41.78	43.89	39.86	40.03	38.01	43.43	39.21	41.90	41.78	43.00	39.66	40.03	48.21	43.89	39.86	36.21	41.78	43.89	31.45	
		17	26	13	16	24	27	19	14	33	20	17	22	29	17	36	19	22	24	22	



©Copyright 2013 Institute for Healthcare Improvement/R. Lloyd

## PERCENT PATIENTS C/O CHEST PAIN SEEN BY CARDIOLOGIST WITHIN 10 MINUTES OF ARRIVAL TO ED EXAMPLE CHART

Are there special causes on this chart?



**Target Goal / Desired Direction:**  
INCREASE in the PERCENT of patients c/o chest pain seen by cardiologist within 10 minutes of arrival to Emergency Department.

**Interpretation:** Current performance shows (desirable) upward trend.



XYZ Medical Center  
Performance Improvement Report  
March 25, 2004  
Fictitious data for educational purposes

24 Weeks: October 2003 -- March 2004

p-chart, possible range 0-100%

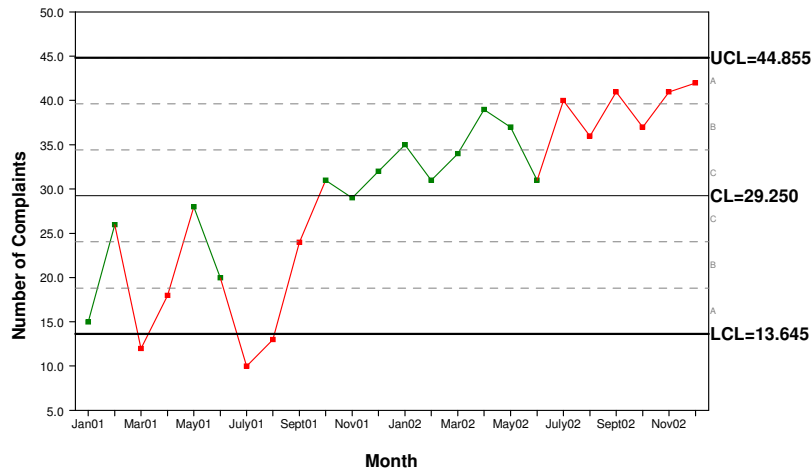
22

©Copyright 2013 Institute for Healthcare Improvement/R. Lloyd

## Number of Patient Complaints by Month

(XmR chart)

Are there any special causes present? If so, what are they?



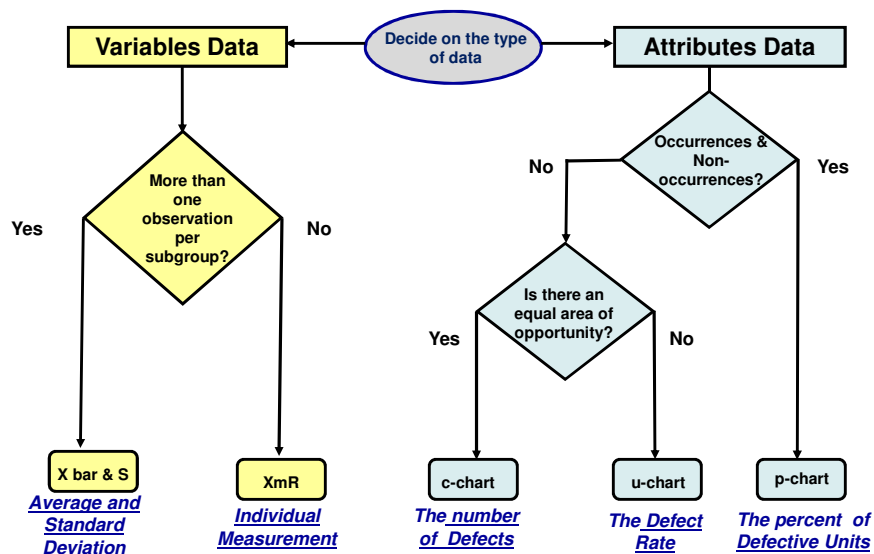
23

©Copyright 2013 Institute for Healthcare Improvement/R. Lloyd



## The Control Chart Decision Tree

Source: R. Lloyd. *Quality Health Care: A Guide to Developing and Using Indicators*. Jones and Bartlett, 2004.



## Is it an XmR (I) or X bar & S?

Measure	XmR ( I chart)	X bar & S chart
Time to clean an inpatient room (in minutes)		
Patient satisfaction scores for subgroups of 15 patients in the outpatient survey area		
Avg. turnaround time for all STAT labs done each day		
Cost for each normal delivery		
A diabetic patient's 3x a day blood sugar readings		
Average length of stay for a subgroup of 20 ICU patients		
The distance (in feet) that a sample of 10 knee replacement patients can walk in 15 seconds		



## You Make the Call!

Measures	Subgroup?	Type of Data?	Chart?
Each day the radiology department records the total number of X-rays performed for Emergency Department patients.		V or A	
The number of central line insertions each week during which all elements of the bundle were followed divided by the total number of central line insertions that week		V or A	
The weekly number of catheter-associated urinary tract infections per 1000 urinary catheter days		V or A	
The total number of patient falls each month (with or without injury to the patient and whether or not assisted by a staff member) divided by the total patient days for the month		V or A	
The number of hand hygiene observations performed consistent with guidelines divided by the total number of hand hygiene observation opportunities		V or A	

© 2013 R. C. Lloyd & Associates

## You Make the Call!

Measures	Subgroup?	Type of Data?	Chart?
An analyst pulls a sample of 50 orthopedic surgery charts per week and counts all discrepancies from standard documentation practice		V or A	
Each medication order is checked against five potential types of errors. You also have the total number of orders placed each week		V or A	
You have data on average length of stay by week for a particular DRG		V or A	
The temperature of the hot food items on a patient tray is collected for a sample of 25 trays each day and stratified by shift.		V or A	
Each day the number of home healthcare visits that are more than 15 minutes late on arrival are recorded and compared with the total number of visits scheduled for that day.		V or A	

© 2013 R. C. Lloyd & Associates

## Selecting the Most Appropriate Chart

Measure Name (Process or Outcome measure?)	Subgroup?	Type of Data?	Chart of Choice?
		V or A	
		V or A	
		V or A	
		V or A	
		V or A	

28

