How will we know that change is an improvement?

The Model for Improvement and Understanding Variation

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Institute for Healthcare Improvement

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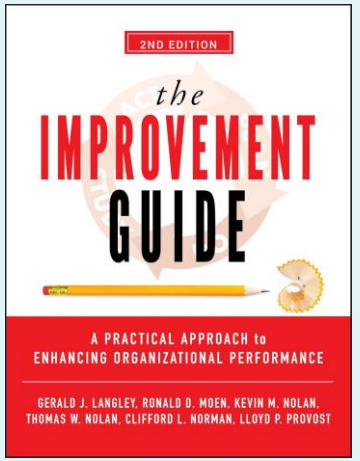
The Model for Improvement and Understanding Variation

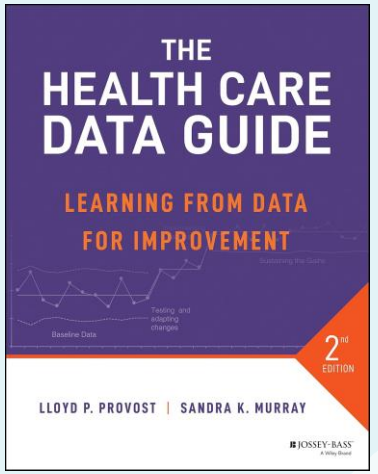
The Model for Improvement has led to proven results globally for more than 30 years and continues to be the engine for improvement today. Key to its success are developing and testing impactful change ideas and measuring their impact over time.

This workshop will explore the model for improvement and real-world results in the Asia Pacific region, with a focus on measurement and variation to understand the impact of changes on the system

Objectives:

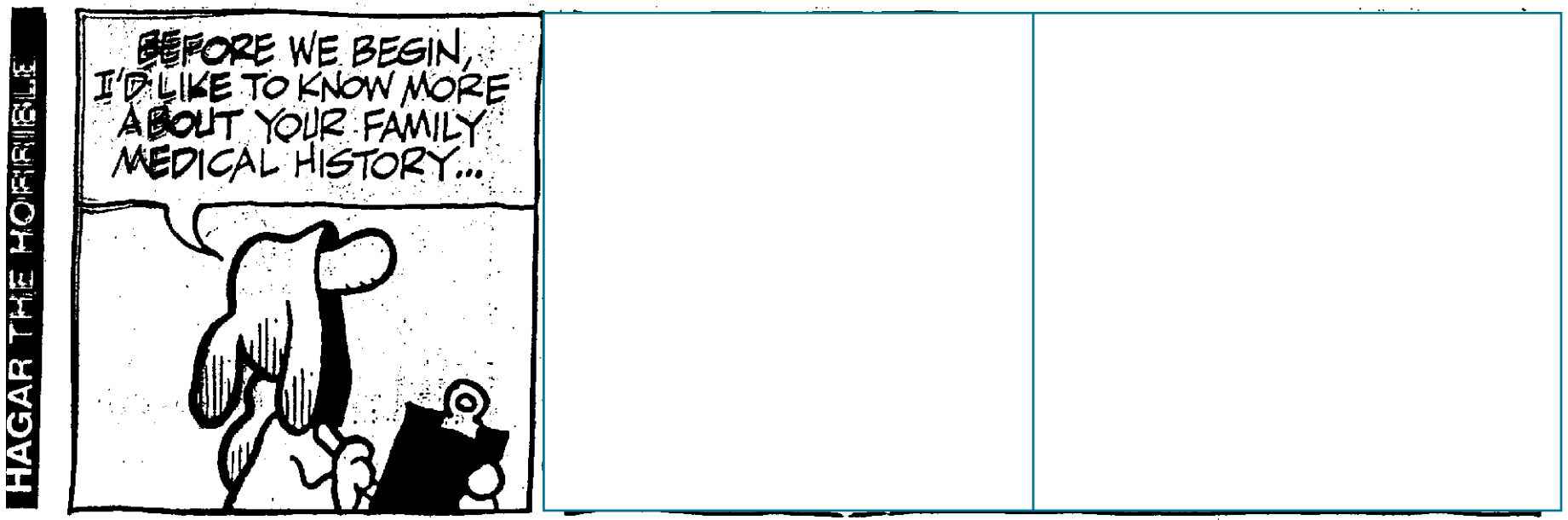
- Understand the Model for Improvement and its use in achieving system change
- Identify the key tools for learning from data and variation in improvement projects
- Appreciate the value of moving from static data to learning from data over time
- Appreciate the value of measurement at both project level and when making small tests of change





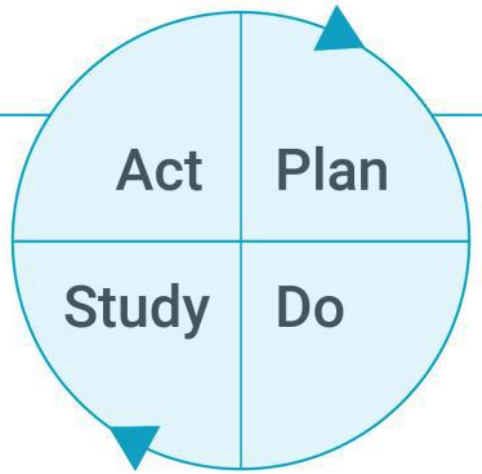
Key References

Hagar Visits the Doctor



Model for Improvement

Aim	Measures	Changes
What are we trying to accomplish?	How will we know that a change is an improvement?	What change can we make that will result in improvement?



Source: Adapted from *The Improvement Guide* (2009)

Fundamental Questions

Aim Statement

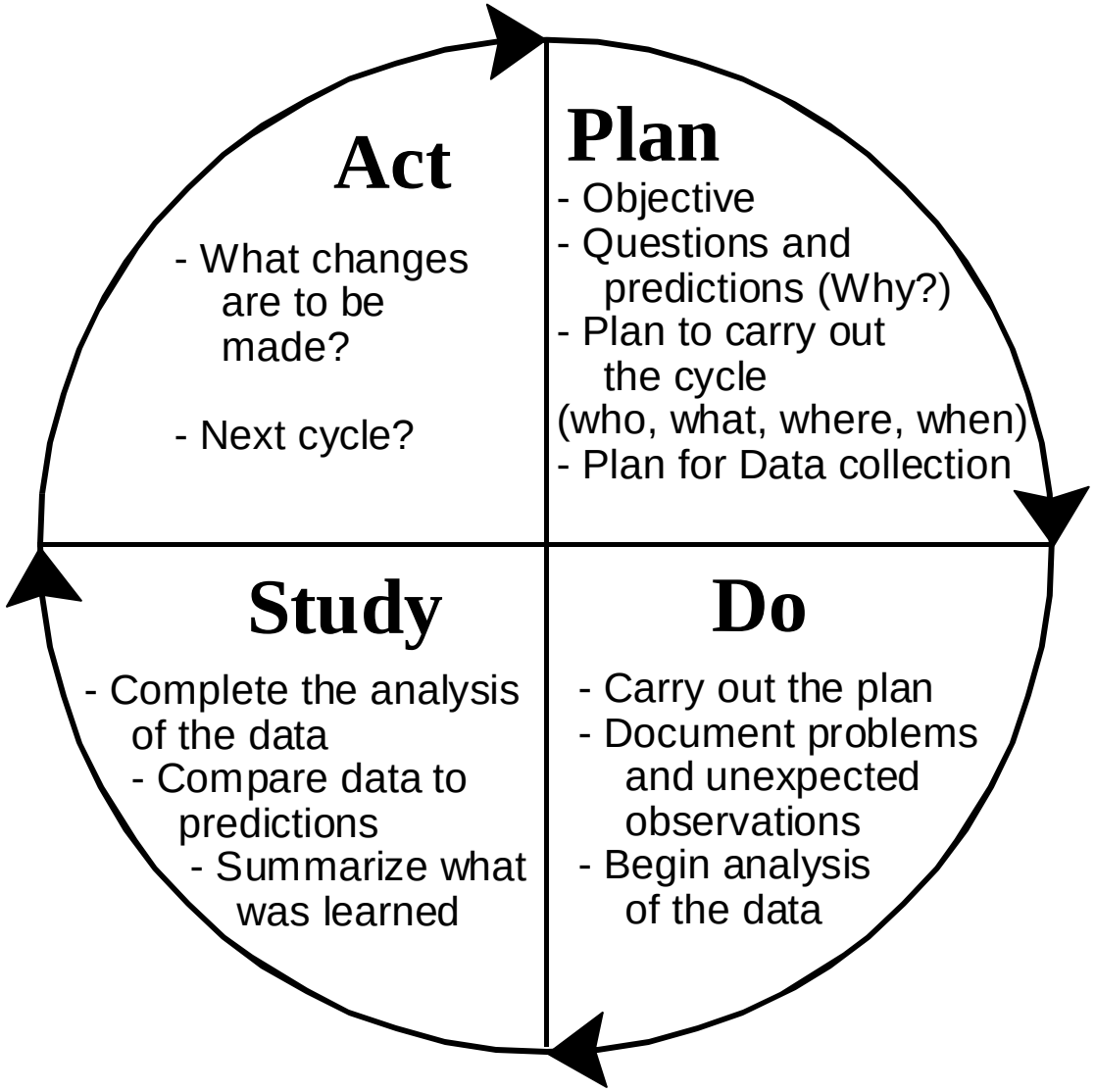
Measurement Strategy

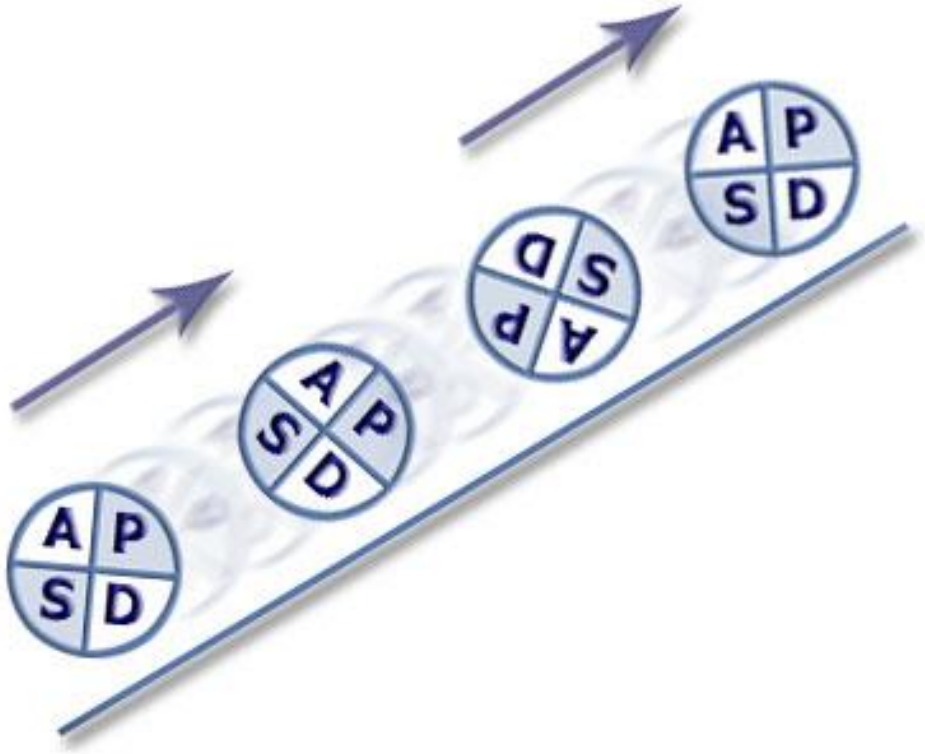
Driver Diagram

Action Methodology

PDSA Cycles

The PDSA Cycle for Learning and Improvement





Strategy for PDSA Cycles

Model for Improvement

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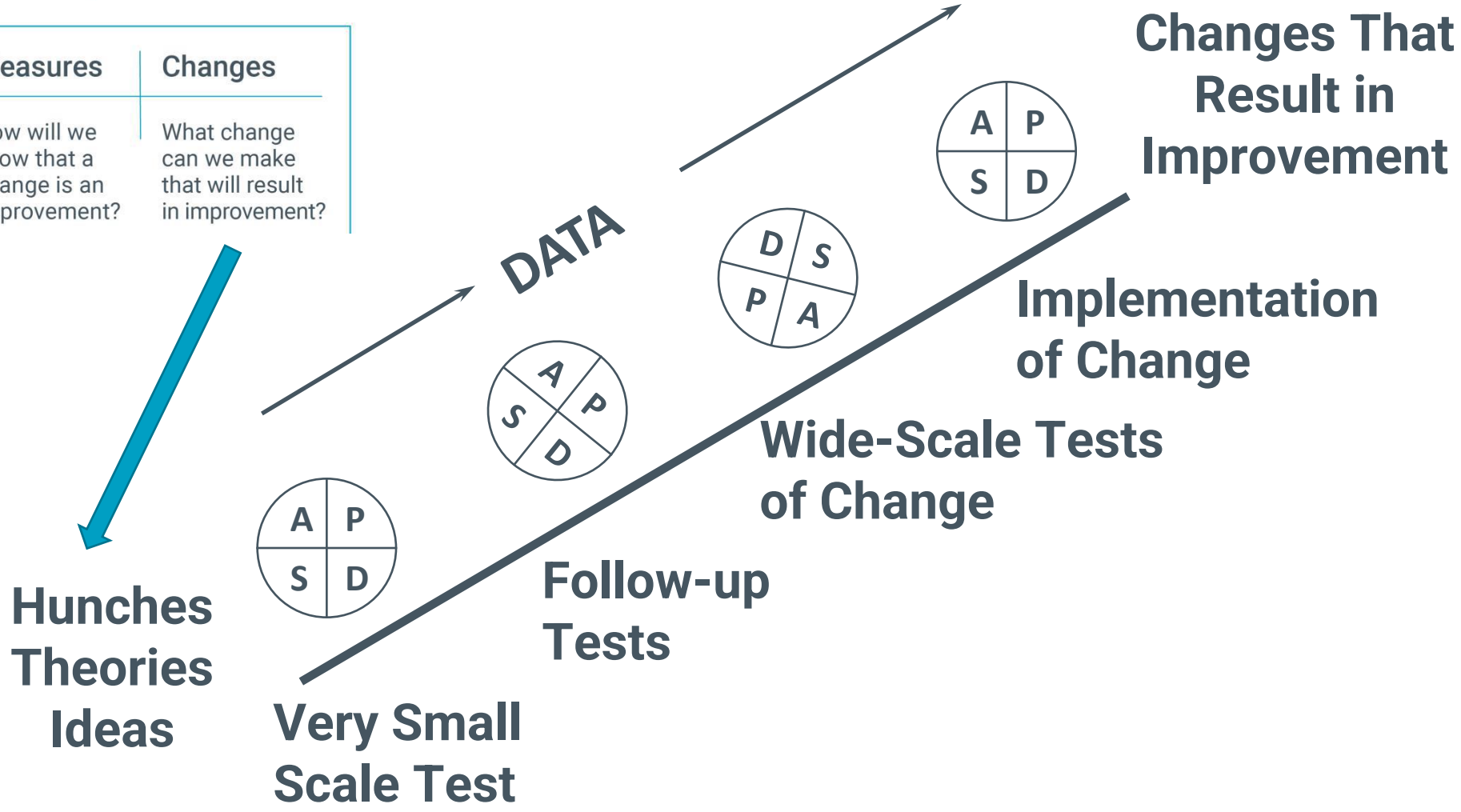
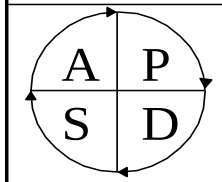
What are we trying to accomplish?	How will we know that a change is an improvement?	What change can we make that will result in improvement?



HINT for Successful PDSA Cycles

Use a form to organise and standardise your documentation and tests!

MODEL FOR IMPROVEMENT CYCLE:____DATE:____



Objective for this PDSA Cycle

PLAN:

QUESTIONS:

PREDICTIONS:

PLAN FOR CHANGE OR TEST: WHO, WHAT, WHEN, WHERE

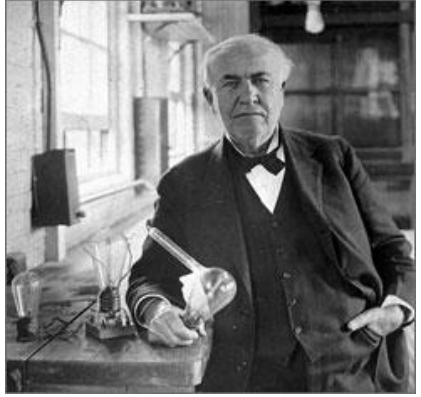
PLAN FOR COLLECTION OF DATA: WHO, WHAT, WHEN, WHERE

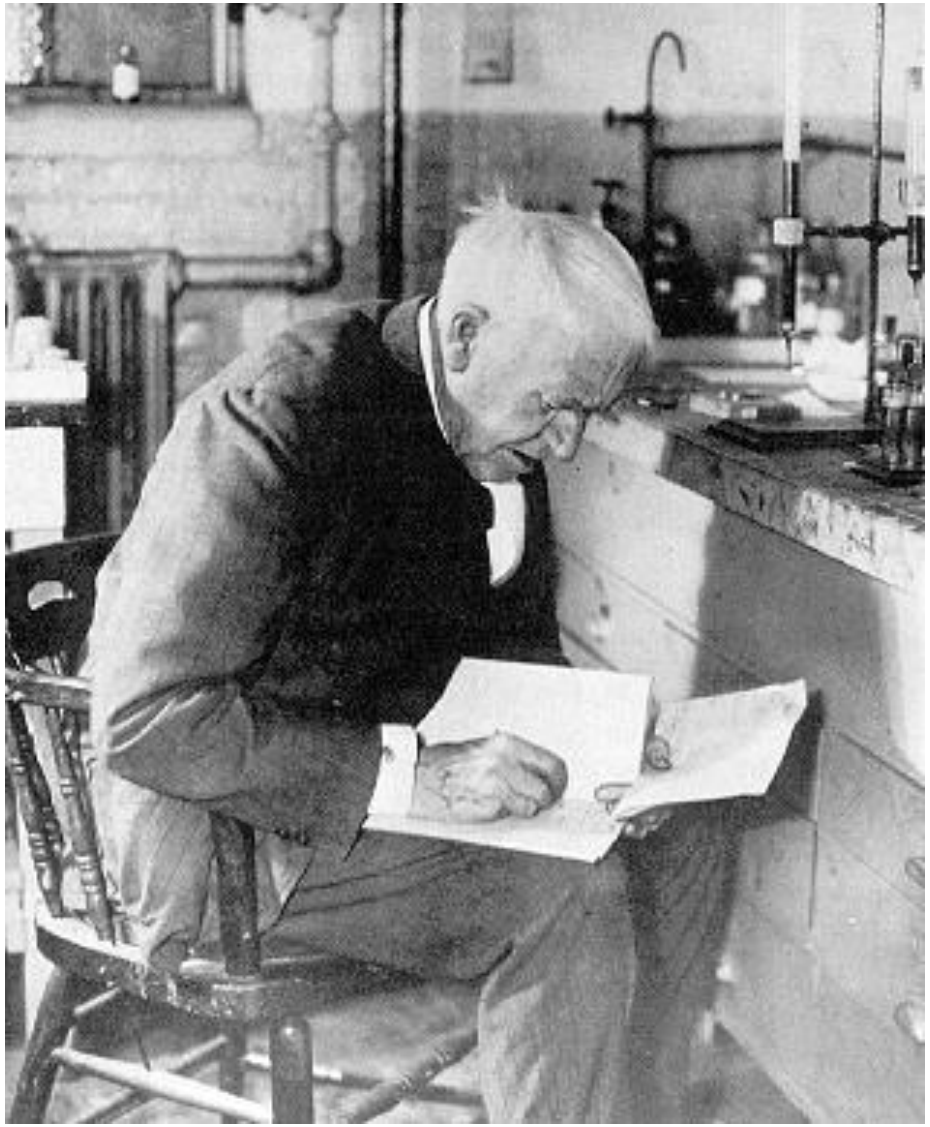
DO: CARRY OUT THE CHANGE OR TEST; COLLECT DATA AND BEGIN ANALYSIS.

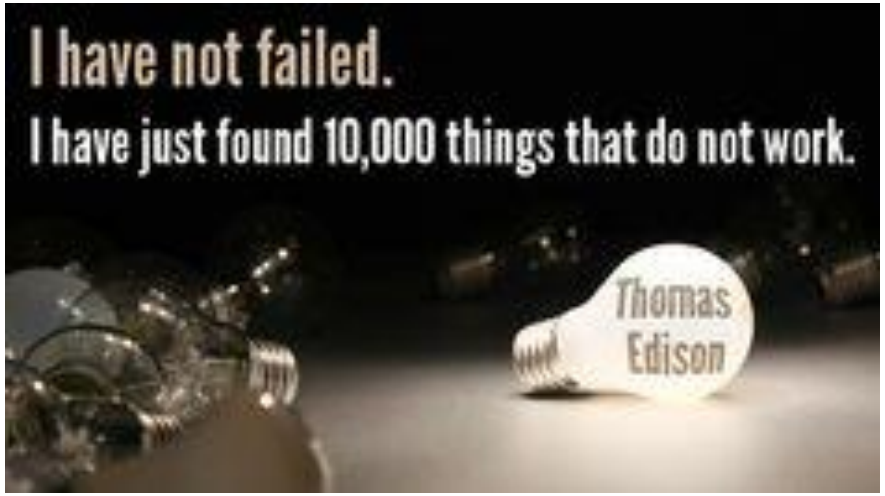
STUDY: COMPLETE ANALYSIS OF DATA; SUMMARIZE WHAT WAS LEARNED.

ACT: ARE WE READY TO MAKE A CHANGE? PLAN FOR THE NEXT CYCLE.

Thomas Edison, documenting his PDSA's







PDSA Cycles: Why Test?

- Increasing degree of belief that the change will result in an improvement.
- Deciding which of several proposed specific changes will lead to the desired improvement.
- Evaluating how much improvement we can expect if we make the change.
- Deciding how to adapt the proposed change to the actual environment of interest.
- Evaluating cost implications and possible side effects of the change.
- Giving individuals a chance to experience the change prior to implementation.

Improvement Guide, Chapter 7, p. 142

Some hints for planning useful Cycles for testing changes include:

- Think a couple of Cycles ahead of the initial test (future tests, implementation).
- Scale down the size and decrease the time required for the initial test.
- Do not try to get buy-in or consensus for the test; recruit volunteers for the test.
- Use temporary supports to make the change feasible during the test.
- Be innovative to make the test feasible.

Improvement Guide, Chapter 7, p. 143

PDSA Cycles for Implementation

The change is expected to become part of the routine operation of the system.

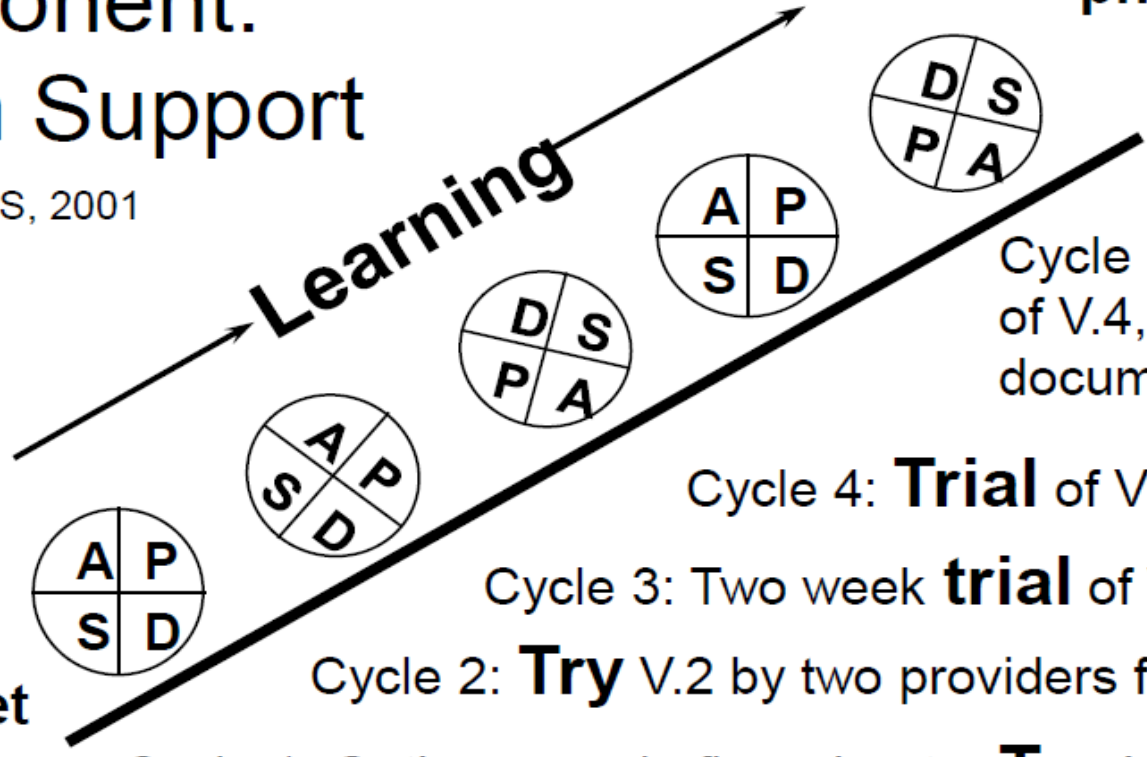
- The supporting processes to maintain the change will usually need to be designed or redesigned.
- Because learning can occur anytime action is taken, implementation should be carried out as part of a cycle.
- The increased permanence of a change that is a result of moving from testing to implementation is usually accompanied by increased reaction to the change.
- Implementation cycles generally require more time than testing cycles.
- Normally, the same team that tested the changes will be involved in implementing the changes.

Improvement Guide, Chapter 8, p. 174

Multiple Cycles to Implement Components of the ICIC Chronic Care Model

Component:
Decision Support

Chinatown, Asthma BTS, 2001



Use of Flow sheet V.4 by all physicians and nurses

Cycle 5: Implement use of V.4, do peer review of documentation and use

Cycle 4: **Trial** of V.4 by all providers

Cycle 3: Two week **trial** of V.3, review meetings

Cycle 2: **Try** V.2 by two providers for a few days

Cycle 1: Gather sample flow sheets. **Try** V.1 with two patients

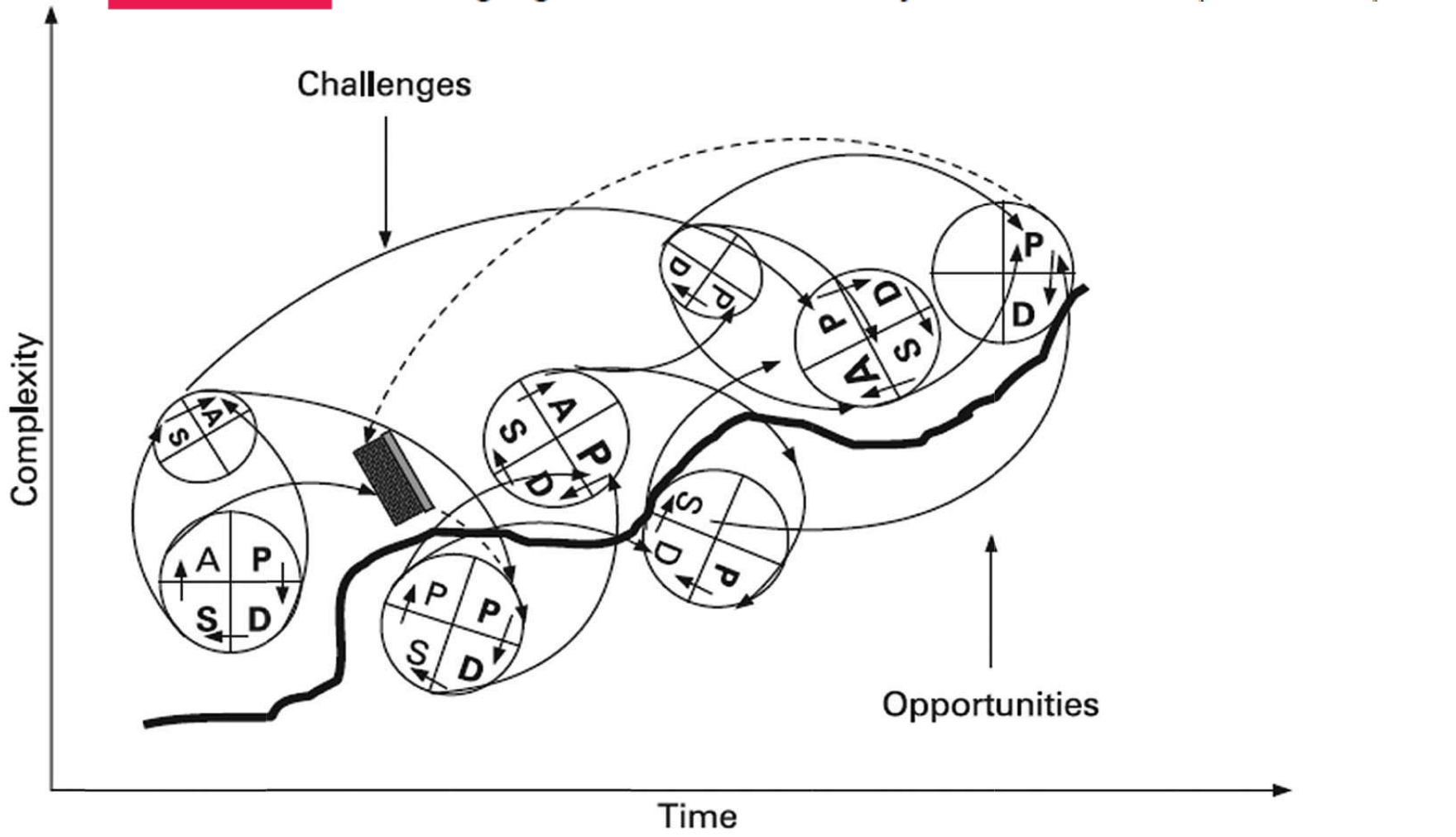
Will a flow sheet be useful for asthma patients?

BMJ Quality & Safety

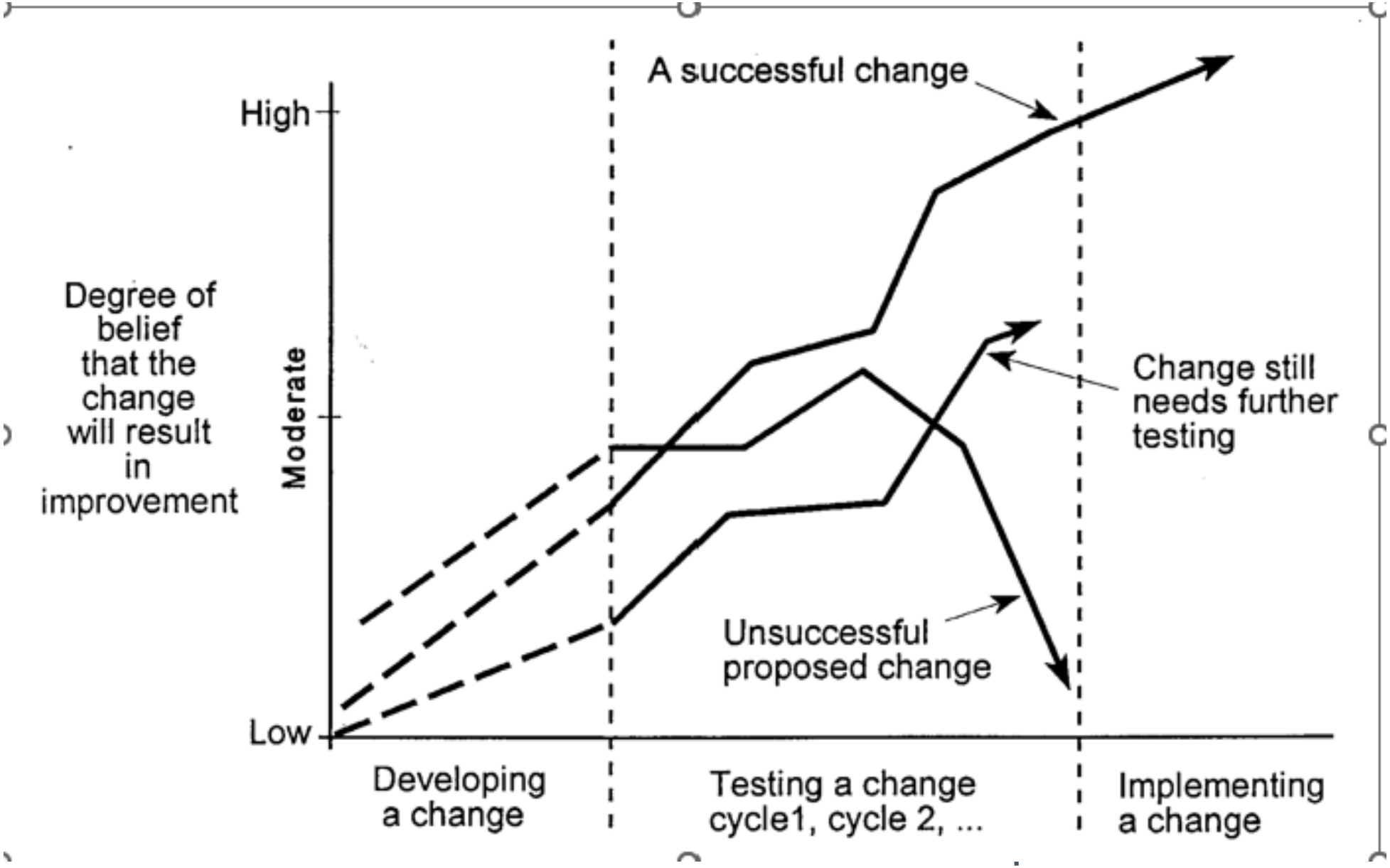
Building knowledge, asking questions

Greg Ogrinc and Kaveh G Shojania

BMJ Qual Saf 2013;**0**:1–3.



Degree of Belief When Making Changes



PDSA Cycle: Deciding on Scale of Test

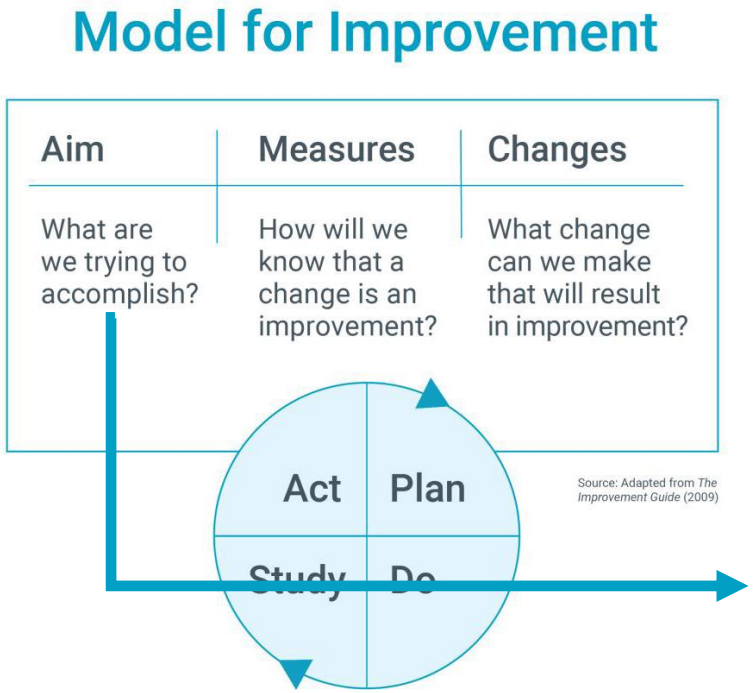
Current Situation		*People Readiness to Test Changes*		
		Resistant (No commitment)	Indifferent (some commitment)	Ready (strong commitment)
Low Degree of Belief that change idea will lead to Improvement	Cost of failure large	Very Small Scale Test	Very Small Scale Test	Very Small Scale Test
	Cost of failure small	Very Small Scale Test	Very Small Scale Test	Small Scale Test
High Degree of Belief that change idea will lead to Improvement	Cost of failure large	Very Small Scale Test	Small Scale Test	Large Scale Test
	Cost of failure small	Small Scale Test	Large Scale Test	Implement

Methods to accelerate the learning

Three principles to guide testing a change:

- Principle 1: Test on a small scale and build knowledge sequentially
- Principle 2: Collect data over time
- Principle 3: Include a wide range of conditions in the sequence of tests

IG, p. 145

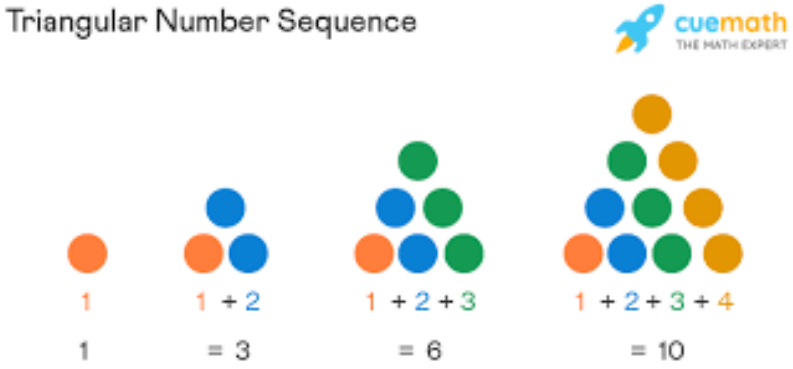


Learning the Sequence

What are we trying to accomplish?

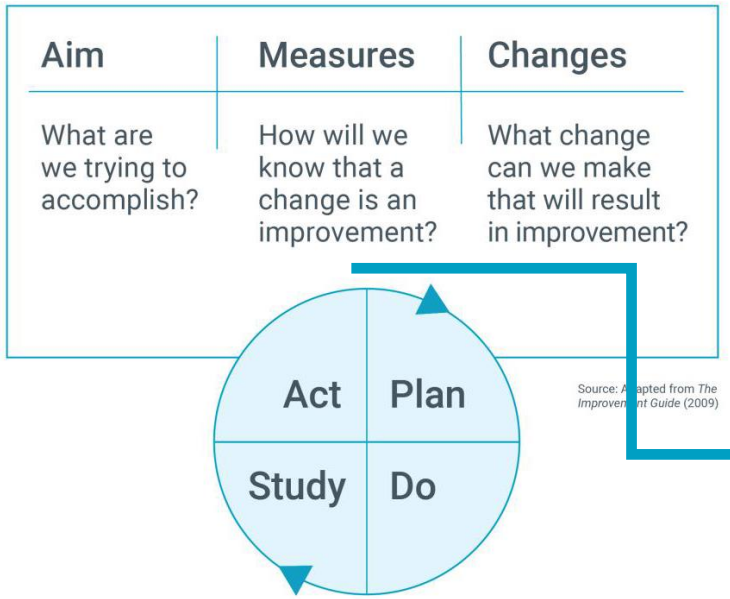
We found a new technology represented by a sequence that gives potentially valuable information to our business. We need to discover the rule (or theory) that generated this sequence.

Each improvement team should run tests to determine the rule. When they are sure that they have the rule (based on enough tests), then implement the technology in the business.



Sequence Observed: 2 4 6

Model for Improvement

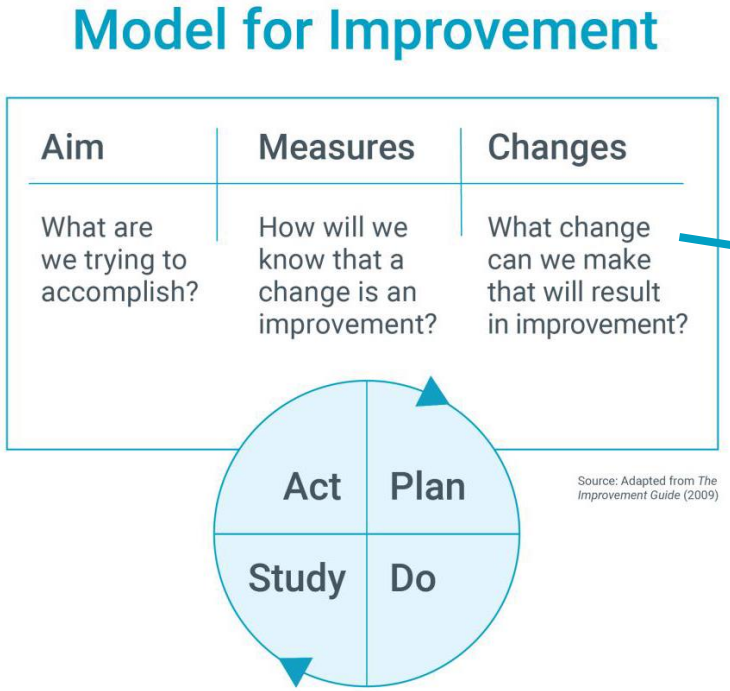


Learning the Sequence

How will we know that a change is an improvement?

1. **Correct predictions of results of tests.**

2. **A statement of the correct rule upon implementation.**



Learning the Sequence

What changes can we make that will result in improvement?

1. **Each team can test one sequence on each Cycle. Write down the specific sequence (example) being tested. The seminar leader will classify as either conforming or nonconforming.**

2. **Run as many Cycles as required until you are sure you know the rule. Keep track of the number of Cycles, and whether the example test sequence was conforming or nonconforming to the rule.**

3. **When testing Cycles are complete, wait until all teams are done to report the implementation Cycle (state the rule).**

Model for Improvement

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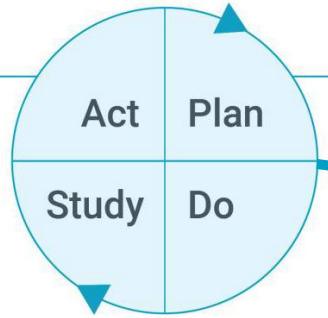

Source: Adapted from *The Improvement Guide* (2009)

Act

Are we ready to implement the change?

What examples should we test on the next cycle?

Plan

Objective - test another sequence.
Predictions - will test sequence be correct?
Plan - write down next sequence.

Do

Carry out the plan.
Show test sequence to instructor.
Record confirming or nonconforming.

Study

Compare data to predictions
Summarize what was learned.
Update the team's theory(s).
What is our degree of belief in our theory?

PDSA

Test

Results

			Match the Rule? Prediction		Actual	
Cycle	**Rule for Sequence**	**Sequence to Test on this Cycle**	**Yes**	**No**	**Yes**	**No**
1	2 4 6 8		x		x	
2	8 10 12		x		x	
3	1 3 5		x		x	
4	2 4 6 9			x	x	
5	1 2 3 4 5		x			x
6	0 1 1 2 3 5		x			x
7	3 6 9			x	x	
8	8 6 4 2			x		x
9	1 2 3 4			x	x	
10	4 8 12		x		x	
11	2 6 10 8 6			x		x
12	2 7 12 3042		x		x	
13	6 8		x			x
14	1 1 3			x		x
15	Mo Rat Dog Horse		x			x
16	12 37 51 62		x		x	
17	2 4 6.7543		x		x	
18	2 6 4 8			x		x
19	-6 -4 -2 x		x		x	
20						

Model for Improvement

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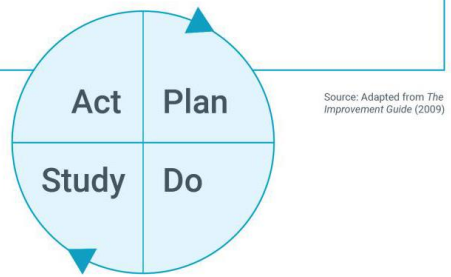

Source: Adapted from *The Improvement Guide* (2009)

"Negative results on the fish... Let's try rubbing two sticks together."

He uses data as a drunken man uses lamp posts, for support rather than illumination

Andrew Lang, Scottish Writer

THE JOINT COMMISSION JOURNAL ON QUALITY IMPROVEMENT

MARCH 1997 VOLUME 23 NUMBER 3

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PERFORMANCE MEASURES AND MEASUREMENT

The Three Faces of Performance Measurement:

Improvement, Accountability, and Research

"We are increasingly realizing not only how critical measurement is to the quality improvement we seek but also how counterproductive it can be to mix measurement for accountability or research with measurement for improvement."

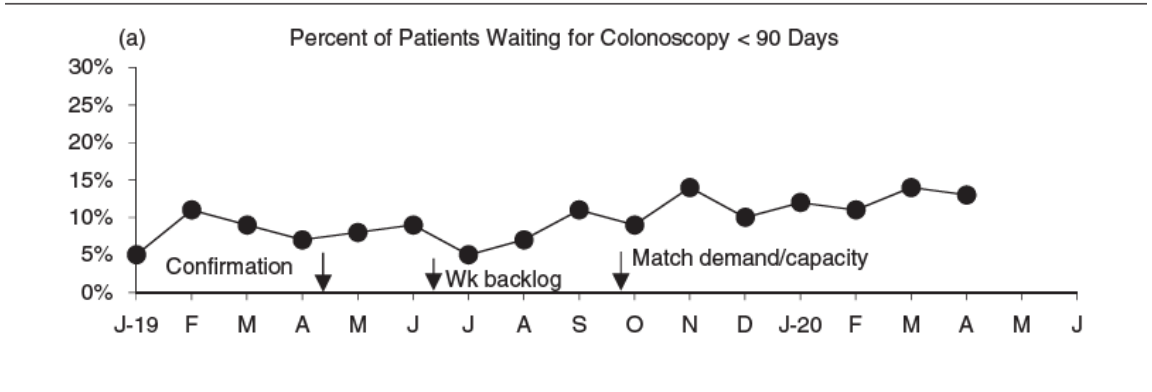
Referenced in HCDG, page 29

Data for Improvement, Accountability and Research

Aspect	Improvement	Accountability	Research
Aim	Improvement of care	Comparison, choice, reassurance, spur for change	New knowledge
Test Observability	Test observable	No test, evaluate current performance	Test blinded or controlled
Bias	Accept consistent bias	Measure and adjust to reduce bias	Design to eliminate bias
Sample Size	"Just enough" data, small sequential samples	Obtain 100% of available, relevant data	Sample to use inference methods, "Just in case" data (oversampling?)
Hypothesis	Hypothesis flexible, changes as learning takes place	No hypothesis	Fixed hypothesis
Variation	Adjust measures to reduce variation	Design to eliminate unwanted variation	Accept consistent variation
Testing Strategy	Sequential tests	No tests	One large test
Determining if change results in improvement	Run charts or Shewhart control charts	No change focus	Hypothesis, statistical tests (t-test, F-test, chi square), p-values
Data confidentiality	Data used only by those involved with improvement work	Data available for public review	Research subjects' identities protected

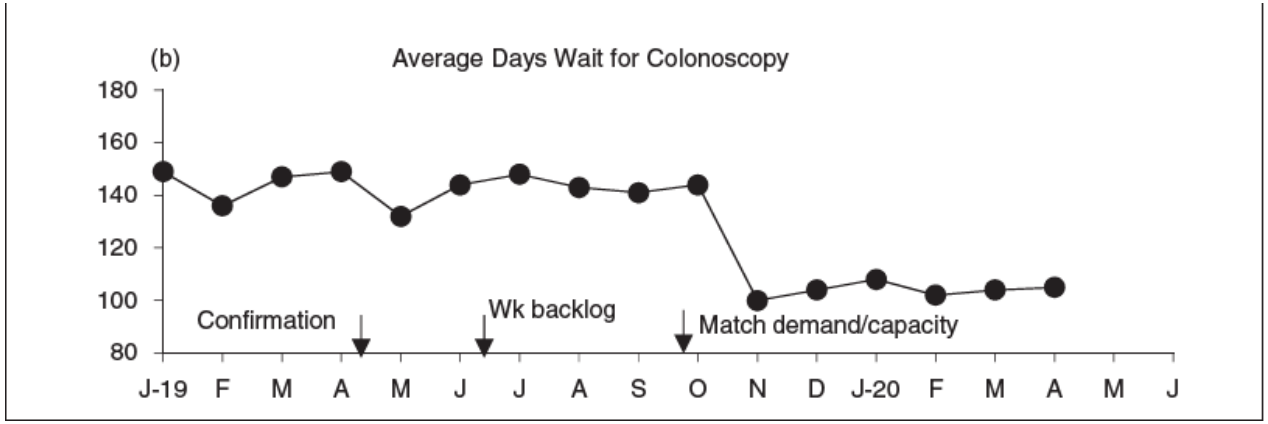
Table 2.1, HC Data Guide, p. 29

Measurement for Judgment and Accountability



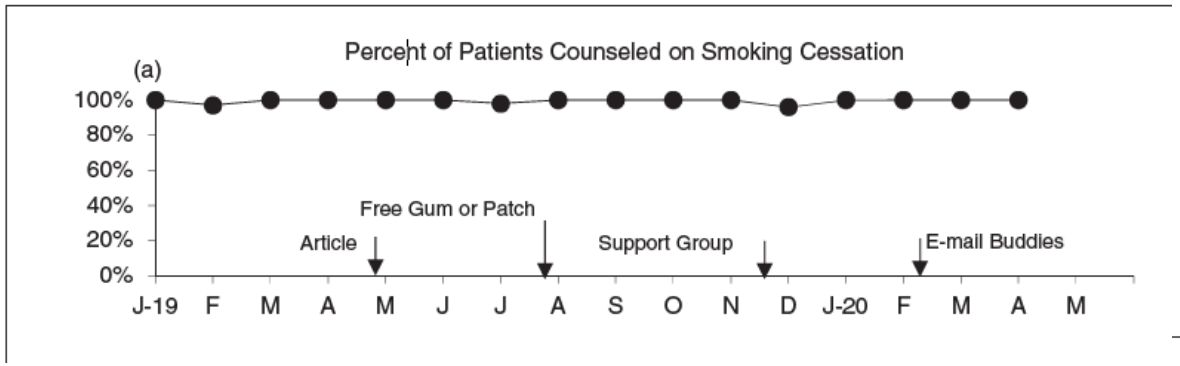
These data may not be very helpful to an improvement team testing changes to reduce waiting time.

Measurement for Learning and Improvement



Tracking actual waiting time will be more useful than solely tracking the % that meet a waiting time standard.

Measurement for Judgment and Accountability



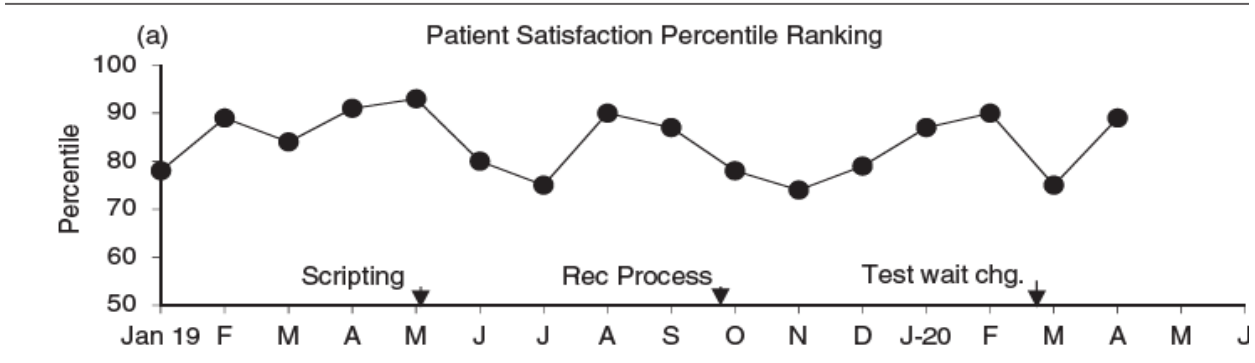
Measurement for judgment often results in data recorded as 100% or 0%, limiting opportunities for learning from the measure.

Measurement for Learning and Improvement

Tracking the % of patients who have not smoked provides the team with a strong degree of belief that their changes yielded improvement.

HC Data Guide, p. 33

Measurement for Judgment and Accountability

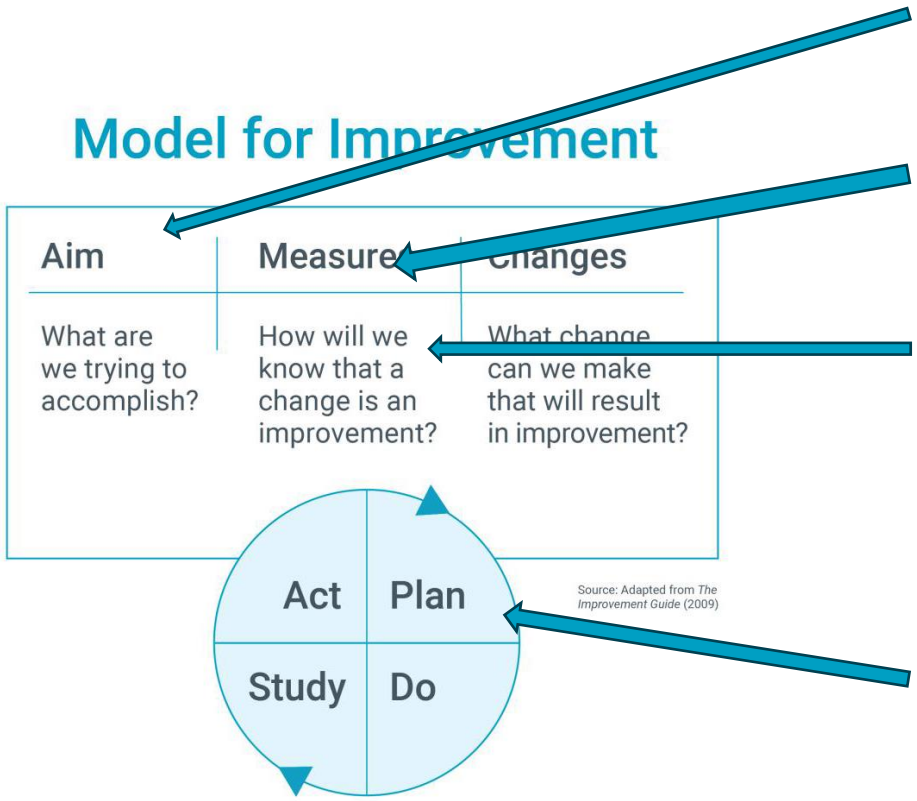


Percentile rankings can create confusing situations. Did improvement occur because of the changes tested? Or because of others' poor performance in the comparison pool?

Measurement for Learning and Improvement

Improvement teams will find it more helpful to track the actual average satisfaction scores in their organization.

Using Data for Improvement



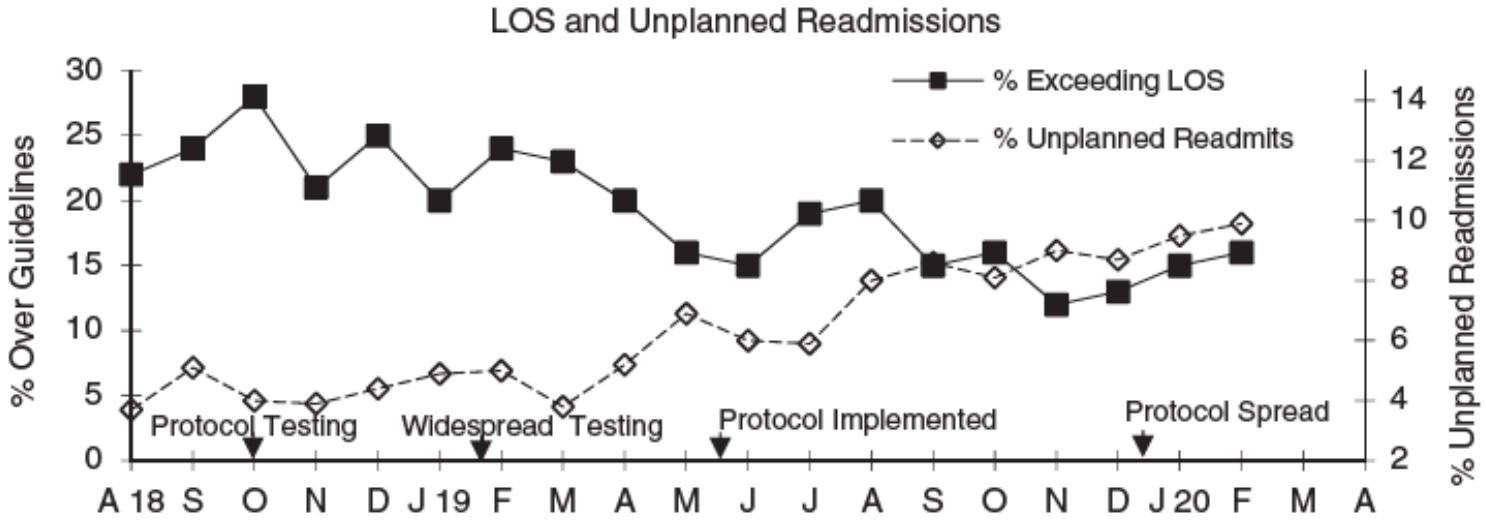
- Use outcome measures to assess progress towards the project's aim
- Use process measures to see if changes are being implemented
- Use balancing measures to assess whether the system as a whole is being improved
- Using data from the system to focus improvement and refine changes
- Using specific measures for learning during PDSA cycles

HC Data Guide, p 25

Family of Measures (FOM)

- Health care systems are complex.
- Any single measure used as the sole means of determining improvement to a particular system is inadequate.
- When working to improve a system, multiple measures are usually necessary to better evaluate the impact of our changes on the many facets of the system.
- Improvement projects typically require a family of 2-8 measures

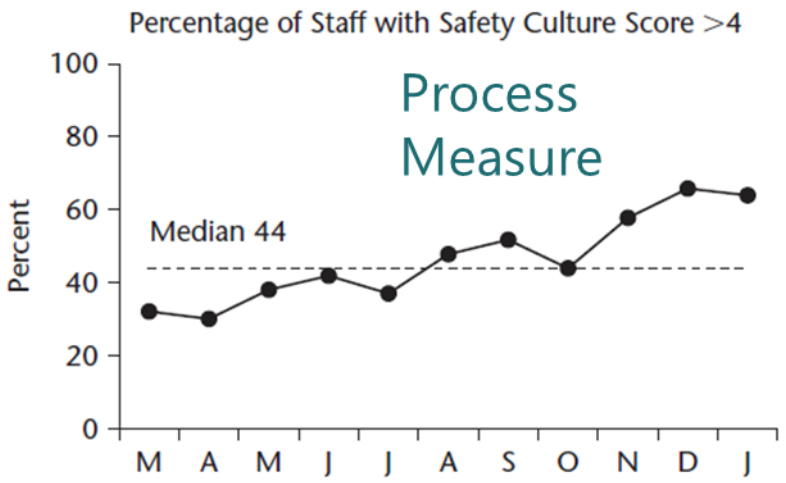
FIGURE 2.9 Multiple Measures on a Single Graph

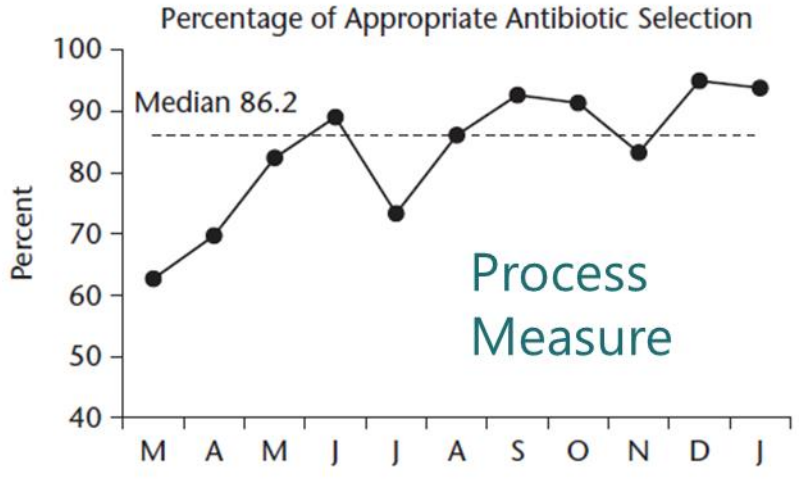


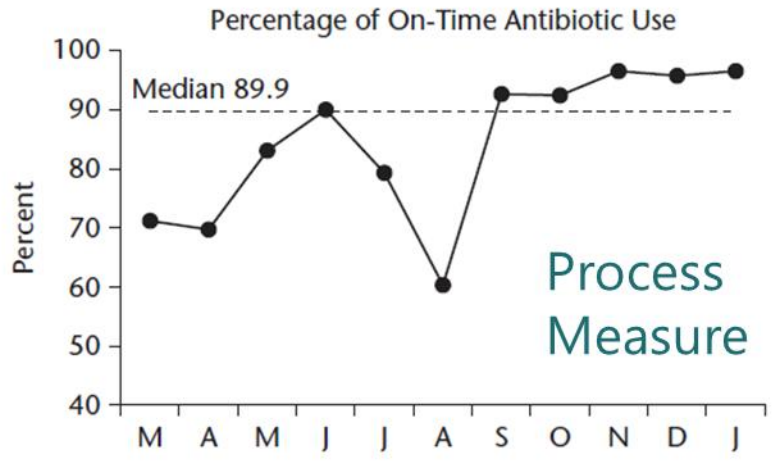
Improved LOS but readmissions are creeping up

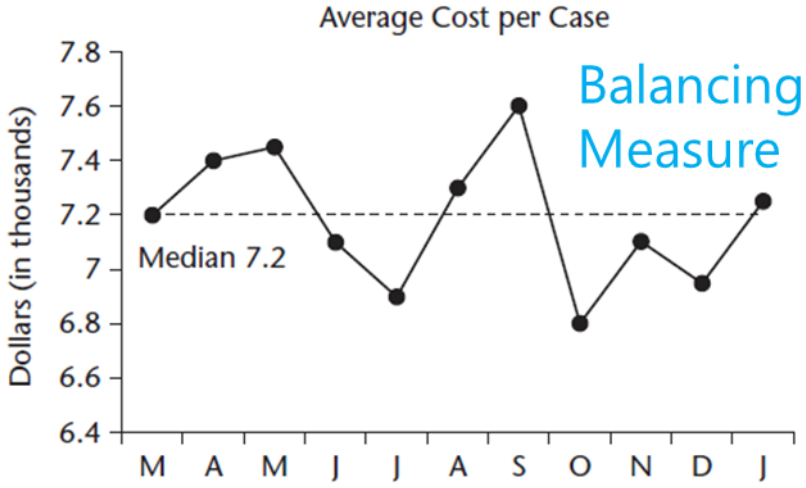
HC Data Guide, p. 43

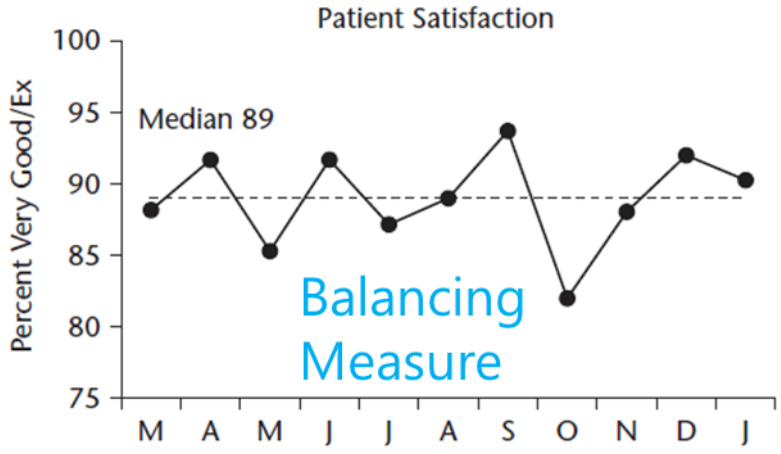
Surgical Safety Family of Measures

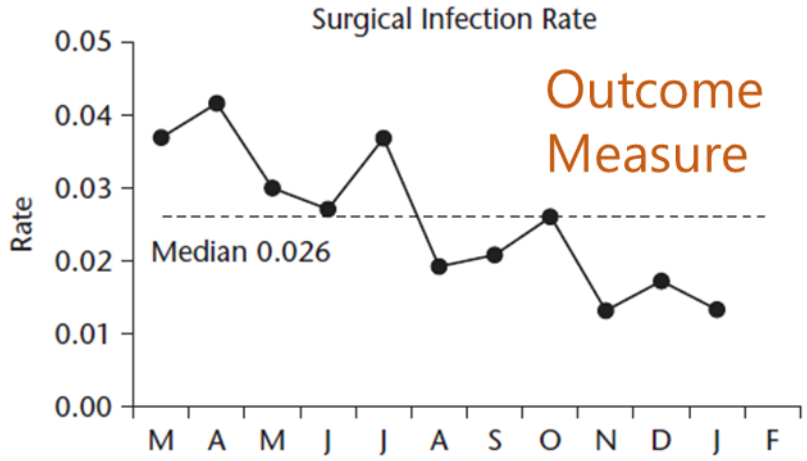












HC Data Guide, p. 36

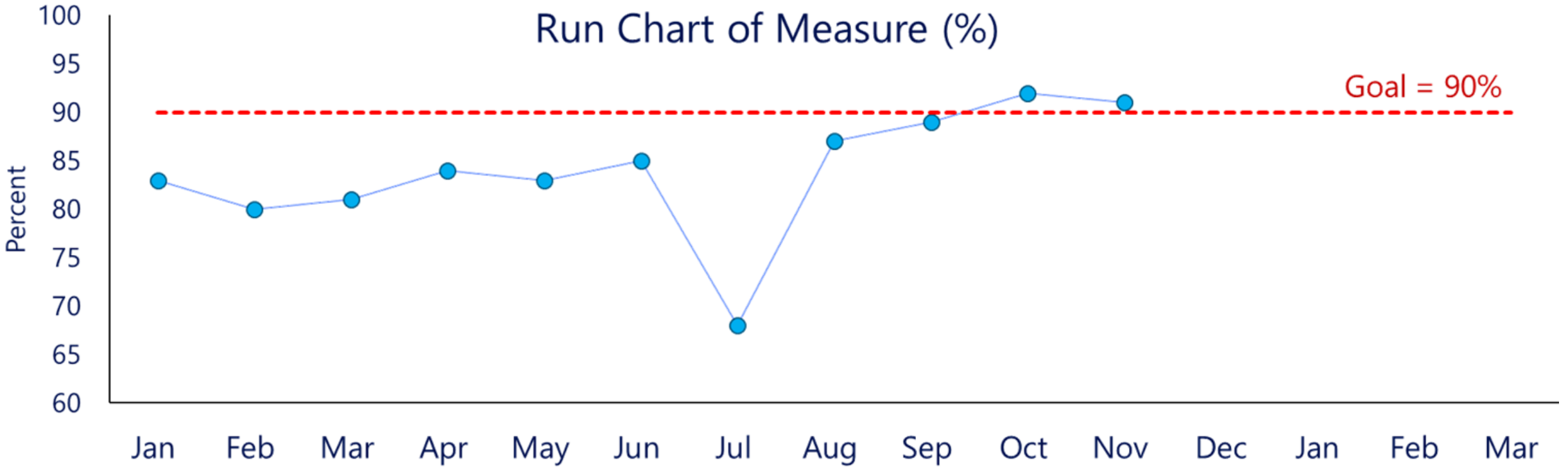
Guidelines for Collecting Data for Improvement

- A few key measures that clarify the aim of the improvement effort and make it tangible should be regularly reported throughout the life of the project
- Be careful about over-doing process measures. A balance of outcome, process and balancing measures is important
- Plot data visually on the key measures over time
- Make use of existing databases and data already collected for developing measures.
- Whenever feasible, integrate data collection for measurement into the daily work routine.
- The second question of the MFI, "How will we know that a change is an improvement?" usually requires more than one measure. A balanced set of three to eight measures will ensure that the system is improved.

HC Data Guide, p. 32

Why do we need to learn from graphs of the data?

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Measure (%)	83	80	81	84	83	85	68	87	89	92	91



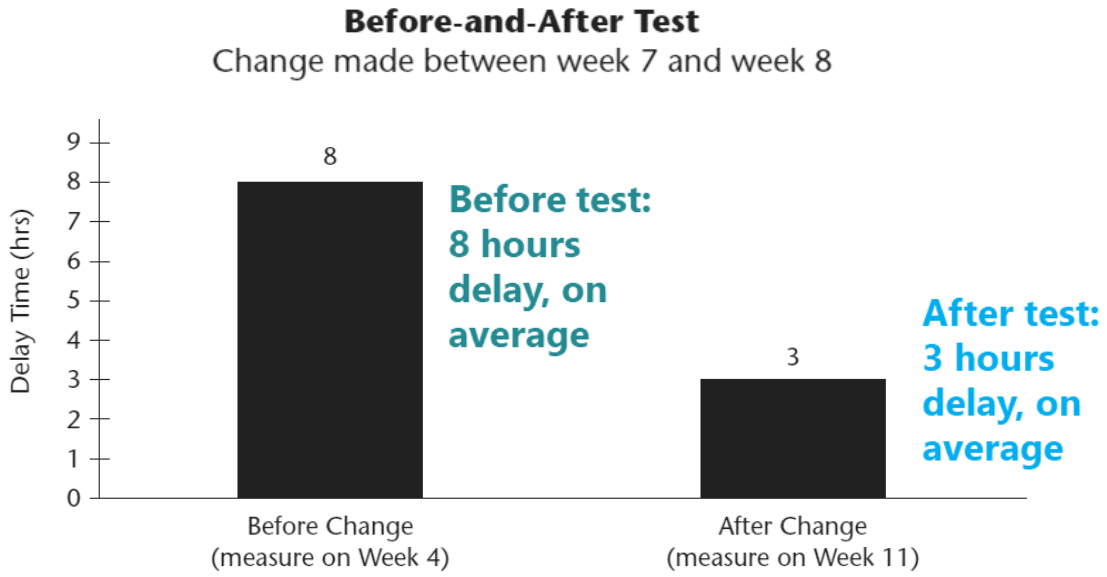
Adapted from *Health Care Data Guide*, p. 68

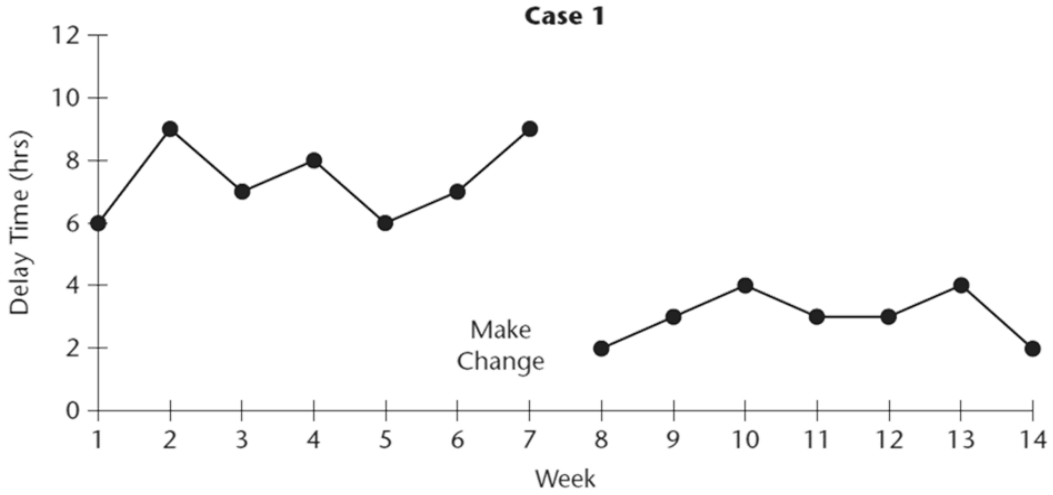
"Plotting measurements over time turns out, in my view, to be one of the most powerful devices we have for systemic learning... Several important things happen when you plot data over time. First, you have to ask what data to plot. In the exploration of the answer you begin to clarify aims, and also to see the system from a wider viewpoint. *Where are the data? What do they mean? To whom? Who should see them? Why?* These are questions that integrate and clarify aims and systems all at once...

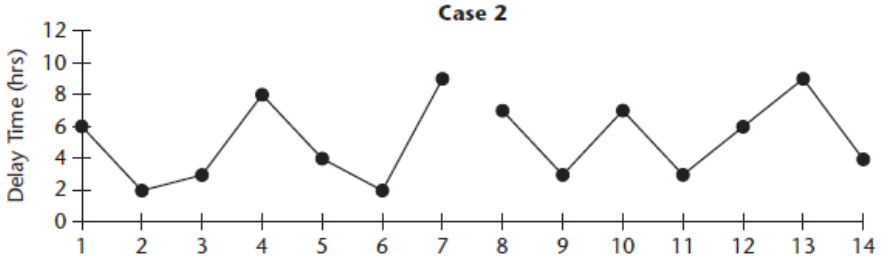
If you follow only one piece of advice from this lecture when you get home, pick a measurement you care about and begin to plot it regularly over time. You won't be sorry."

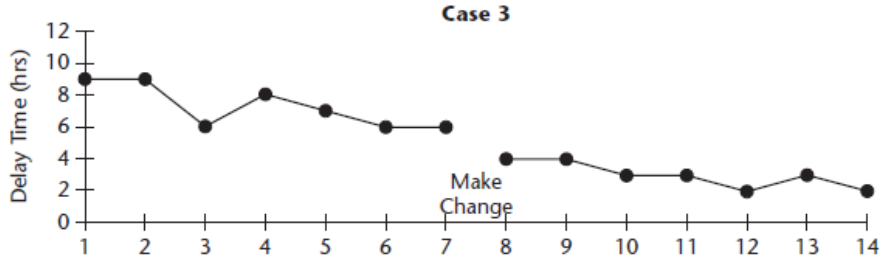
– Donald M. Berwick MD, 1995,
National Forum for Quality Improvement in Health Care

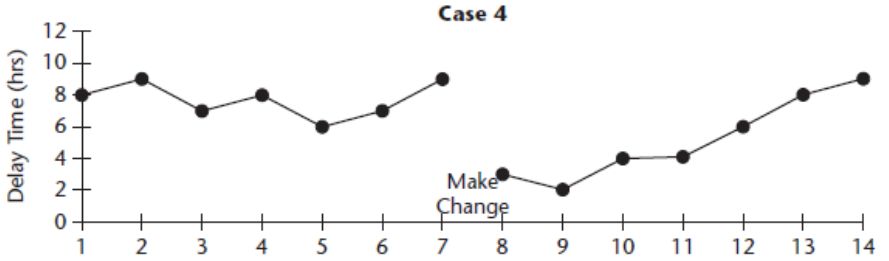
Improvement Projects need Time Series Charts!

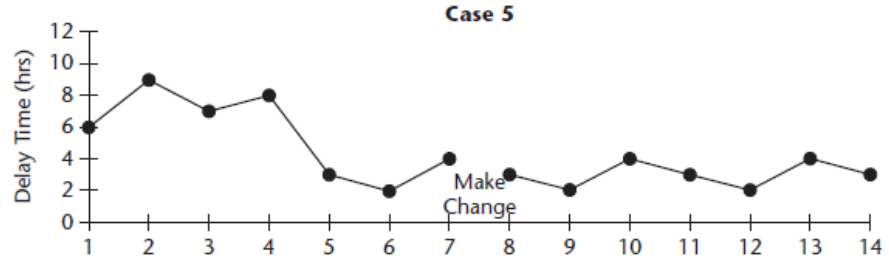


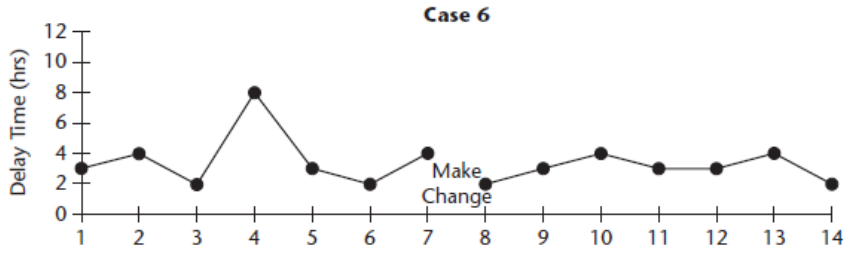






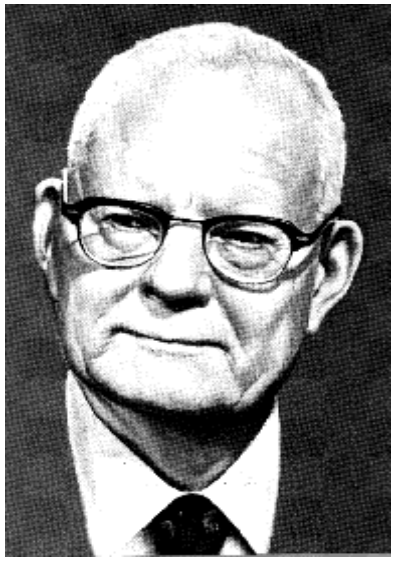




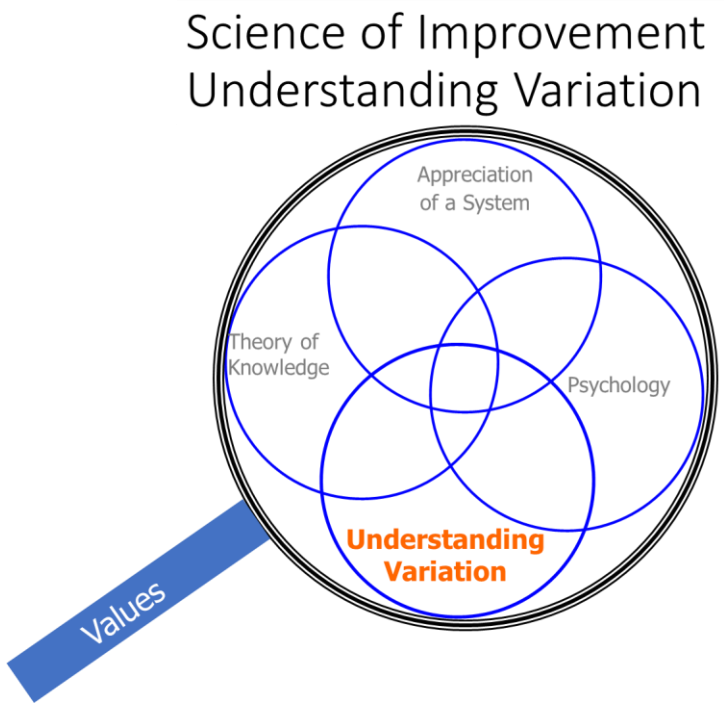


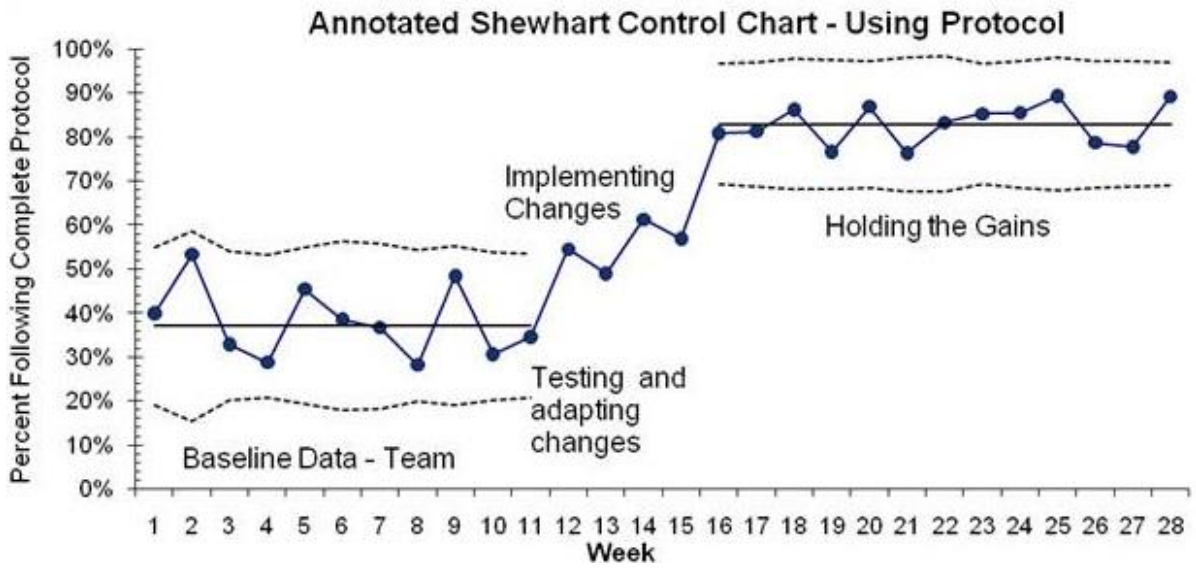
HC Data Guide, p. 17

The Pioneers of Understanding Variation and the foundation for the Science of Improvement



W. Edwards Deming
(1900 - 1993)

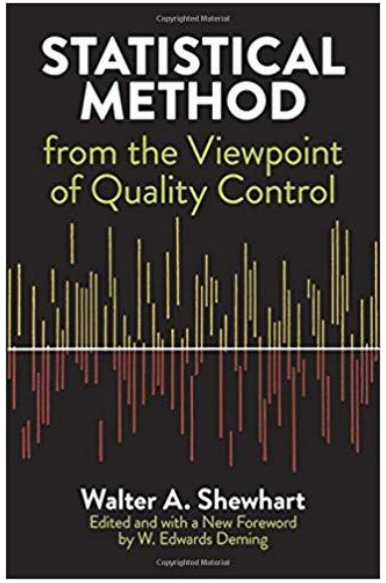




Walter Shewhart
(1891 – 1967)

Shewhart's Theory of Variation

A fundamental concept of the science of improvement is that variation in a measure has two potential origins: **common causes** and **special causes**.



Walter A. Shewhart, Ph.D.
1891–1967

Another half-century may pass before the full spectrum of Dr. Shewhart's contributions has been revealed in liberal education, science, and industry.

W. Edwards Deming

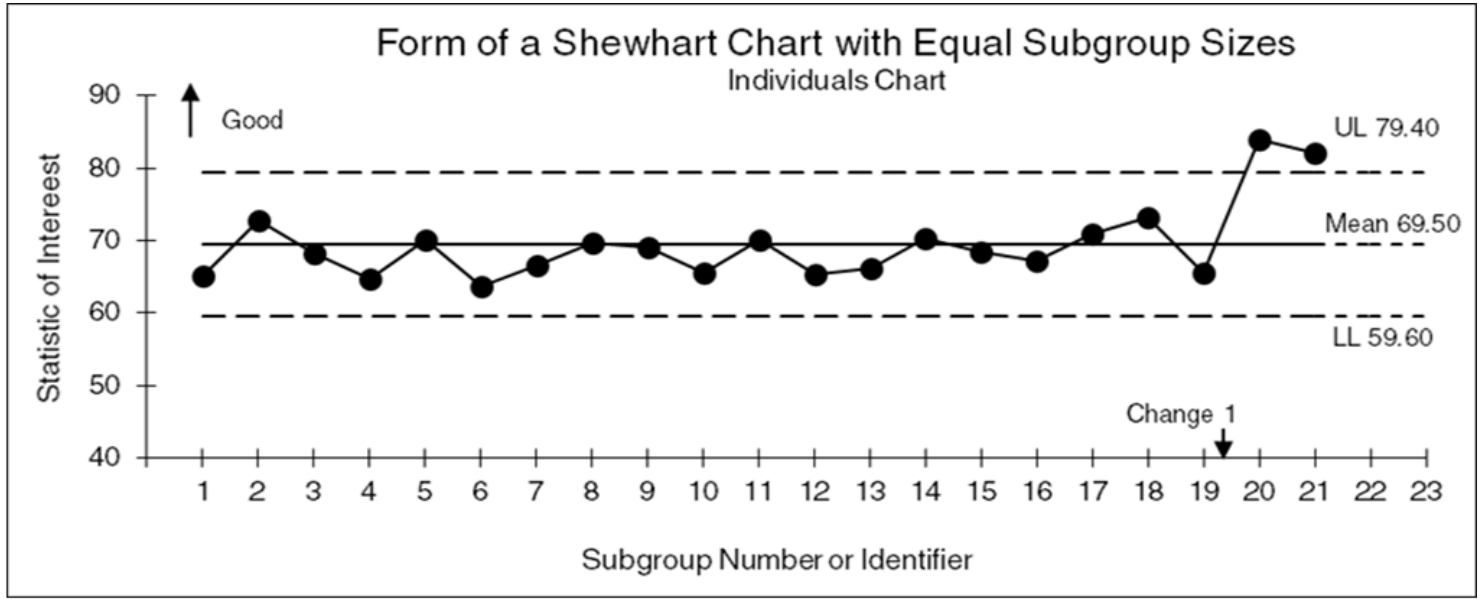
Common Causes are inherent in the system over time, affecting everyone working in the system and all system outcomes.

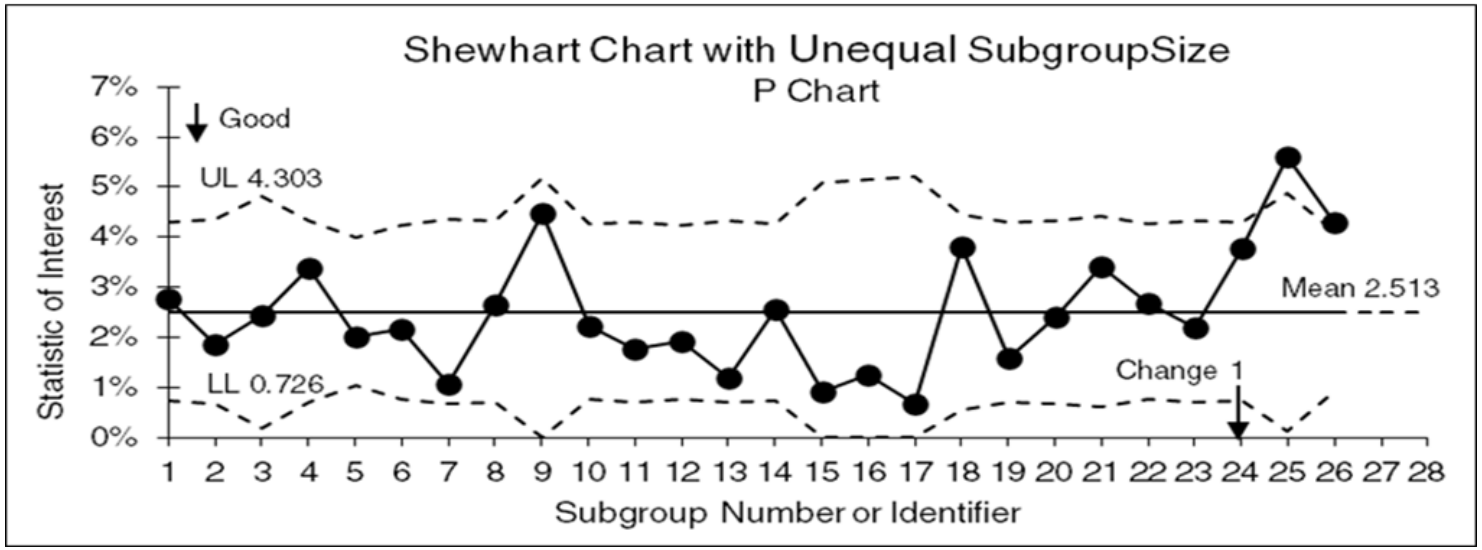
Special Causes are not part of the regular system but arise because of particular circumstances or some "special" source of variation that can be assigned to some identifiable cause

HC Data Guide, p. 124

Shewhart Charts

The Shewhart chart is a statistical tool used to distinguish between variation in a measure due to common causes and variation due to special causes

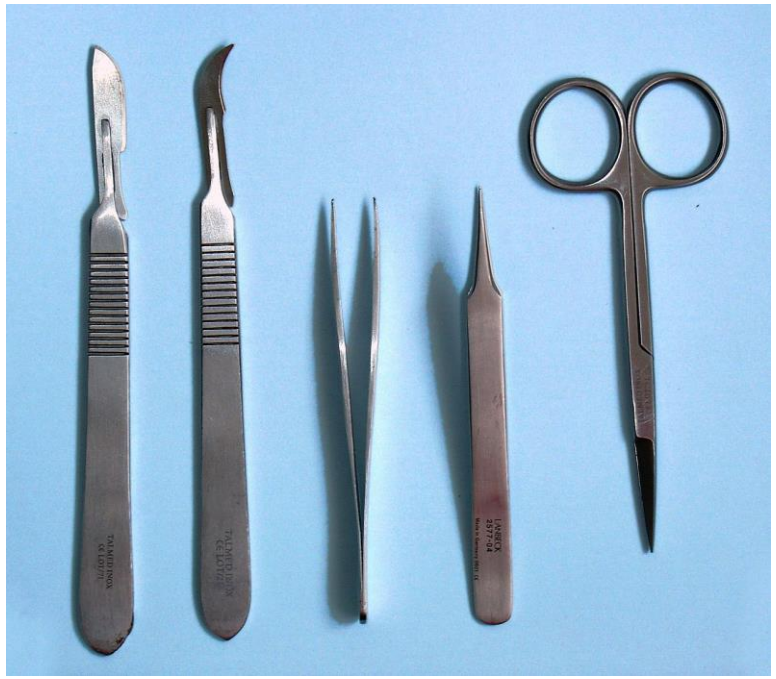


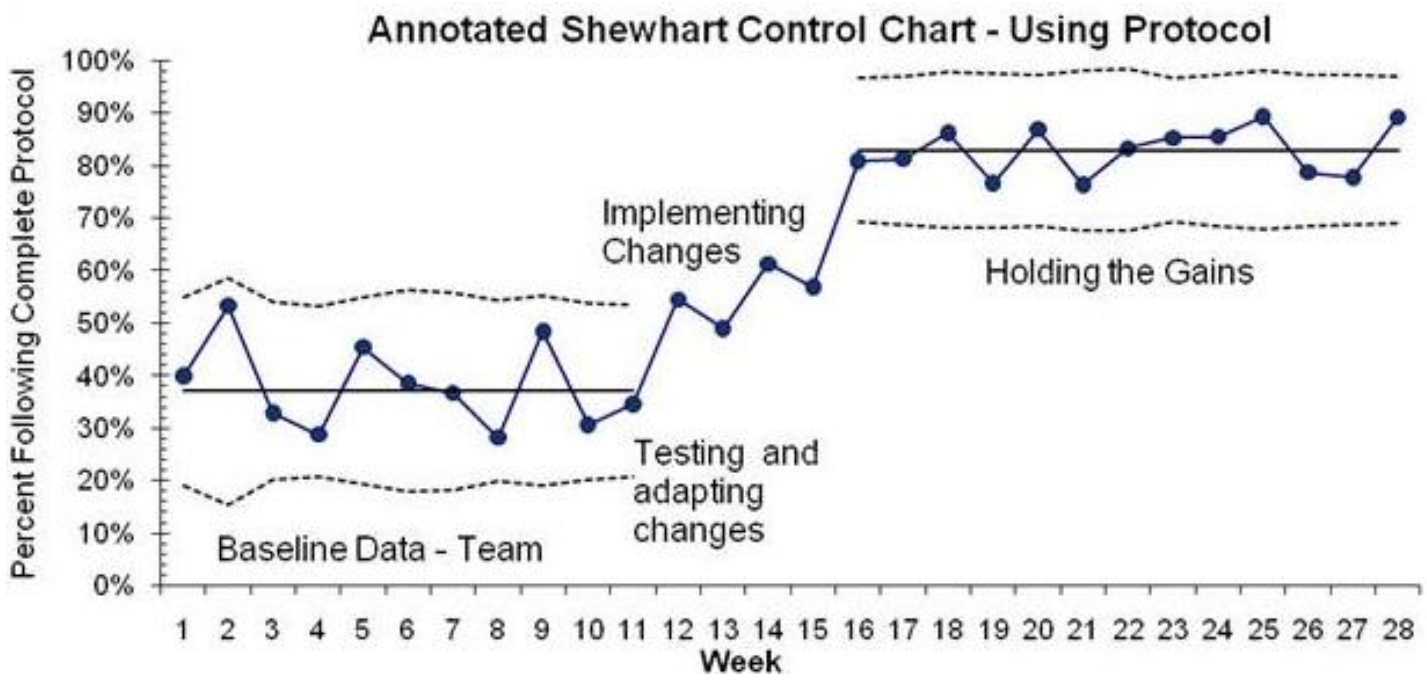


(Most common name is a control chart, more descriptive is learning charts or system performance charts)

HC Data Guide, p. 130-131

Using the Tool with the Model for Improvement





Institute for Healthcare Improvement

How will we know if we're improving?

The Model for Improvement and Understanding Variation

A case study from Victoria, Australia

International Forum on Quality and Safety in Healthcare

Institute for Healthcare Improvement

1. Overview of the Timely Emergency Care Collaborative (TECC)
2. Developing a measurement strategy
3. Using data to support improvement
4. What next, where to?

Timely Emergency Care Collaborative

Institute for Healthcare Improvement

VICTORIA State Government

AIM

"By improving system-wide patient flow, we'll provide more timely emergency care to Victorians"

By 30 June 2024, we aimed to reduce the length of stay in participating hospital Emergency Departments by:

- 15% for non-admitted patients, and
- 20% for admitted patients.

WHO

14 health services

9 metropolitan hospitals
6 regional hospitals

Ambulance Victoria

Collaborative project team

Dept. of Health improvement advisors
Clinical faculty
IHI improvement and patient flow experts

WHAT

Focus on high-leverage change ideas

- Changes within health service locus of control
- Identified through co-design with international experts and participating teams
- Mapped across patient flow and organised into workstreams
- Refined through testing

HOW

Programme duration: December 2022 – June 2024

6 learning session events

- 2 days each, in-person
- Participating teams of 8-12 people attending
- International expert speakers and facilitated workshops
- Marketplace events to share ideas, progress and learning

6 leadership oversight calls

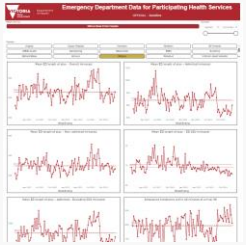
- Executive leaders
- Progress updates, risks, issues
- Areas of focus for leadership

6 action periods

- Monthly action period calls
- Site visits, and virtual and onsite coaching from clinical faculty and improvement advisors (Dept. and IHI faculty)
- Action period guides, tools and resources

Collaborative patient flow dashboard

- Central dashboard of weekly data
- ED, Inpatient and Ambulance data
- Filter by health service or hospital
- Accessible by all participating teams



Progress reporting and targeted support

- Monthly reports sent to each participating health service
- Highlights, risks and recommendations provided
- Check-ins with executive to discuss progress and issues
- Intensive on-site improvement sprints and coaching clinics

IMPACT

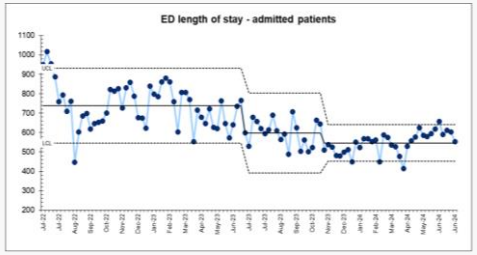
High engagement from participants

All teams remained engaged with 100% participation in learning events across the program

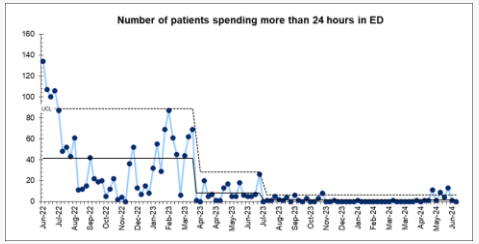
Significant improvements seen across all key metrics

- 93% of teams significantly improved either ED admitted or non-admitted length of stay
- 71% had sustained improvement in at least one outcome metric for >3 months
- Outstanding improvement achieved by both metro and regional hospitals (exemplar shown below)

Reduction in ED admitted length of stay of **more than 3 hours!**



Dramatic reduction in number of patients spending >24 hours in ED



For more information contact apac@ihi.og

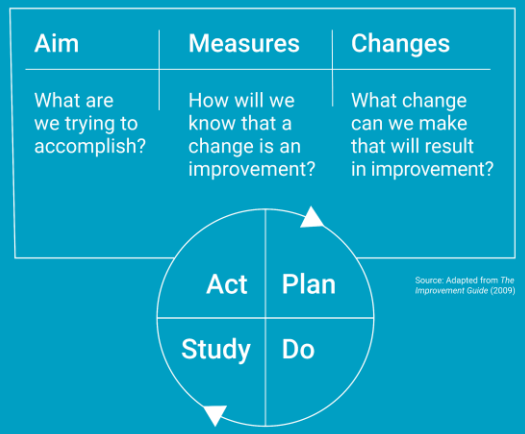
The Collaborative included teams that had significant QI experience, and teams who were new to QI.

	Organisation type A	Organisation type B	Organisation type C
Organisational characteristics	**Keen, enthusiastic**, but **new to improvement work**; has good staff engagement but low prior experience in structured QI	**Large, busy**, with some QI experience, but **previous efforts have not been sustained or deeply integrated**; faces resource constraints.	**Experienced with continuous improvement**, integrated quality management, but still facing significant flow challenges in specific areas
Team composition	**MDT with keen interest** in learning, mostly front-line clinical staff, and junior leaders.	**MDT, some experienced in past QI work**, though participation may be uneven	**Balanced MDT team with strong leadership support**, QI leads, and experienced staff in improvement projects.
Prior experience	**Little to no prior experience in structured QI methods**; has done smaller, ad-hoc improvement efforts	Some prior improvement work, but **inconsistent use of structured improvement methodology**	**Significant prior experience** using structured QI approaches, including the Model for Improvement

We applied the Model for Improvement.

Aim statement
Theory of Change

Model for Improvement



Aim Statement

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- 15% for non-admitted patients, and
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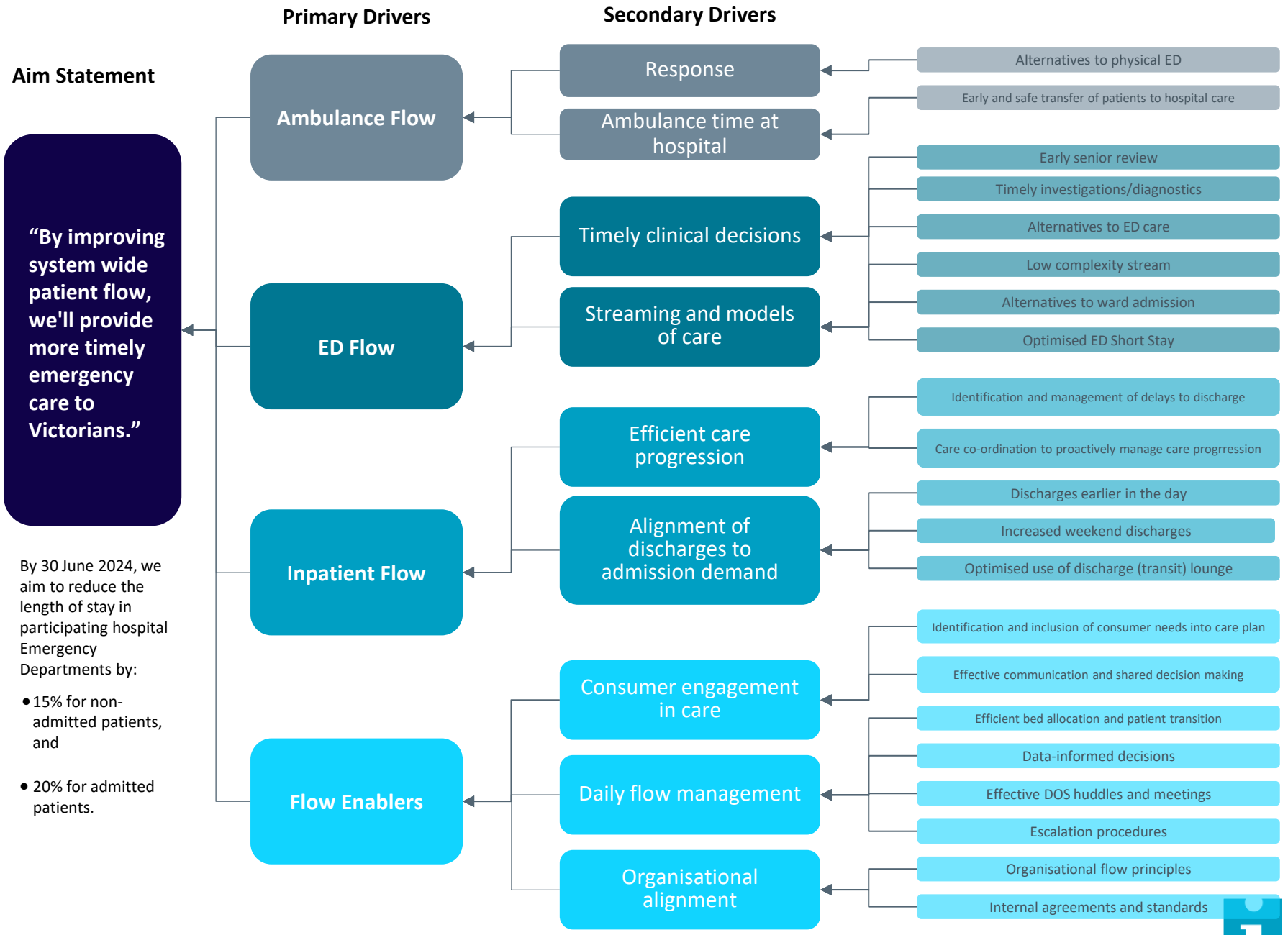
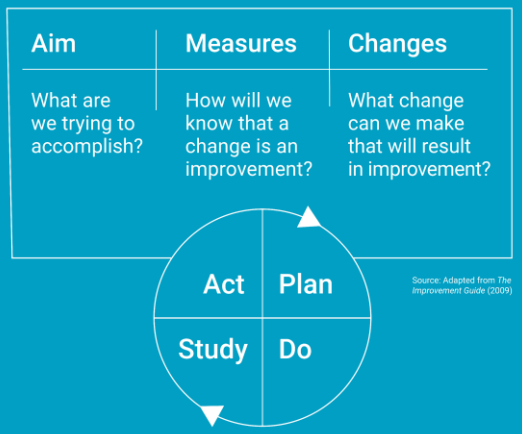


We applied the Model for Improvement.

Model for Improvement



Measurement strategy principles

- **Family of measures** to determine whether improvement strategies are working
- **Pragmatic**: don't let perfect be the enemy of good
- **Reduce data collection burden** and use existing central data collections
- Make the data self-service and **visible to everyone** via dashboards
- **Continuously adapt** as we learn: additional measures to be added as new focus areas (drivers) are identified
- **Measurement for improvement**, not for judgement
- **Use run charts** and Shewhart charts and work with teams to use them to support improvement

Data related challenges were common. Here are examples of questions that were fielded…

How will this be any different to the other 5…10…20… patient flow improvement projects we've started?

Why aren't we including other important measures: *time to analgesia, number of falls, imaging turnaround….*?

The central data collections have known data quality issues. We can't use them until we know exactly how/why/where they're not quite right!

You can make data say *what you want it to say*… How will we know that we're making care better for consumers?

Why aren't we using the median? Isn't that a much better measure as it isn't as sensitive to outliers?

We applied the Model for Improvement.

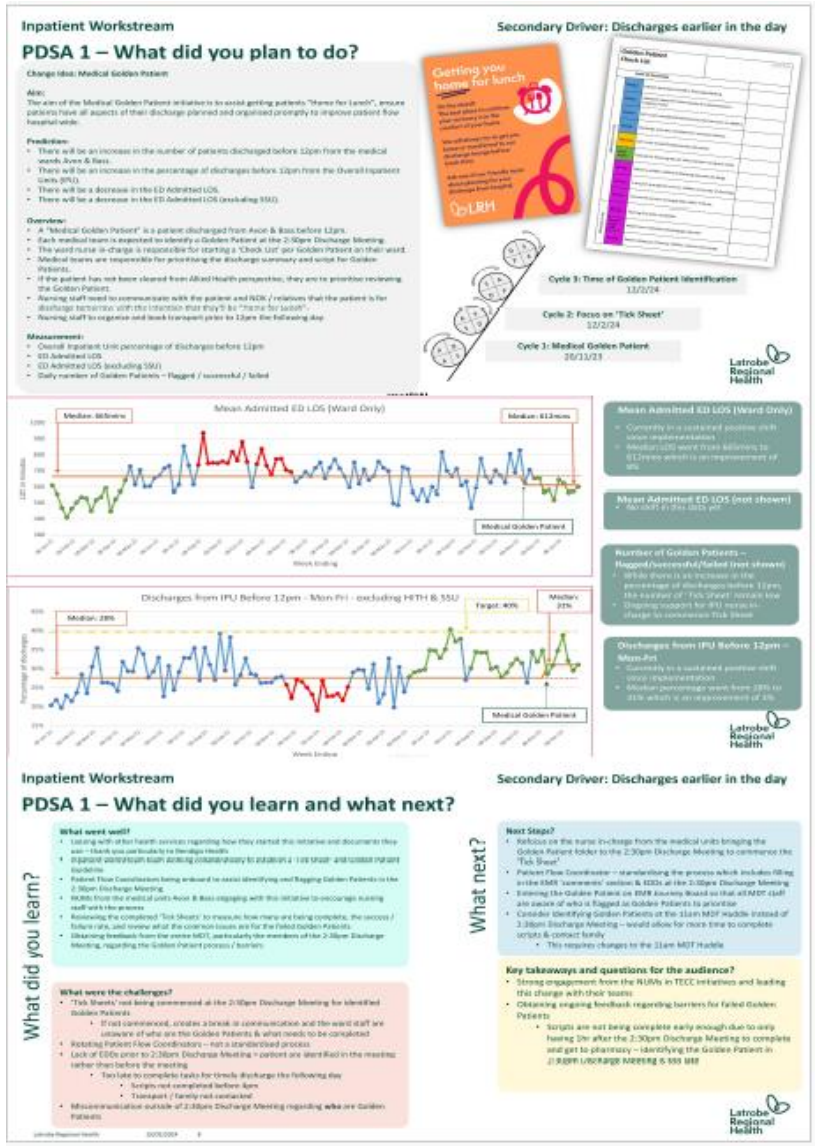
Teams tested via PDSA

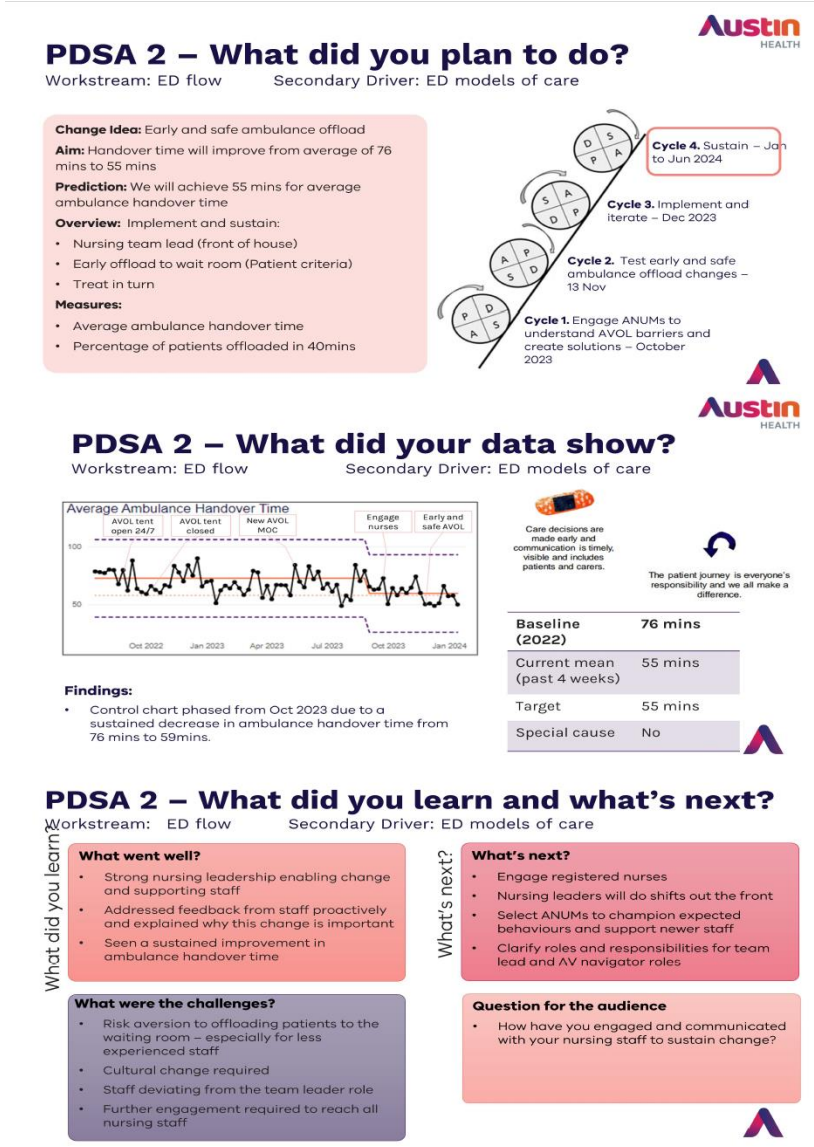
Model for Improvement

Aim	Measures	Changes
What are we trying to accomplish?	How will we know that a change is an improvement?	What change can we make that will result in improvement?

Source: Adapted from *The Improvement Guide* (2009)

Hundreds of PDSA cycles were run across the Collaborative





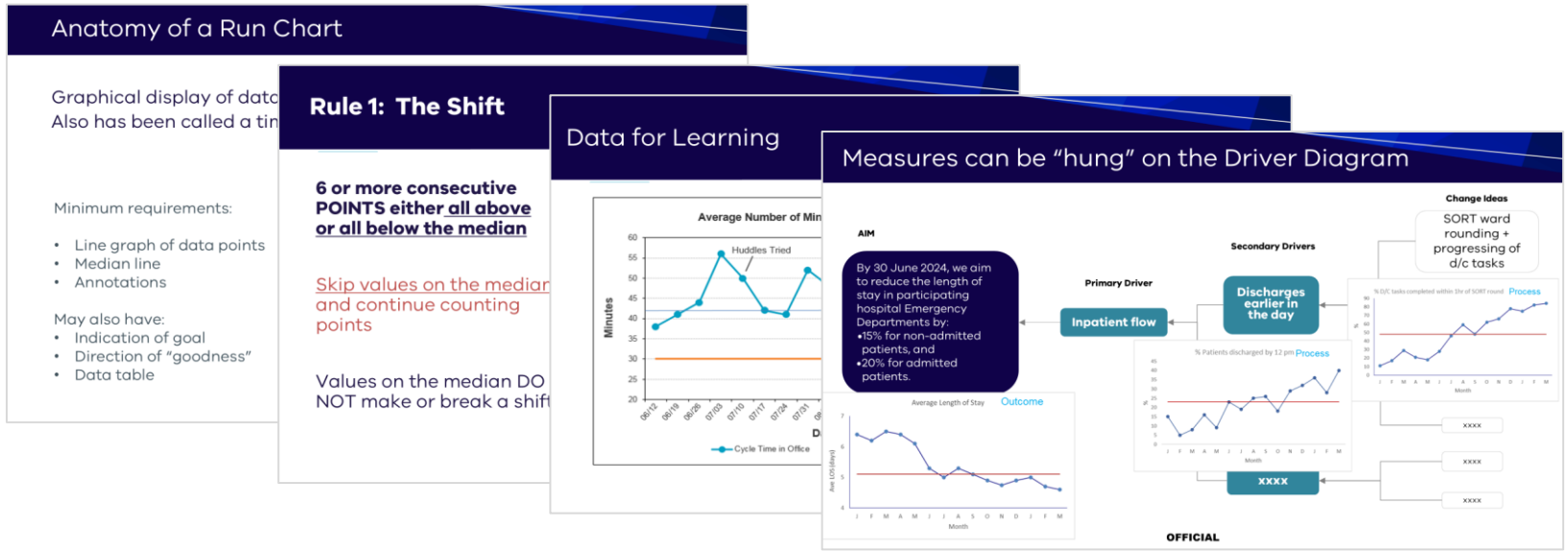
We supported teams to understand variability and use measurement for improvement.

Model for Improvement

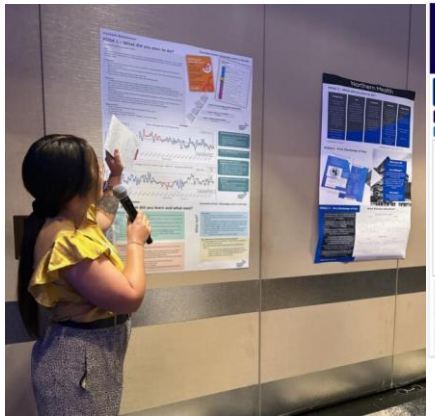
Aim	Measures	Changes
What are we trying to accomplish?	How will we know that a change is an improvement?	What change can we make that will result in improvement?

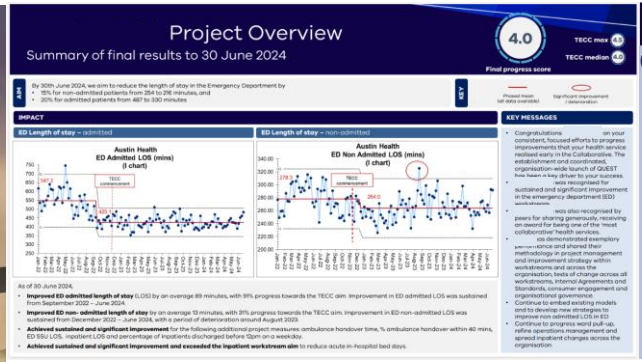
Source: Adapted from *The Improvement Guide* (2009)

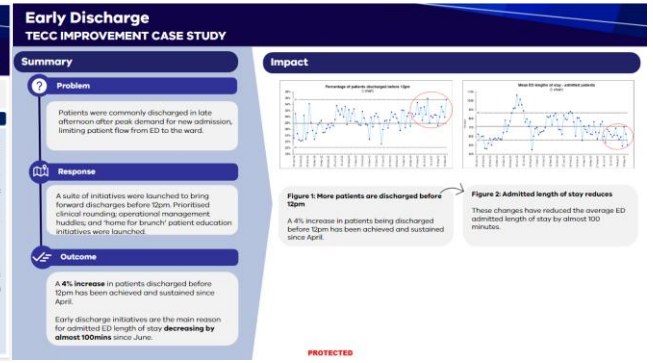
Running masterclasses and 1:1 coaching via Improvement Advisors



Presenting and reporting in a way that explores variation







Outcomes from TECC

- **93% of teams significantly improved** either ED admitted or non-admitted length of stay
- **71% had sustained improvement** in at least one outcome metric for >3 months
- Outstanding improvement achieved by **both metro and regional hospitals**
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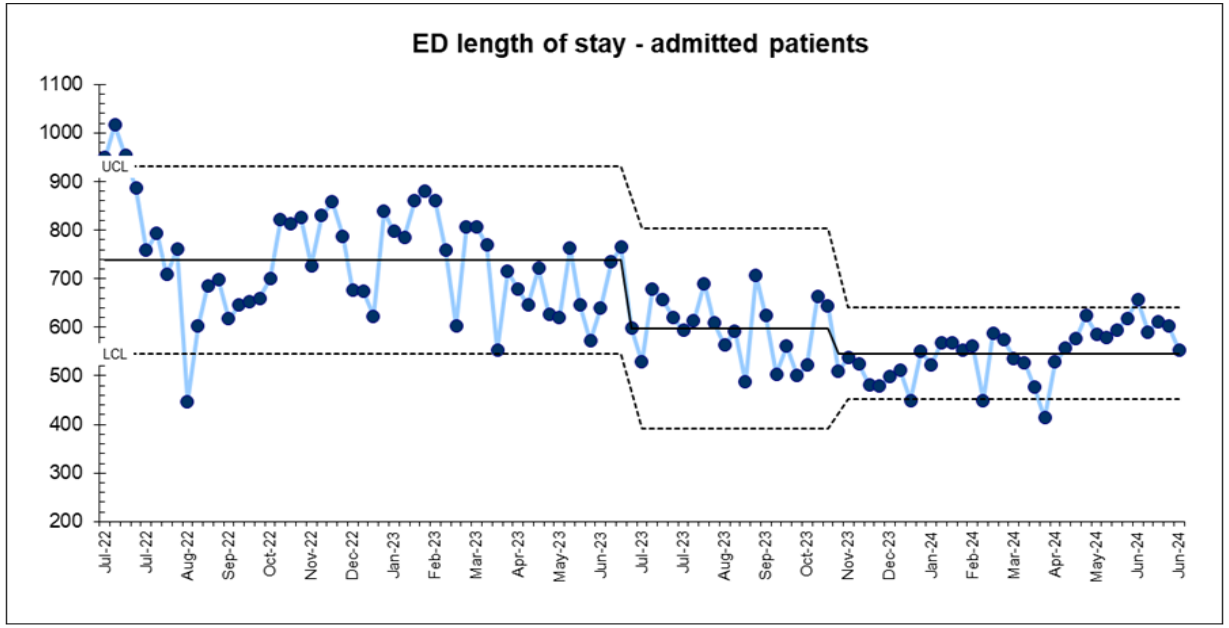

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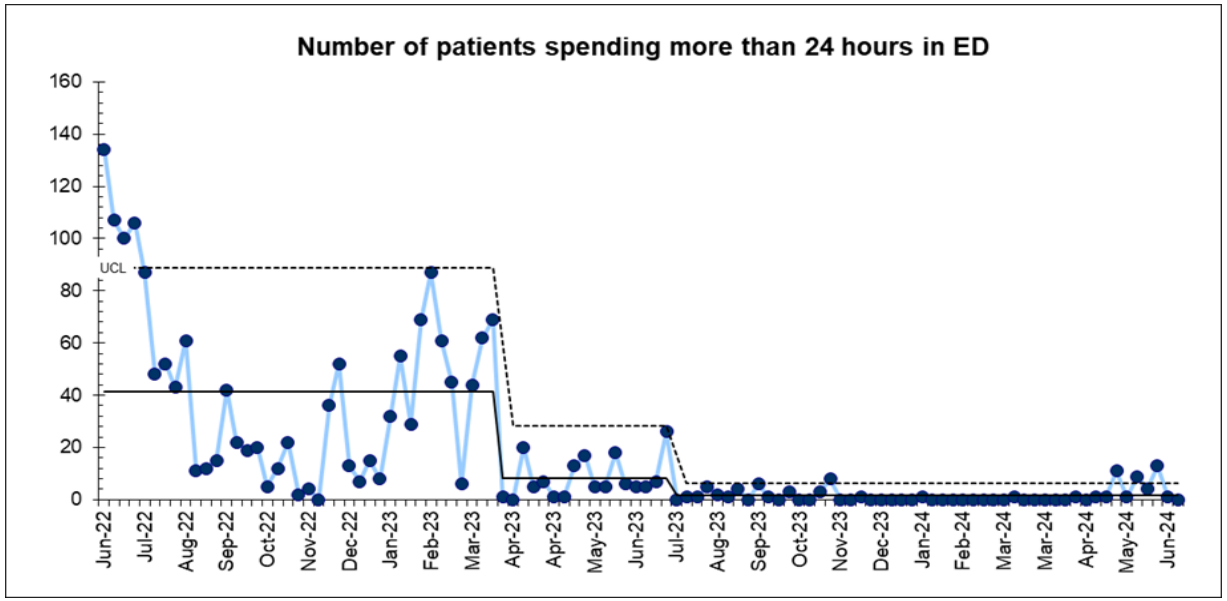
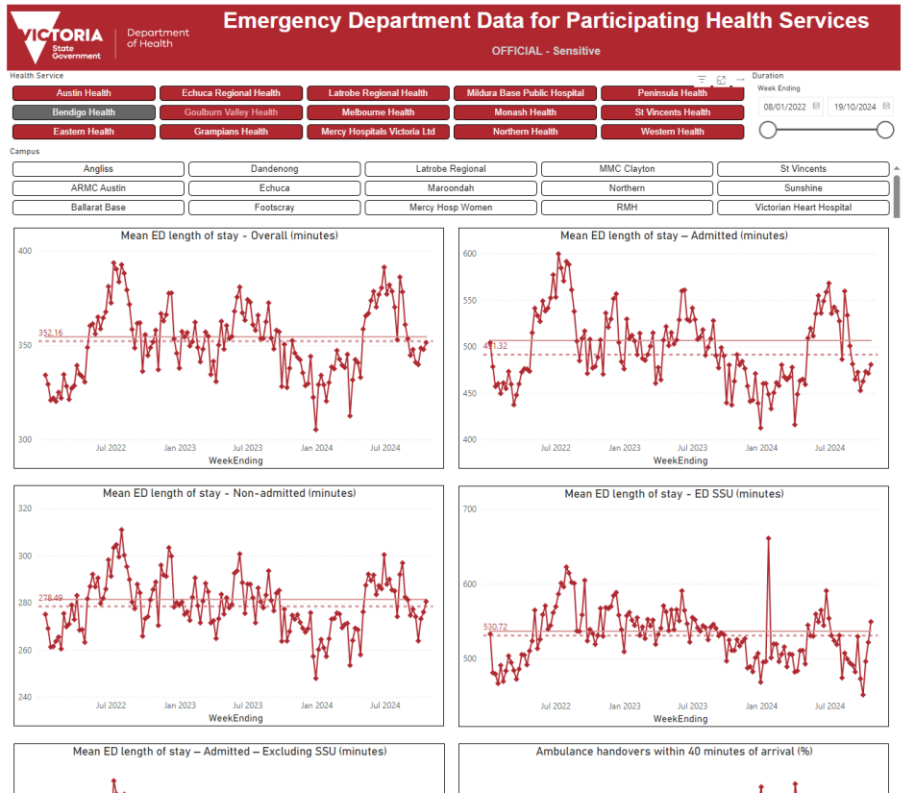


The approach to measurement and identifying insights has matured. We're excited about what's next.

Timely Emergency Care Collaborative



Timely Emergency Care 2

So, what is next?

1. **A 15-month collaborative to build on TECC**

   14 hospitals

2. **A collaborative focusing on acute care of older patients**

   13 hospitals

3. **Three innovation focus areas**
   i. 7-day patient flow (weekend discharges)
   ii. Innovating care at home
   iii. ED performance enhancements

4. **Enhanced state-wide patient flow performance insights**

Shewhart's Theory of Variation

The improvement strategy for common causes will involve:

- Realising that since that the process is performing as well as possible, to make it perform better will require process redesign.
- Avoid tampering!
  (reacting to individual data points)
- Identifying aspects of the process to change.
- Testing those changes using the Plan-Do-Study-Act (PDSA) cycle.
- Implementing successful changes using the PDSA cycle.

Some Typical Common Causes

- Everyday variation in usual processes, care pathways, standard operation procedures (SOPs)
- The current design of the process
- Normal biological fluctuations in blood pressure, blood sugar, weights, cholesterol levels, etc.
- Usual hourly and daily fluctuations in volumes associated with the process
- Current equipment maintenance practices
- Current working conditions, e.g. lighting, noise, dirt, temperature, ventilation
- Current medications, supplies and equipment being used
- Measurement variation
- Ambient temperature and humidity (e.g. in the OR)
- Normal wear and tear
- Everyday human fatigue
- Variability in motor skills, coordination, or dexterity
- Variability in pump or other equipment settings
- Variation in computer response time

The Health Care Data Guide, p. 125

Shewhart's Theory of Variation

The improvement strategy for special causes:

- Identifying when the special cause occurred.
- Learning from the special cause.
- Taking action based on the special cause.
  - Undesirable special cause--remove it and make it difficult for it to occur again.
  - Desirable special cause--make it a permanent part of the health care process.

Some Typical Special Causes

- A change in the design of the work process or care pathway
- Implementation of or upgrades to electronic health record
- People using different operational definitions of measure
- A change in the operational definition of a measure
- Different sampling or measurement methods
- A change in case-mix of patients
- Changes in personnel (e.g. new interns in July)
- Changes in staffing levels
- A pandemic
- Computer system crash
- Unusual volume (number of patients, low or high, flu season)
- Different equipment
- Equipment malfunction
- A change in supply or supply source
- Unusual weather (e.g. storm, flood)
- Different supplies or drugs

The Health Care Data Guide, p. 125-126

Letter to Plant Superintendent R. L. Jones and Original Shewhart Chart 1924

Jones requested *an acceptable form of inspection report which might be modified from time to time, in order to give, at a glance, the greatest amount of accurate information*

Case 1801)

WAS-724-5-16-24-PQ

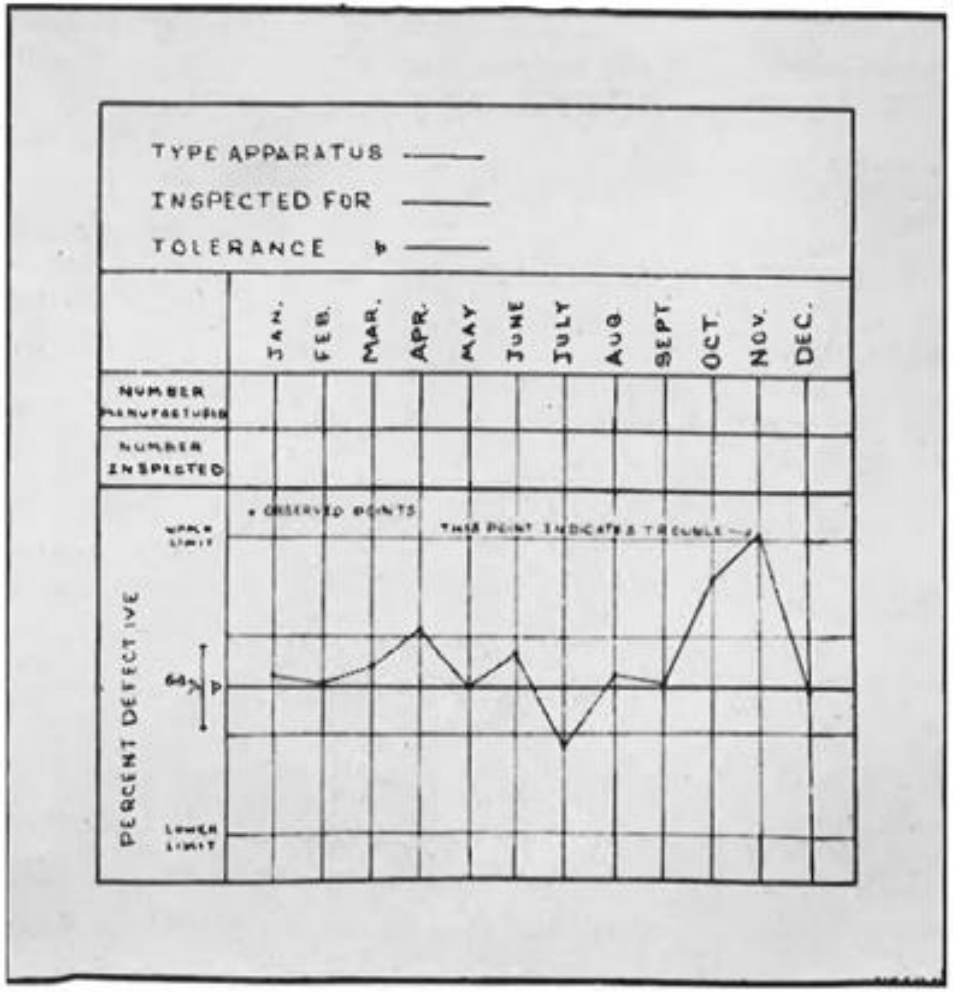
MR. R. L. JONES:-

A few days ago, you mentioned some of the problems connected with the development of an acceptable form of inspection report which might be modified from time to time, in order to give at a glance the greatest amount of accurate information.

The attached form of report is designed to indicate whether or not the observed variations in the percent of defective apparatus of a given type are significant; that is, to indicate whether or not the product is satisfactory. The theory underlying the method of determining the significance of the variations in the value of p is somewhat involved when considered in such a form as to cover practically all types of problems. I have already started the preparation of a series of memoranda covering these points in detail. Should it be found desirable, however, to make use of this form of chart in any of the studies now being conducted within the Inspection Department, it will be possible to indicate the method to be followed in the particular examples.

W. A. SHEWHART.

Enc.:
Form of Report.

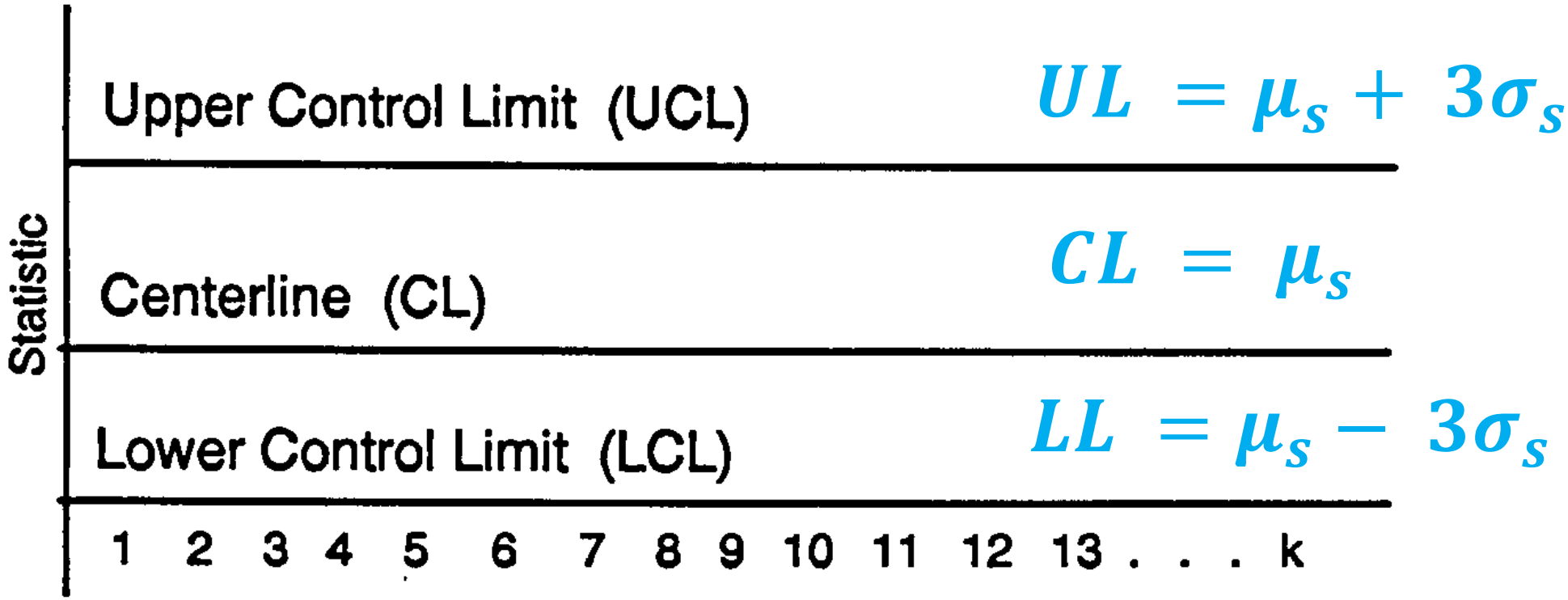


Shewhart Adds: *I have already started the preparation of a series of memoranda covering these points in detail*

"Three-Sigma" Control Limits

Shewhart called the control limits "three-sigma" control limits and gave a general formula to calculate the limits for any statistic.

- Let *S* be the statistic to be charted, then



$$UL = \mu_s + 3\sigma_s$$

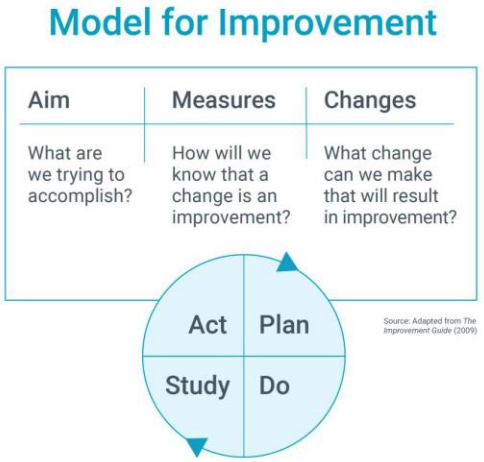
$$CL = \mu_s$$

$$LL = \mu_s - 3\sigma_s$$

μ_s = average of the statistic
σ_s = standard error of statistic estimating common cause variation

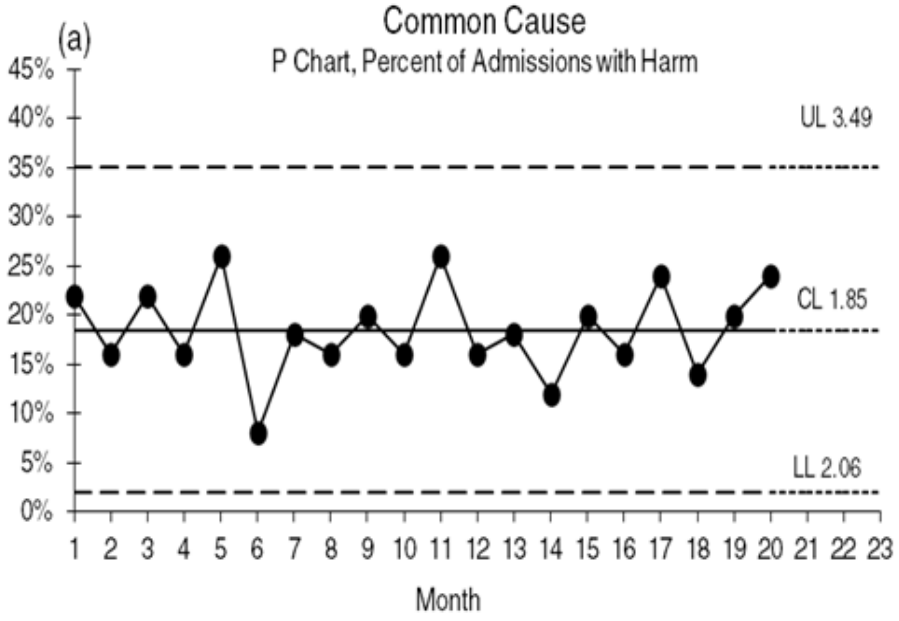
HC Data Guide, p. 132

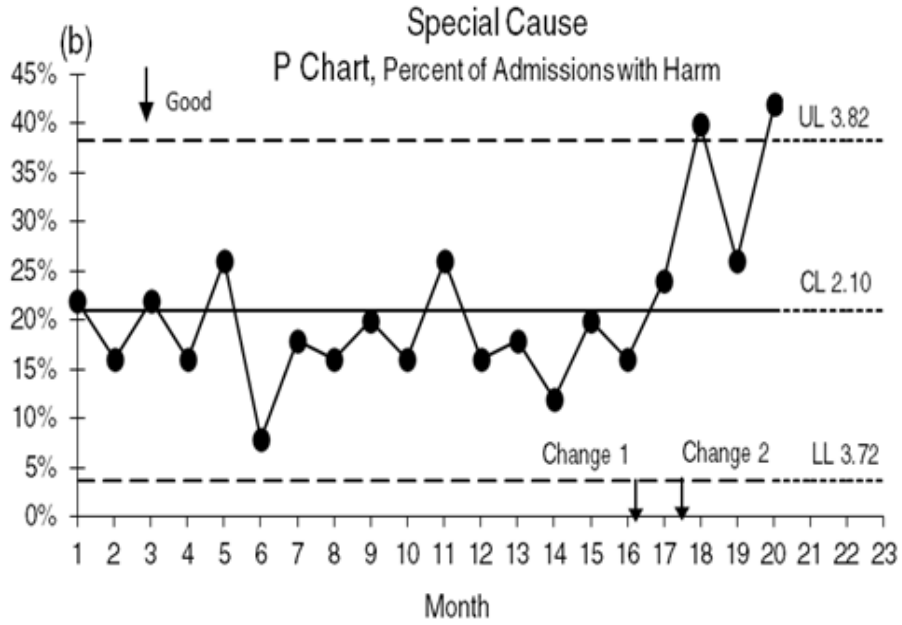
Shewhart Charts Useful in All Parts of Model for Improvement



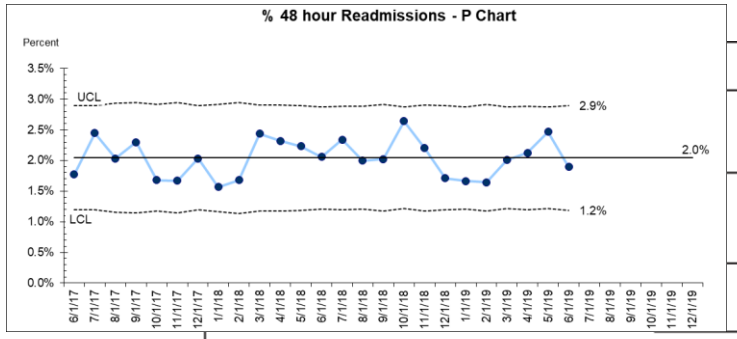
What are we trying to accomplish?

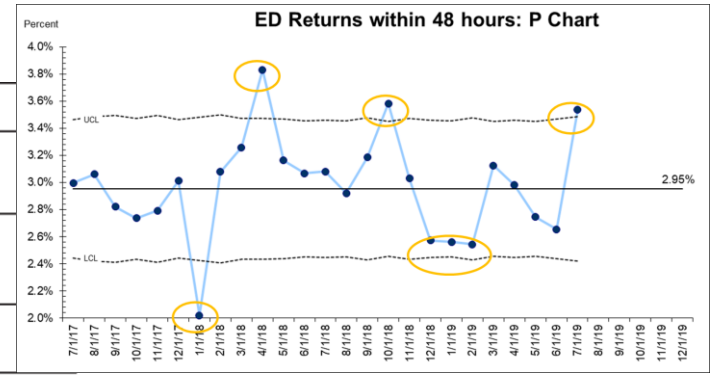
Shewhart charts for baseline project measures can be used to decide whether an improvement effort should be focused on fundamental changes or to fixing the current system or process





Use of Shewhart's Theory to Guide Improvement





Select a Key Measure Related to the Aim of the Improvement Effort

Develop an Appropriate Shewhart Chart for the Measure

Is the System Stable Related to this Measure?

Yes

Identify Common Cause(s)

Tools/Methods:
- -PDSA Tests of Change
- -Cause and Effect Diagram
- -Rational Subgrouping
- -Planned Experimentation

Responsibility:*
1. Subject or technical experts
2. People working inside the healthcare process(es)
3. Patients and family

Change the System to Remove or Reduce Common Cause(s) of Variation

Responsibility:*
1. Healthcare management at the appropriate level

No

Identify Special Cause(s)

Tools/Methods:
- -Shewhart Charts
- -Cause and Effect Diagram
- -Rational Subgrouping
- -PDSA Tests

Responsibility:*
1. People working inside the healthcare process(es)
2. Local healthcare management
3. Subject or technical experts

Learrn from and Act on Special Cause(s)

Responsibility:*
1. Local process supervisors (e.g charge nurse)
2. Subject or technical experts (e.g. infection control)
3. Healthcare managment at the appropriate level

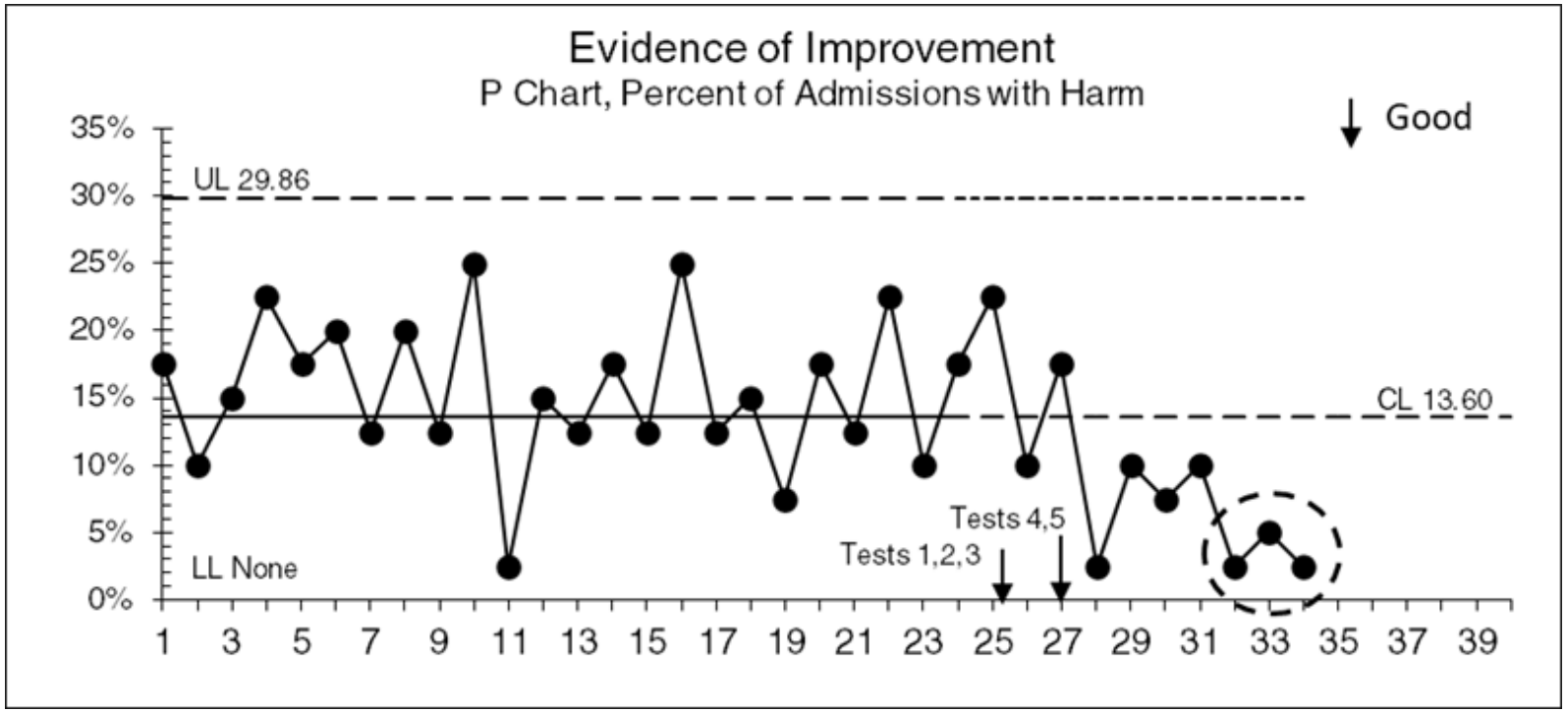
*Lists are ordered by importance

HC Data Guide, Figure 4.1, p. 128

Shewhart Charts Useful in All Parts of Model for Improvement

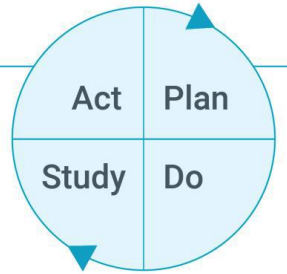
How will we know that a change is an improvement?

The Shewhart chart method provides a formal way to decide whether observed variation in a measure of quality should be attributed to changes made or to other causes of variation in the system (Figure 4.8).



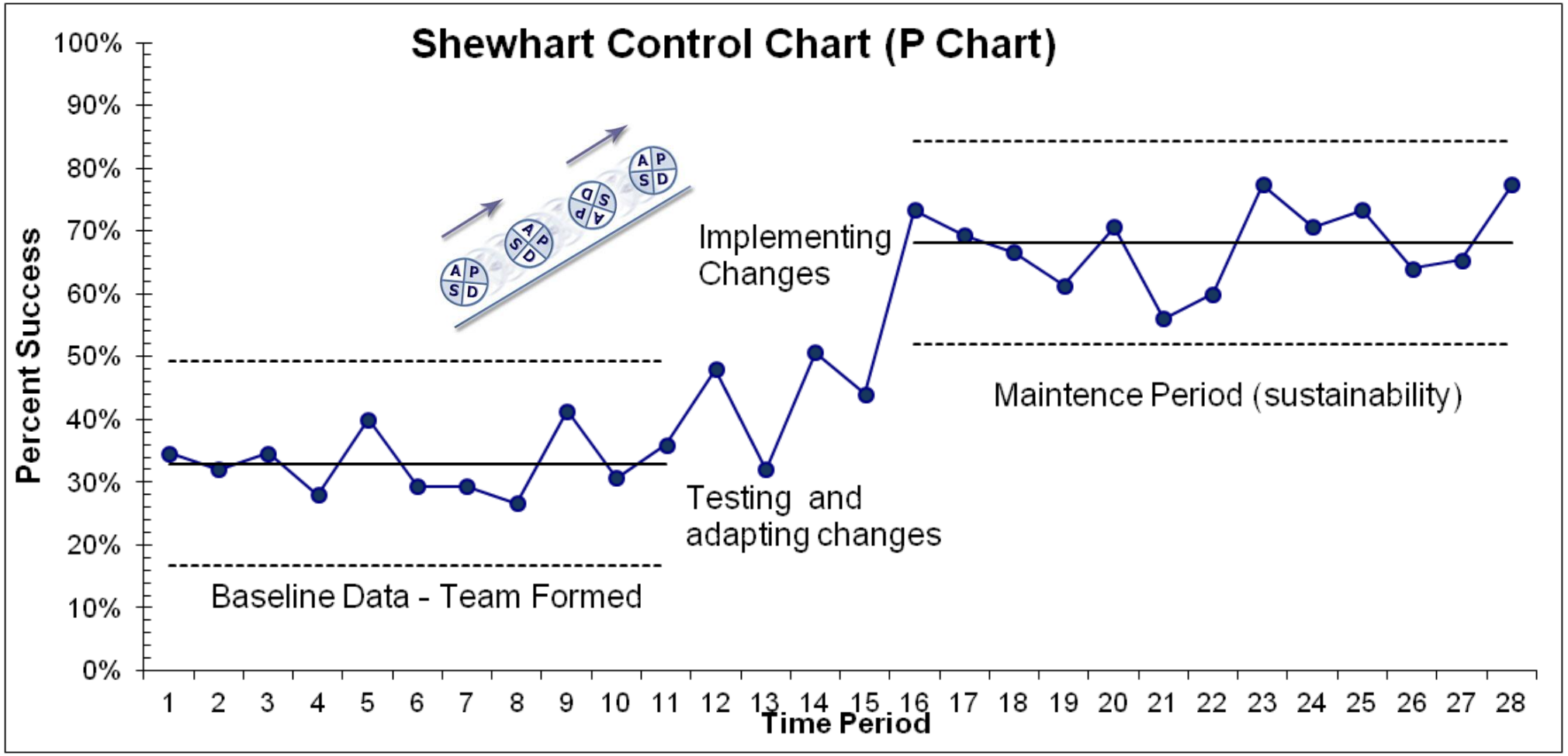
Model for Improvement

Aim	Measures	Changes
What are we trying to accomplish?	How will we know that a change is an improvement?	What change can we make that will result in improvement?



Source: Adapted from *The Improvement Guide* (2009)

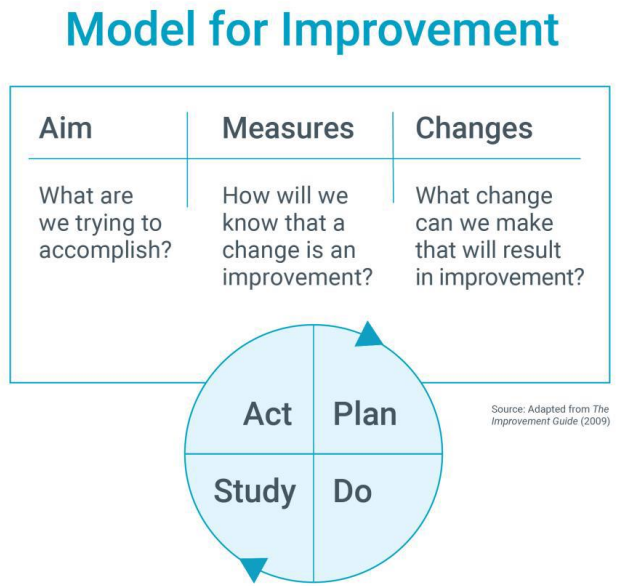
Updating a Shewhart Chart after Signals of Improvement



Shewhart Charts Useful in All Parts of Model for Improvement

What changes can we make that will result in improvement?

- Can help determine focus for the next PDSA cycle
  - identification, understanding, or removal of common causes (fundamental redesign of the system)
  - or focus on understanding and taking action on special causes of variation (fixing the current system).
- Used to detect causes of variation which can lead to ideas for change.
- Stratification, which includes disaggregation and rational subgrouping, is used with Shewhart charts to aid in developing ideas for change.



Detecting Variation Which Could Lead to Ideas for Change

FIGURE 4.9 Shewhart Chart Using Rational Subgrouping

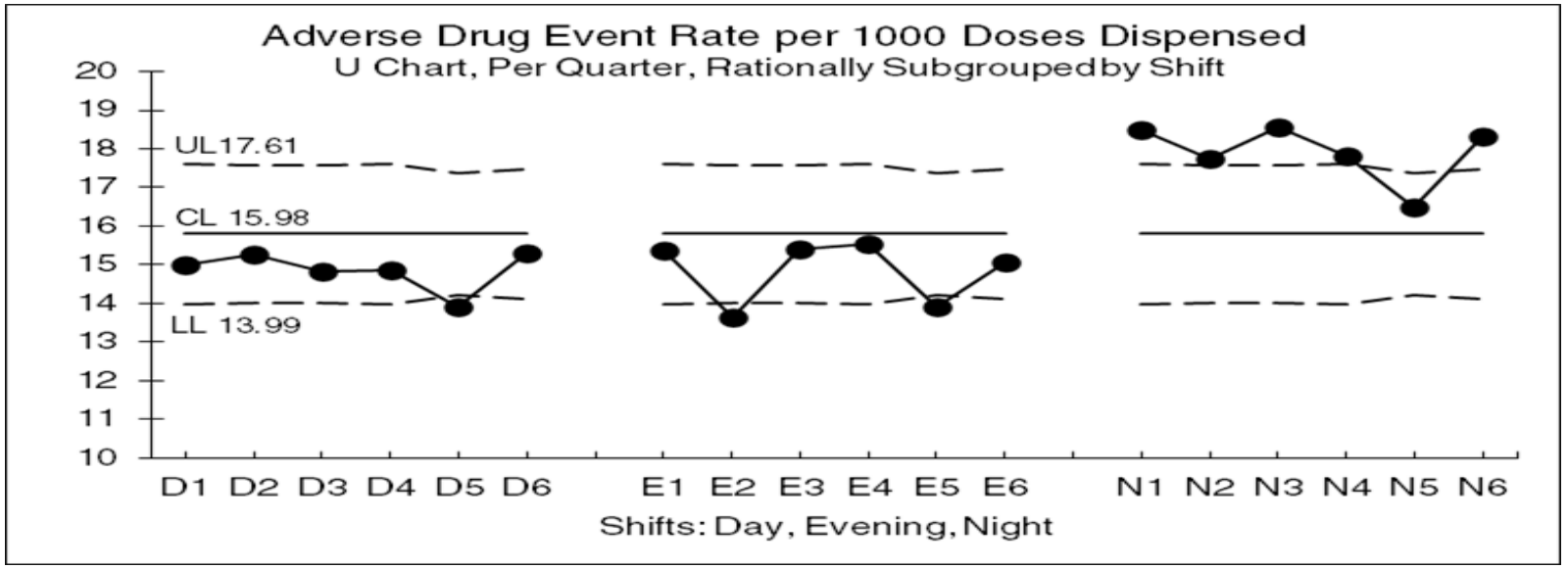


FIGURE 4.10 Shewhart Chart Using Stratification

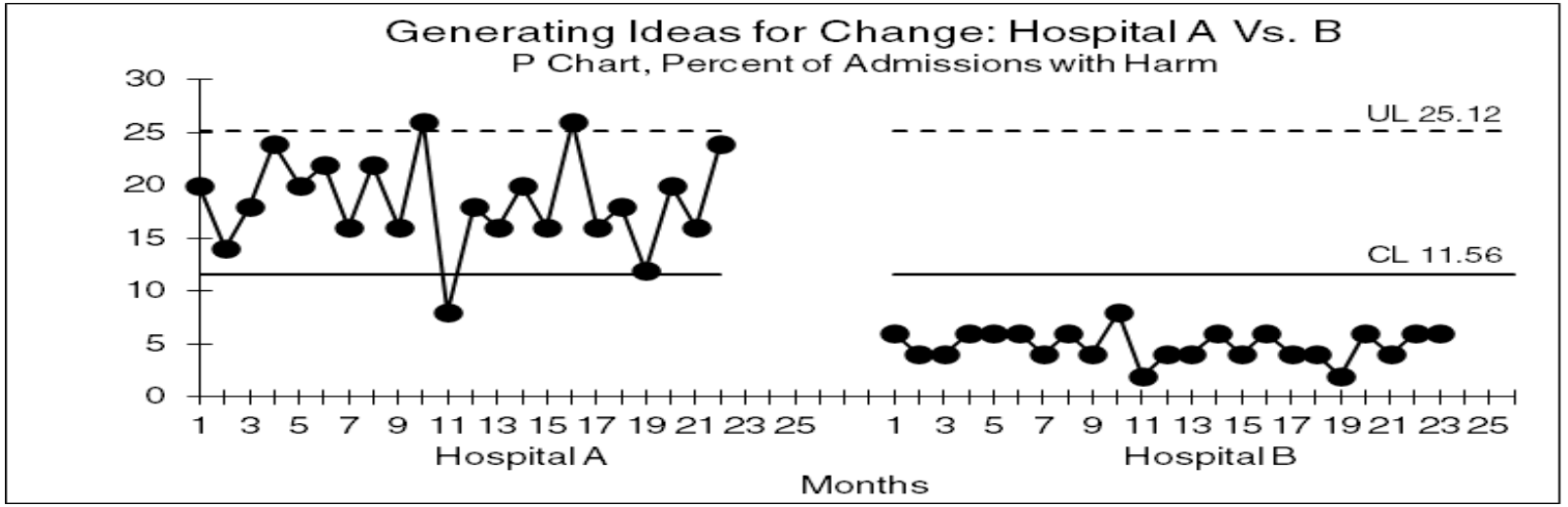
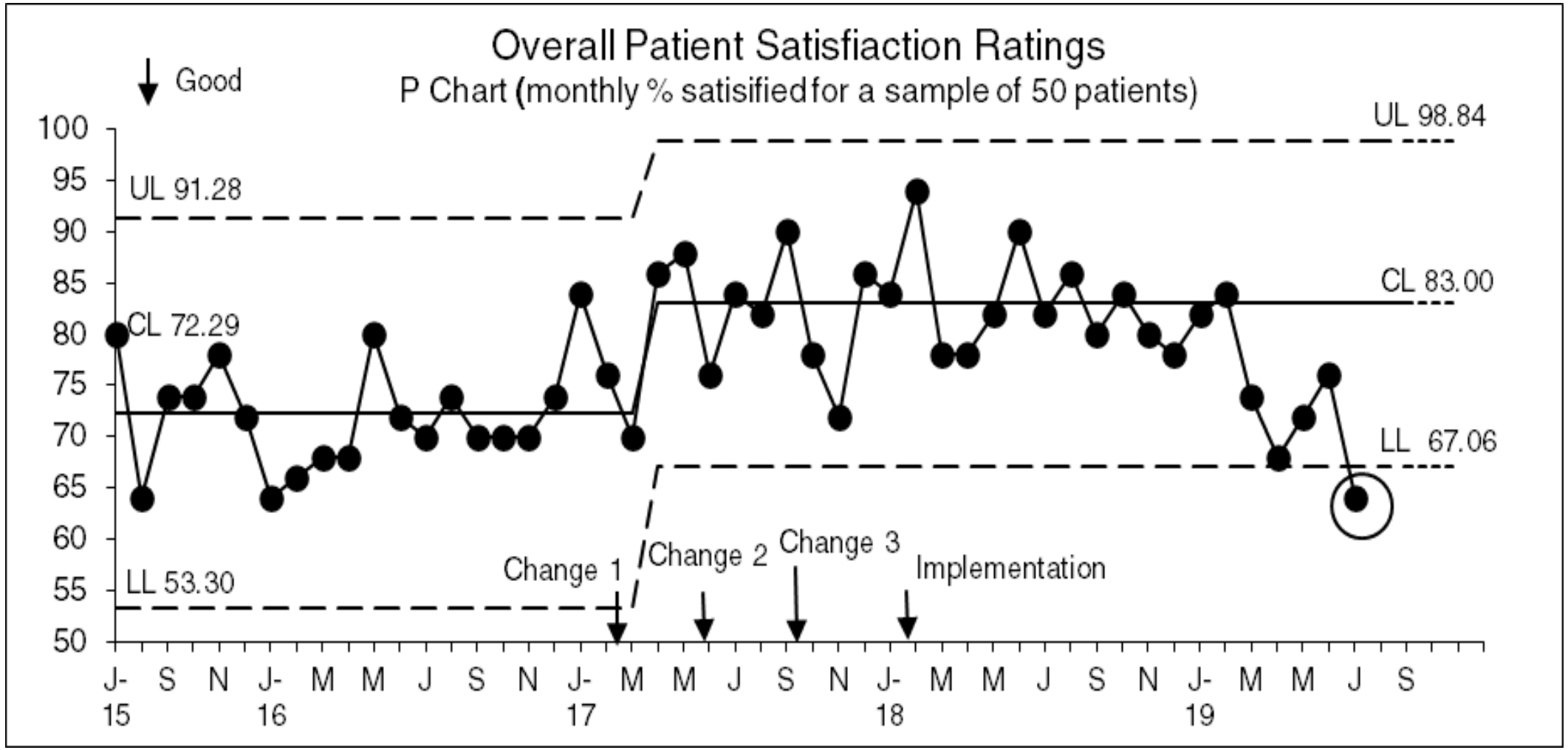


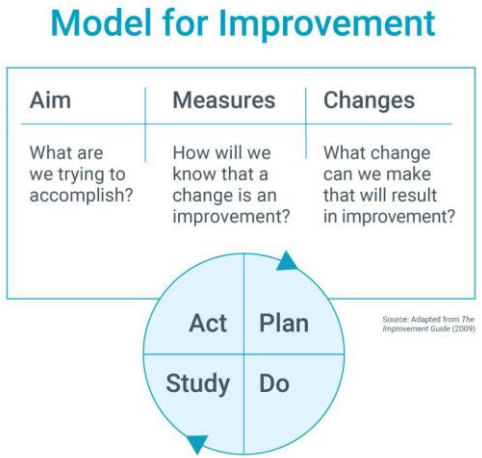
FIGURE 4.5 Detecting "Losing the Gains" for an Improved Process

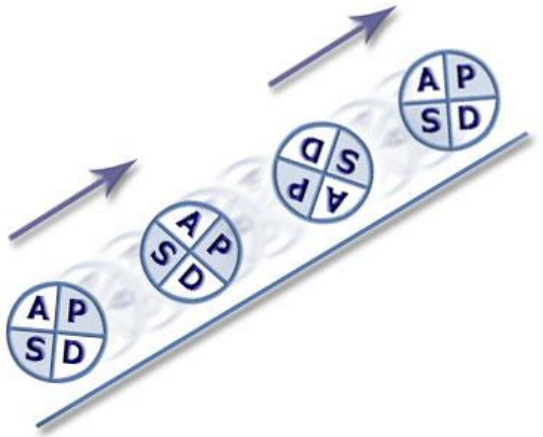


Shewhart Charts Useful in All Parts of Model for Improvement

What are we learning while testing using PDSA Cycles?

- Shewhart chart can be a key aid in learning during PDSA cycles.
- Making predictions prior to testing changes is key to good science and good learning.
- Reduces hindsight bias and focuses the study during the cycle.
- Teams should always make **predictions** about a change(s) before testing.
- Evidence always compared to prediction
- Improvement is determined using the Shewhart chart.
  - If the changes resulted in improvement the Shewhart chart would reveal evidence of favorable special cause after testing the change(s).
  - If the change tested didn't yield improvement the Shewhart chart would show no evidence of favorable special cause.



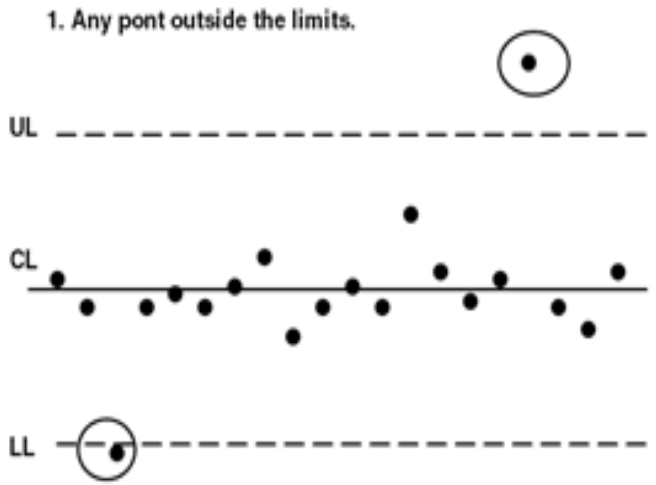


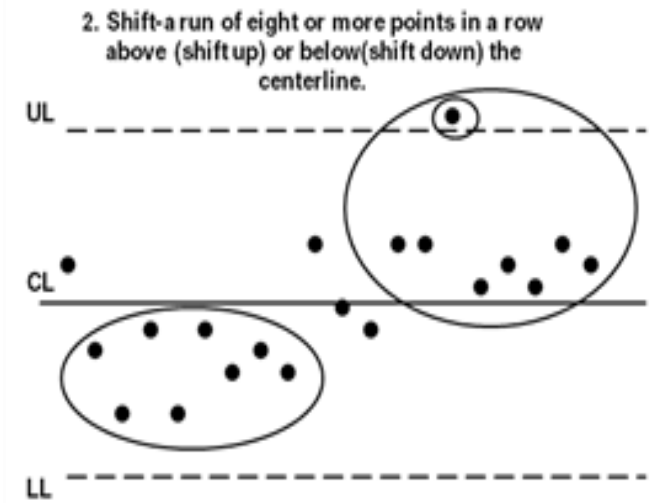
Reaction to Variation

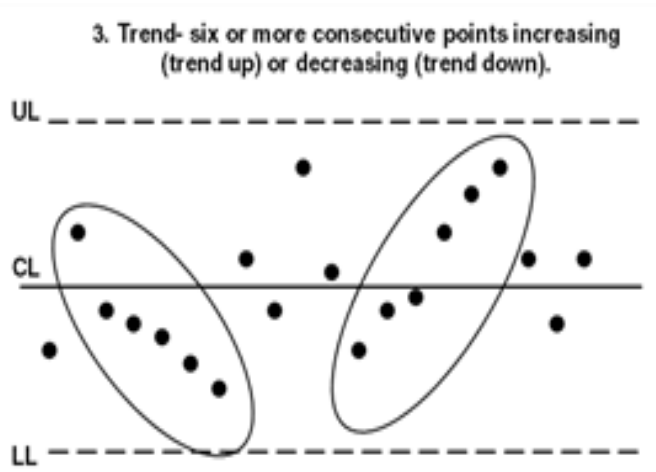
	ACTUAL SITUATION	
ACTION	When **No Special Cause** is Occurring in the System	When **Special Cause is Occurring** in the System
Take action on individual outcome (special cause approach)	Mistake 1: Wasted use of Resources Increased Variation **(Tampering)**	Positive use of Resources
Treat outcome as part of the system; work on changing the system (common cause approach)	Positive use of Resources	Mistake 2: Missed Opportunity to Improve

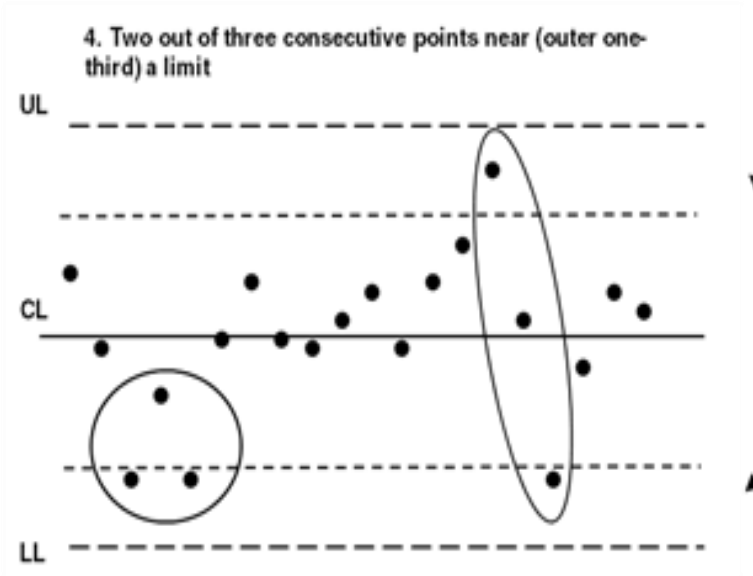
Table 4.1, HC Data Guide, p. 129

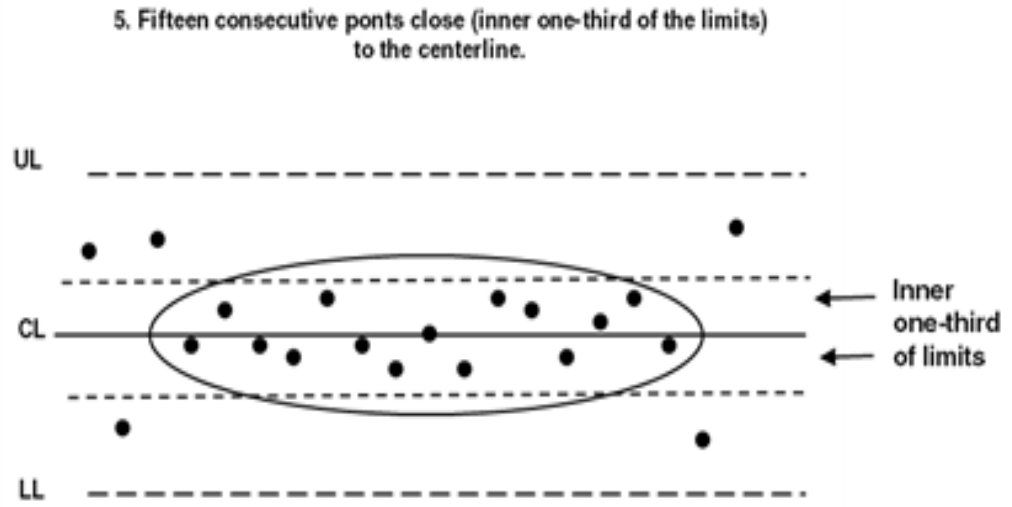
Standard rules for identifying special cause variation



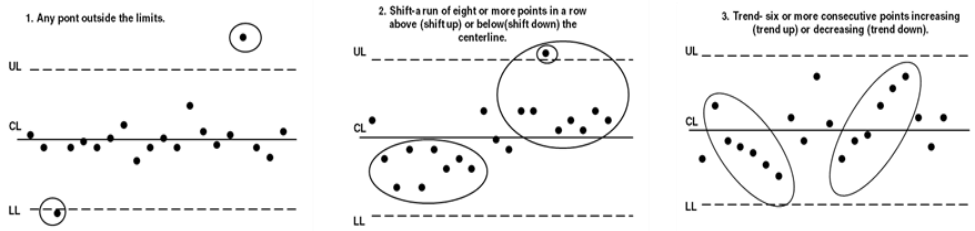


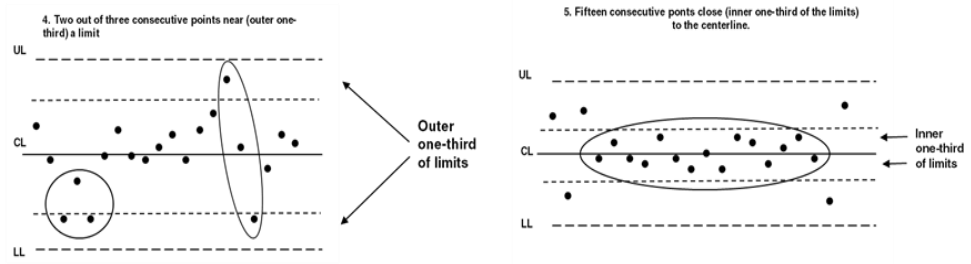






HC Data Guide, p. 116


1. Any pont outside the limits.
UL
CL
LL
2. Shift-a run of eight or more points in a row above (shift up) or below(shift down) the centerline.
UL
CL
LL
3. Trend- six or more consecutive points increasing (trend up) or decreasing (trend down).
UL
CL
LL


4. Two out of three consecutive points near (outer one-third) a limit
UL
CL
LL
Outer one-third of limits
5. Fifteen consecutive ponts close (inner one-third of the limits) to the centerline.
UL
CL
LL
Inner one-third of limits

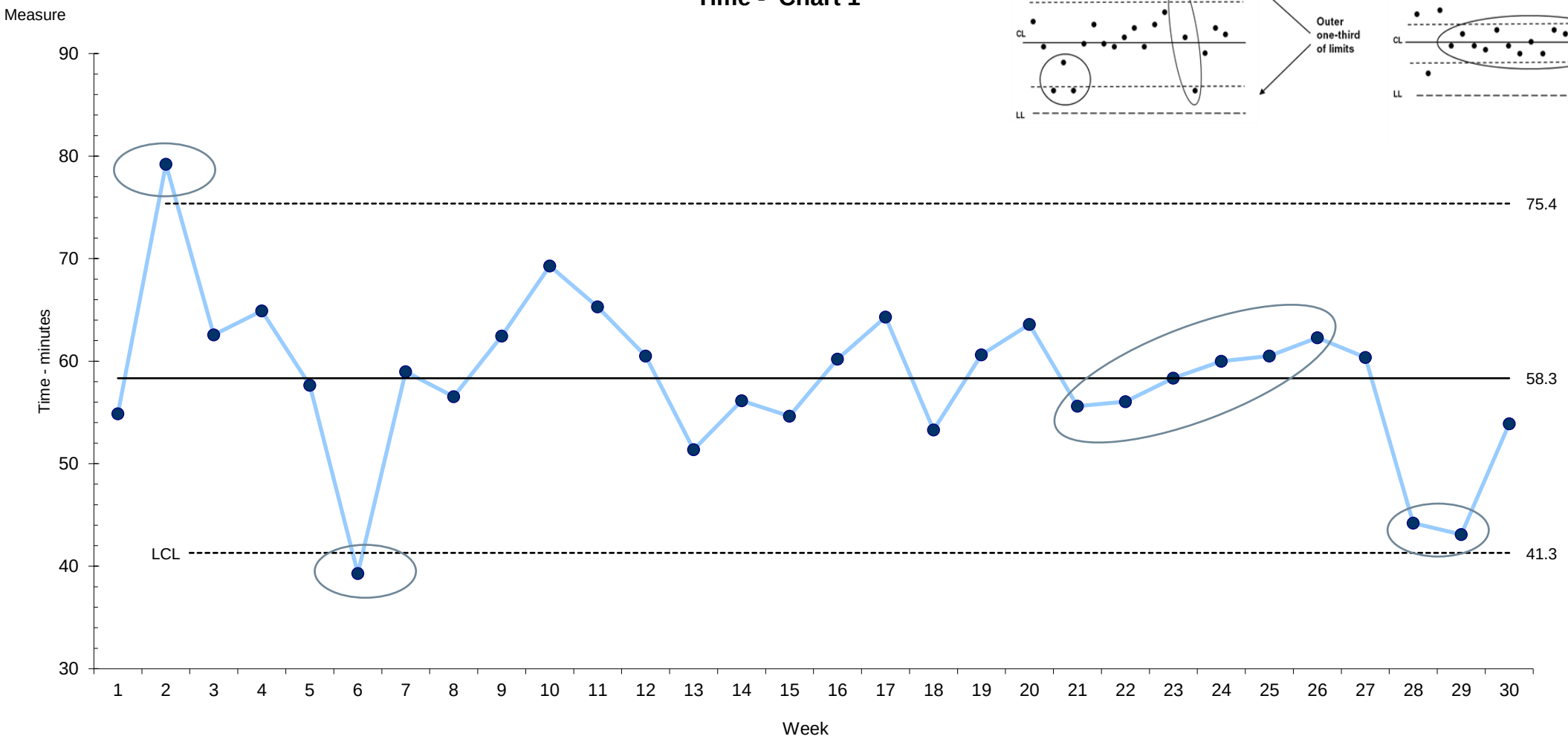
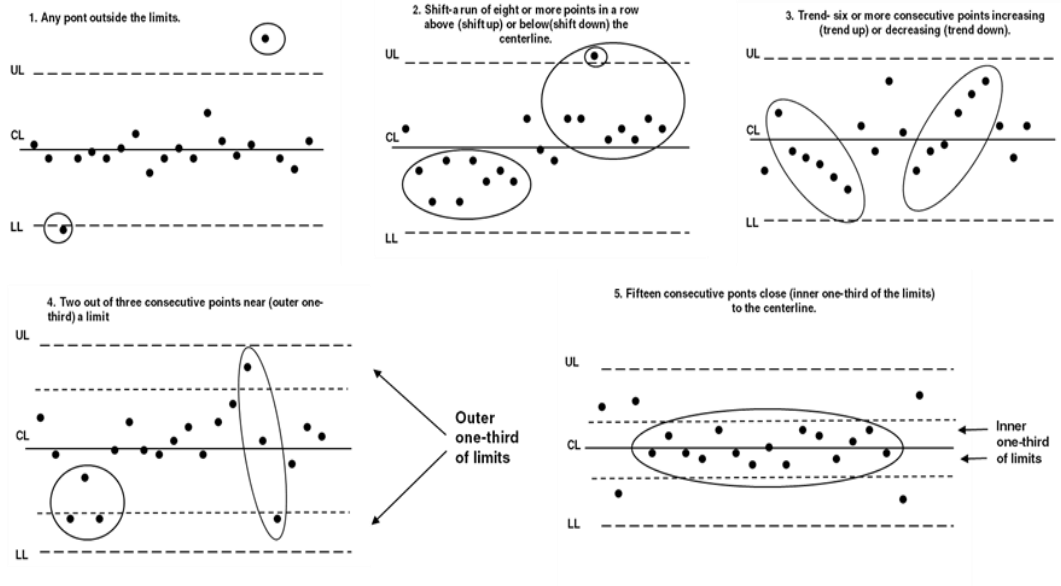

Time - Chart 1
Measure
Time - minutes
90
80
70
60
50
40
30
75.4
58.3
41.3
LCL
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Week

Chart 2


1. Any pont outside the limits.
2. Shift-a run of eight or more points in a row above (shift up) or below(shift down) the centerline.
3. Trend- six or more consecutive points increasing (trend up) or decreasing (trend down).
4. Two out of three consecutive points near (outer one-third) a limit
5. Fifteen consecutive ponts close (inner one-third of the limits) to the centerline.
UL
CL
LL
Outer one-third of limits
Inner one-third of limits

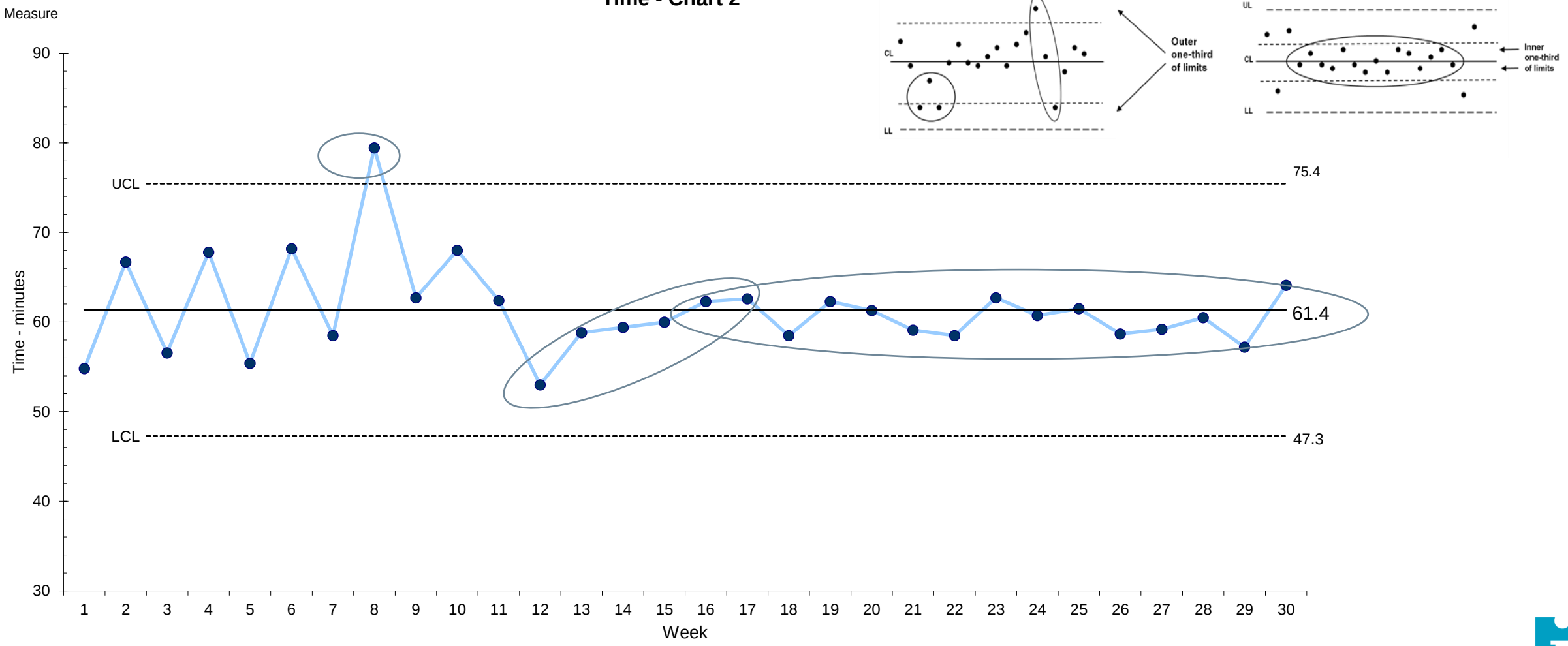
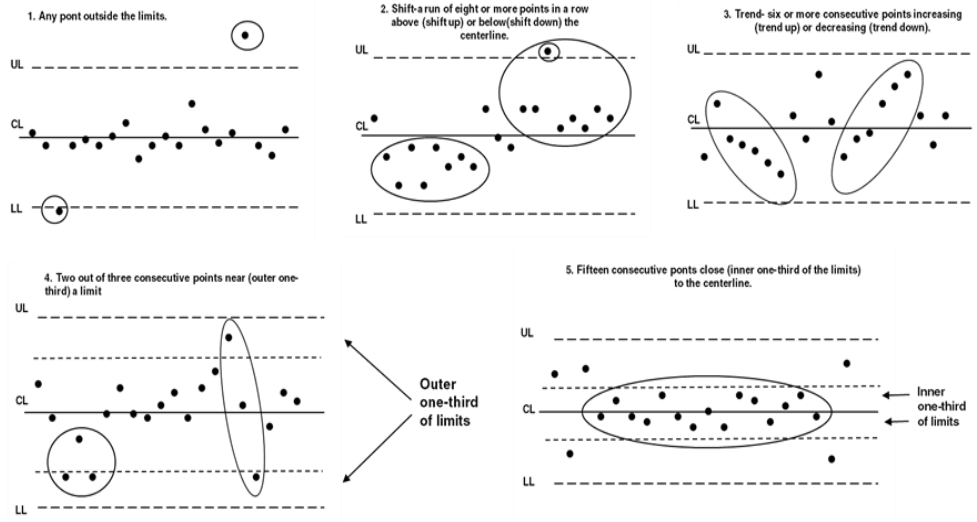
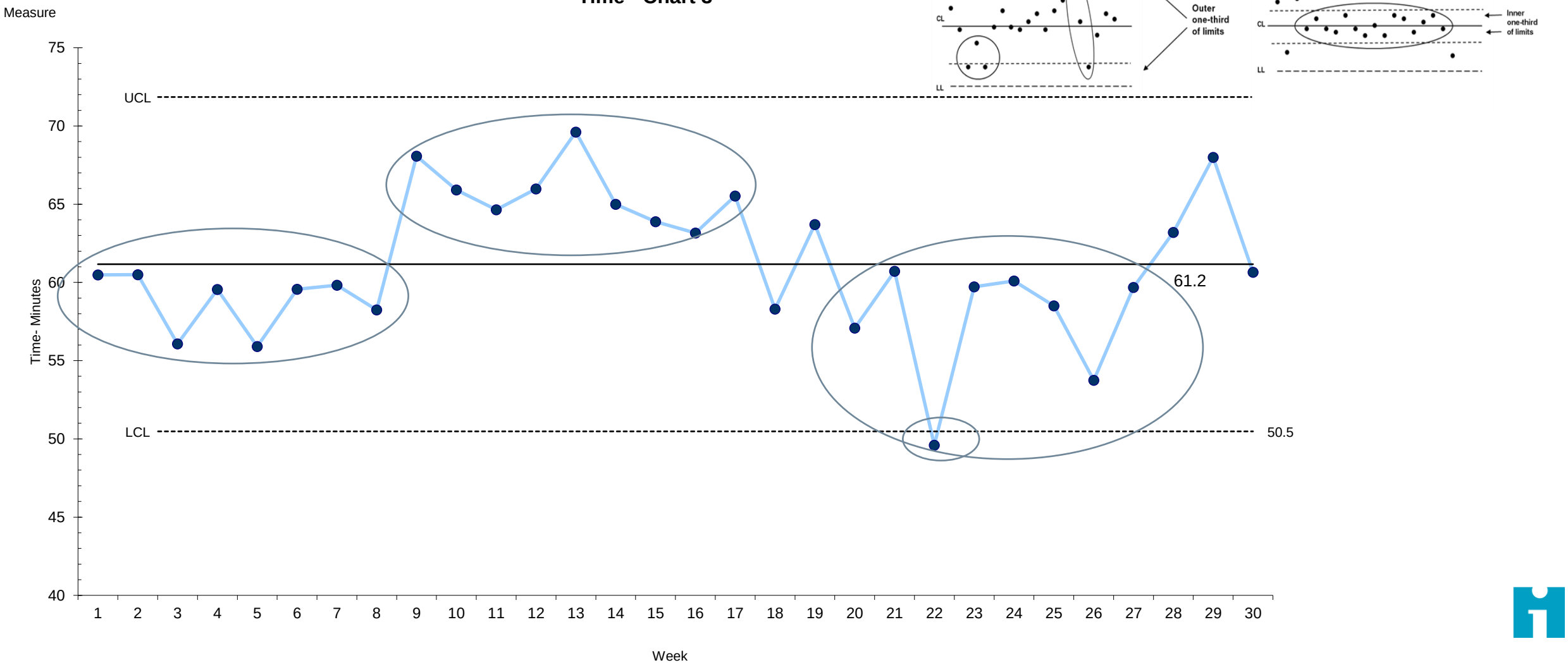
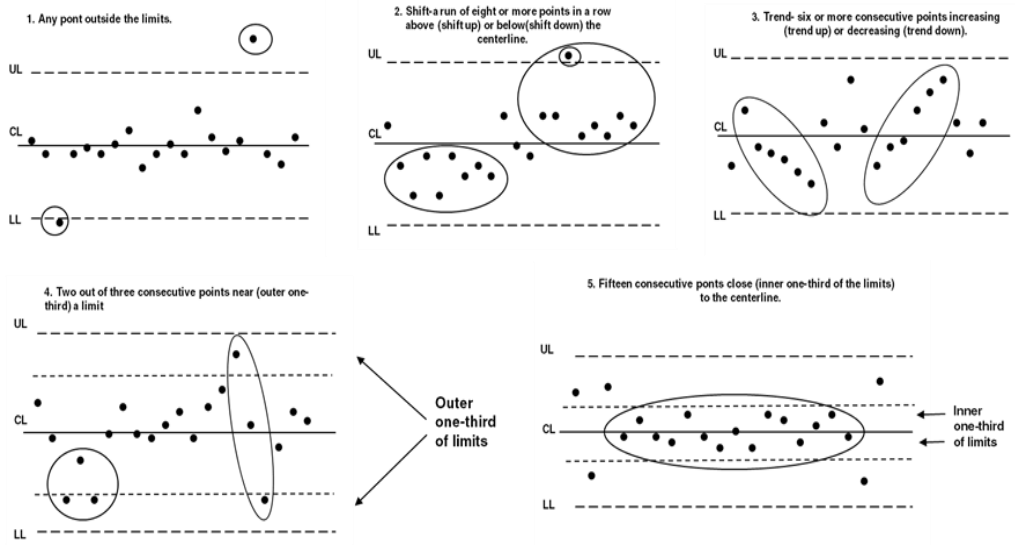

Time - Chart 2
Measure
Time - minutes
Week
UCL
LCL
75.4
61.4
47.3
90
80
70
60
50
40
30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

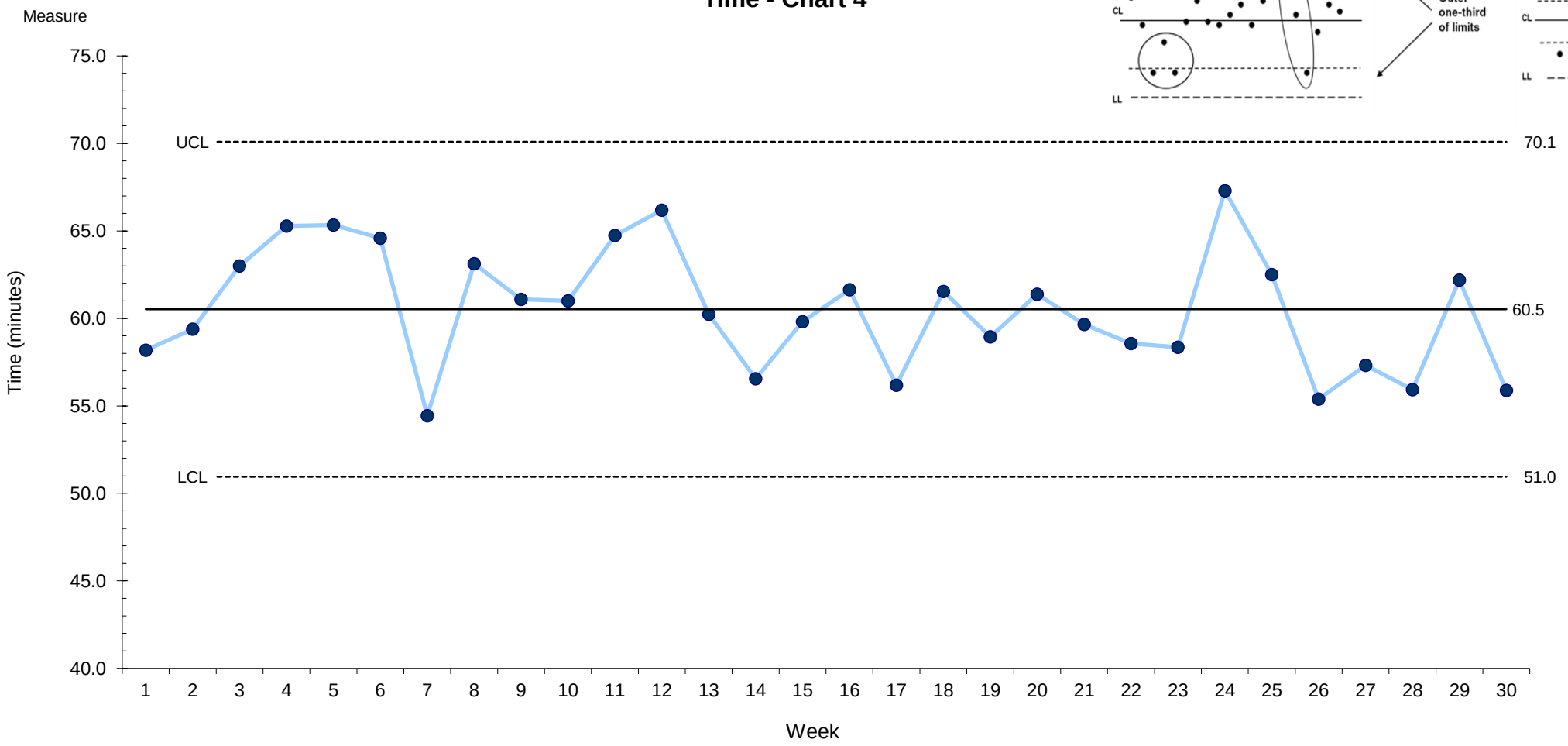
Chart 3


1. Any pont outside the limits.
2. Shift-a run of eight or more points in a row above (shift up) or below(shift down) the centerline.
3. Trend- six or more consecutive points increasing (trend up) or decreasing (trend down).
4. Two out of three consecutive points near (outer one-third) a limit
Outer one-third of limits
5. Fifteen consecutive ponts close (inner one-third of the limits) to the centerline.
Inner one-third of limits
UL
CL
LL


Time - Chart 3
Measure
Time- Minutes
Week
UCL
LCL
61.2
50.5
75
70
65
60
55
50
45
40
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

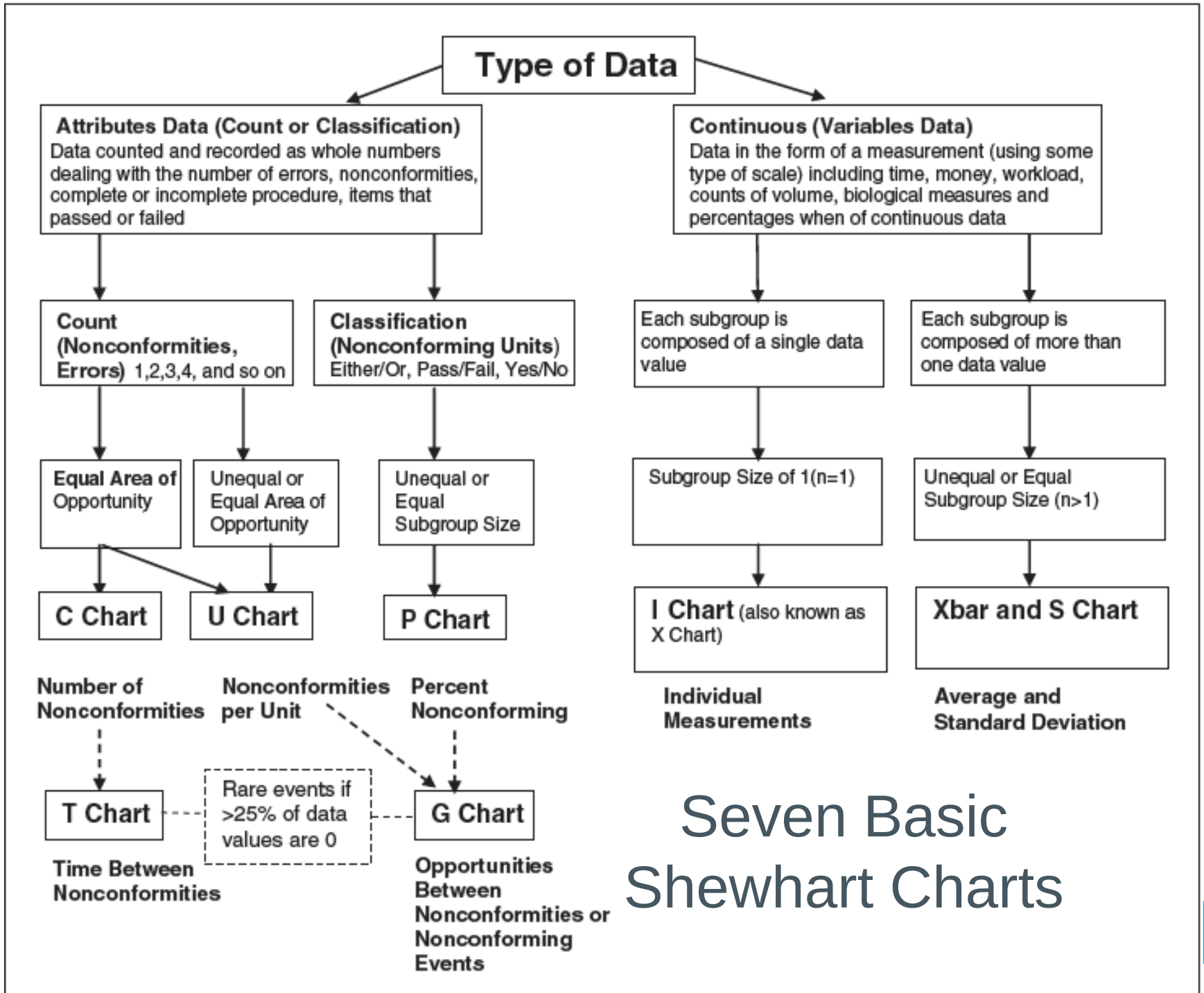
All common cause variation





Different Shewhart Charts depending on type of data and how it is organised.

7 Basic charts and many advanced options

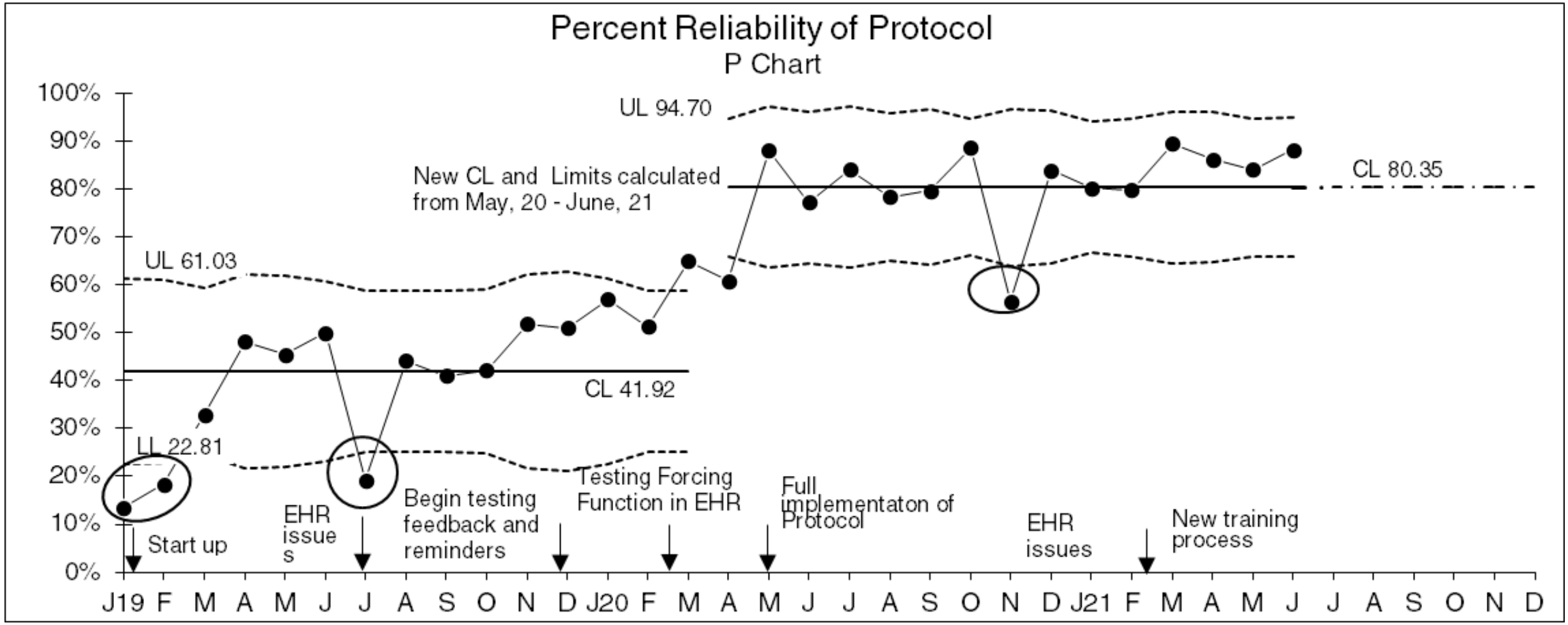


Seven Basic Shewhart Charts

HCDG, Page 161

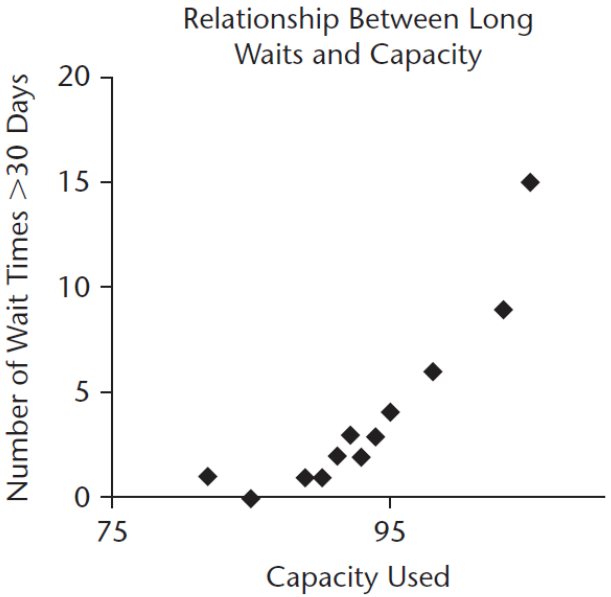
Annotation – the key to learning with Shewhart charts

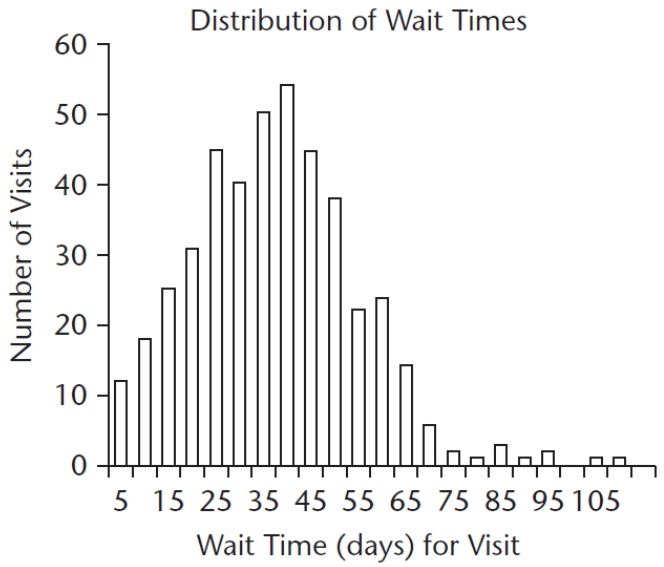
FIGURE 7.6 Example of Shewhart Chart with Appropriate Annotations

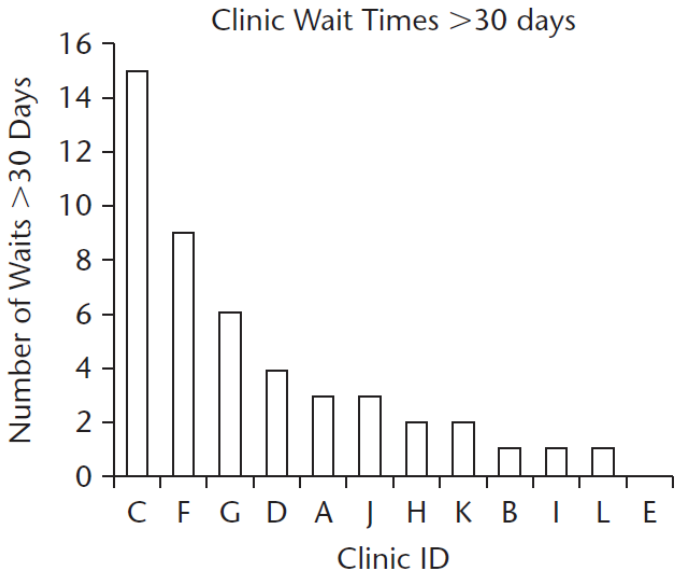


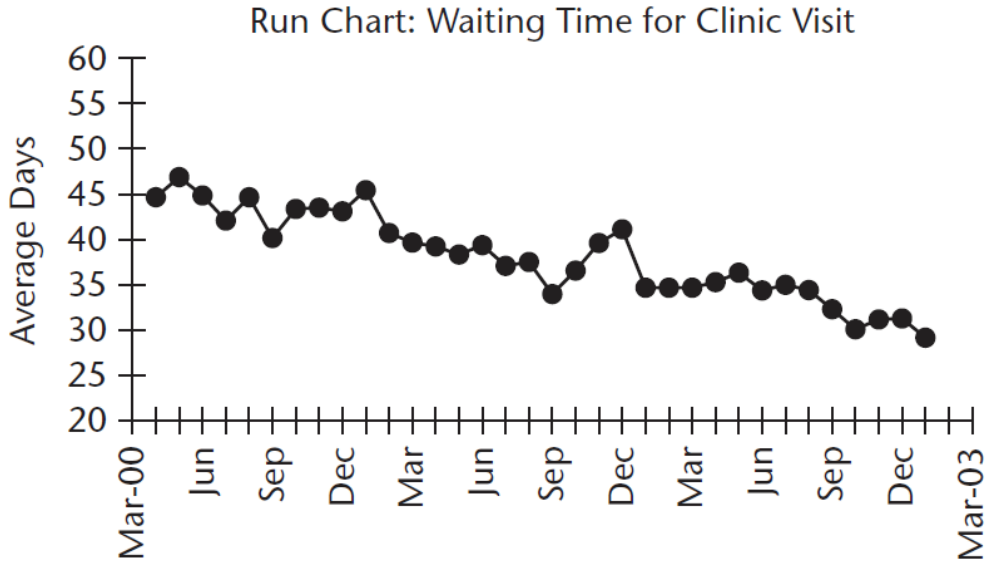
. The Health Care Data Guide, 2nd Edition,

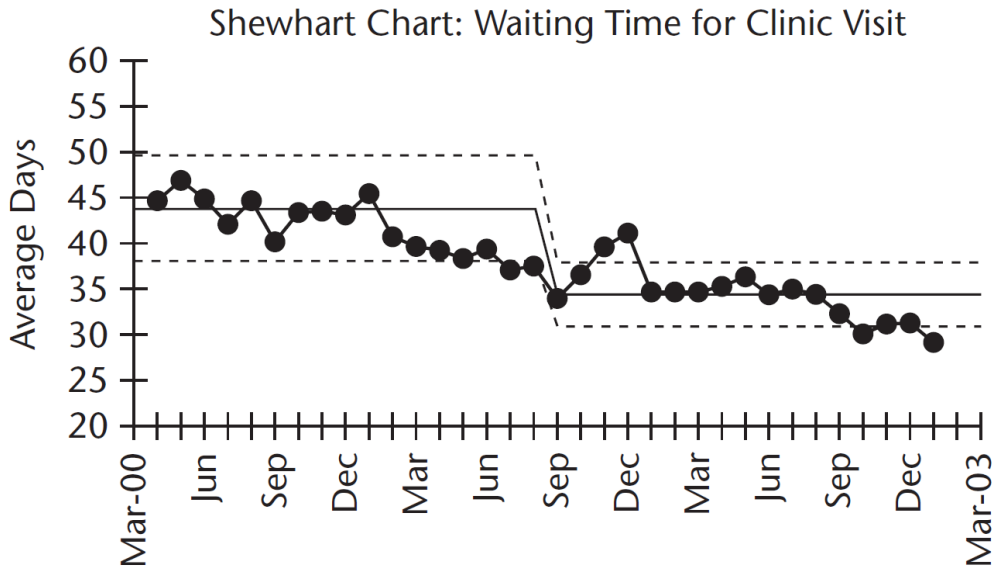
Tools to Learn from Variation in Data







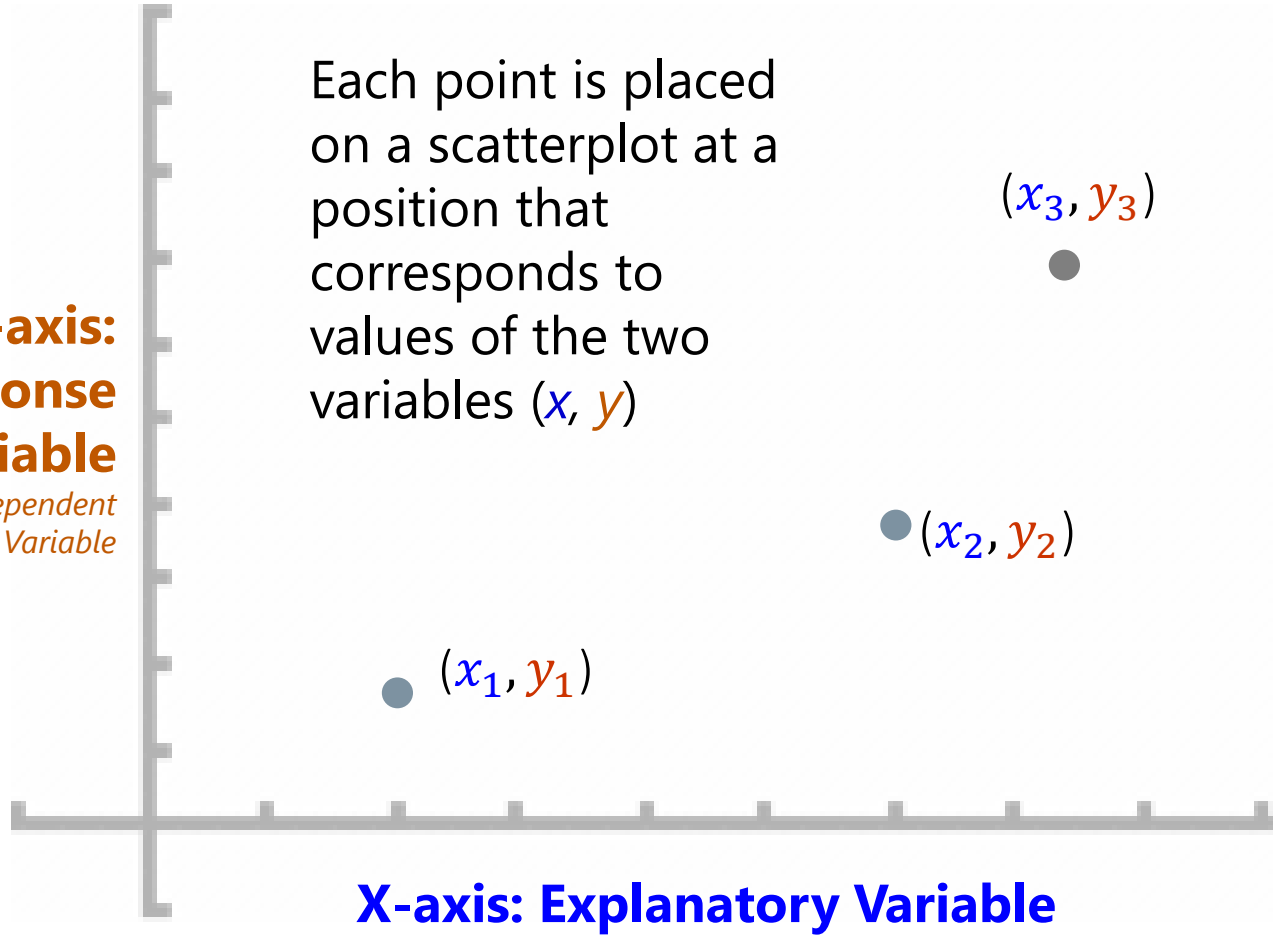


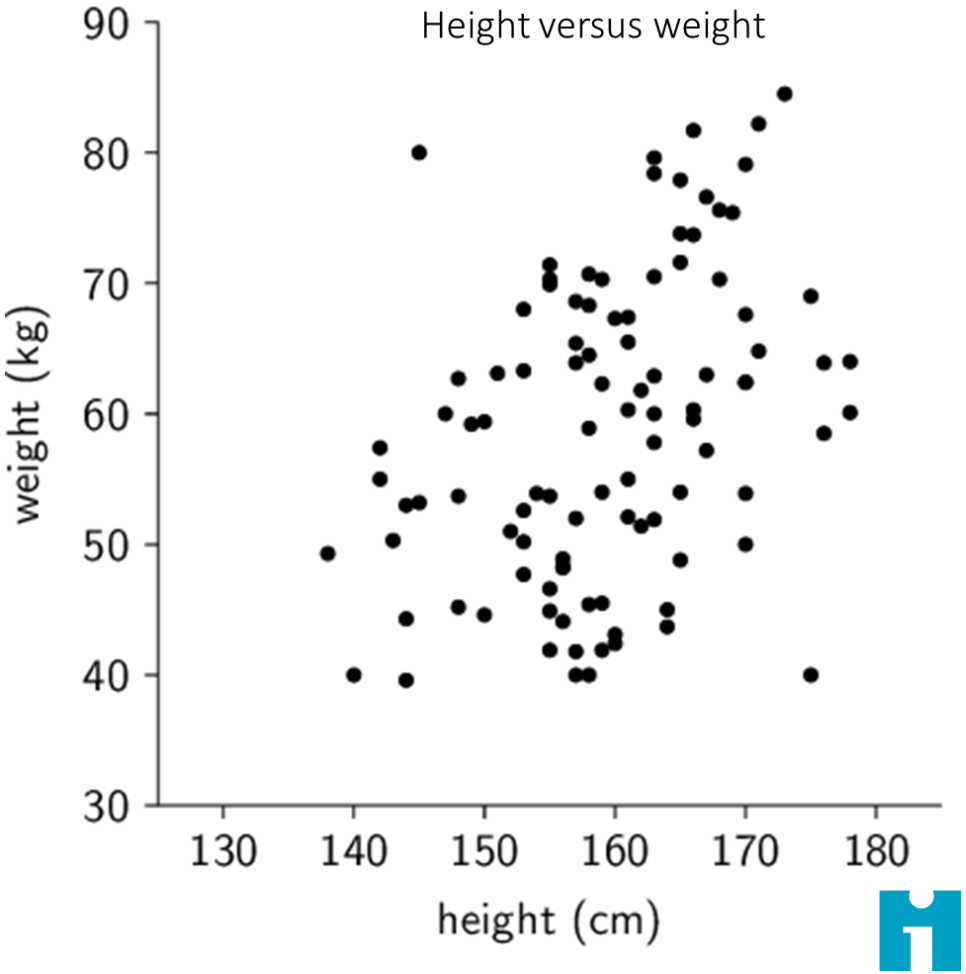


HC Data Guide, p. 65, P. 136-146

Scatter Plots

- Effective display for trends, patterns, and relationship for two variables
- Useful to look at relationships between outcome and process measures
- Understand special cause signals on Shewhart Charts

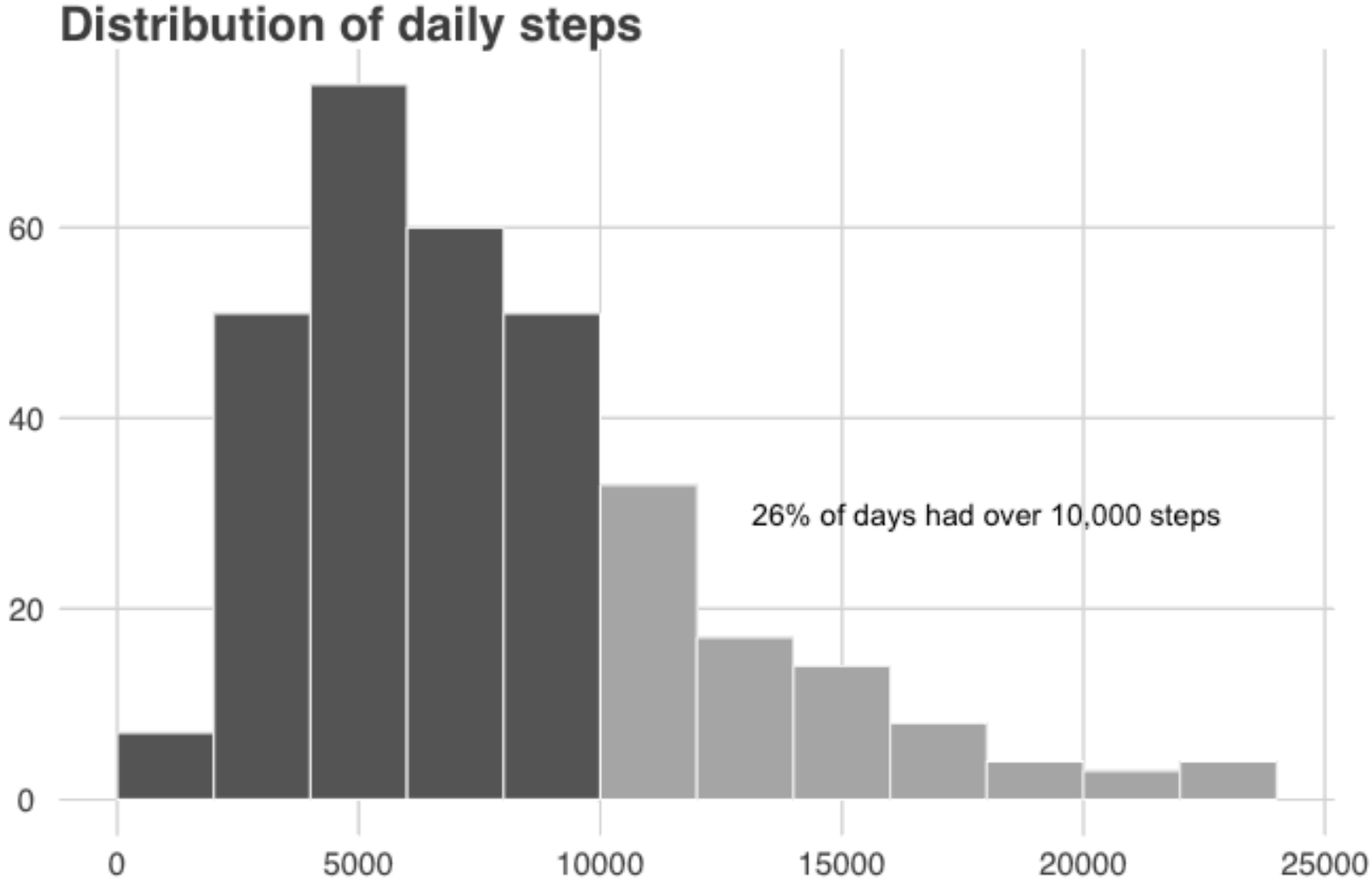




Frequency Plot

Show all the data; good for exploratory analysis.

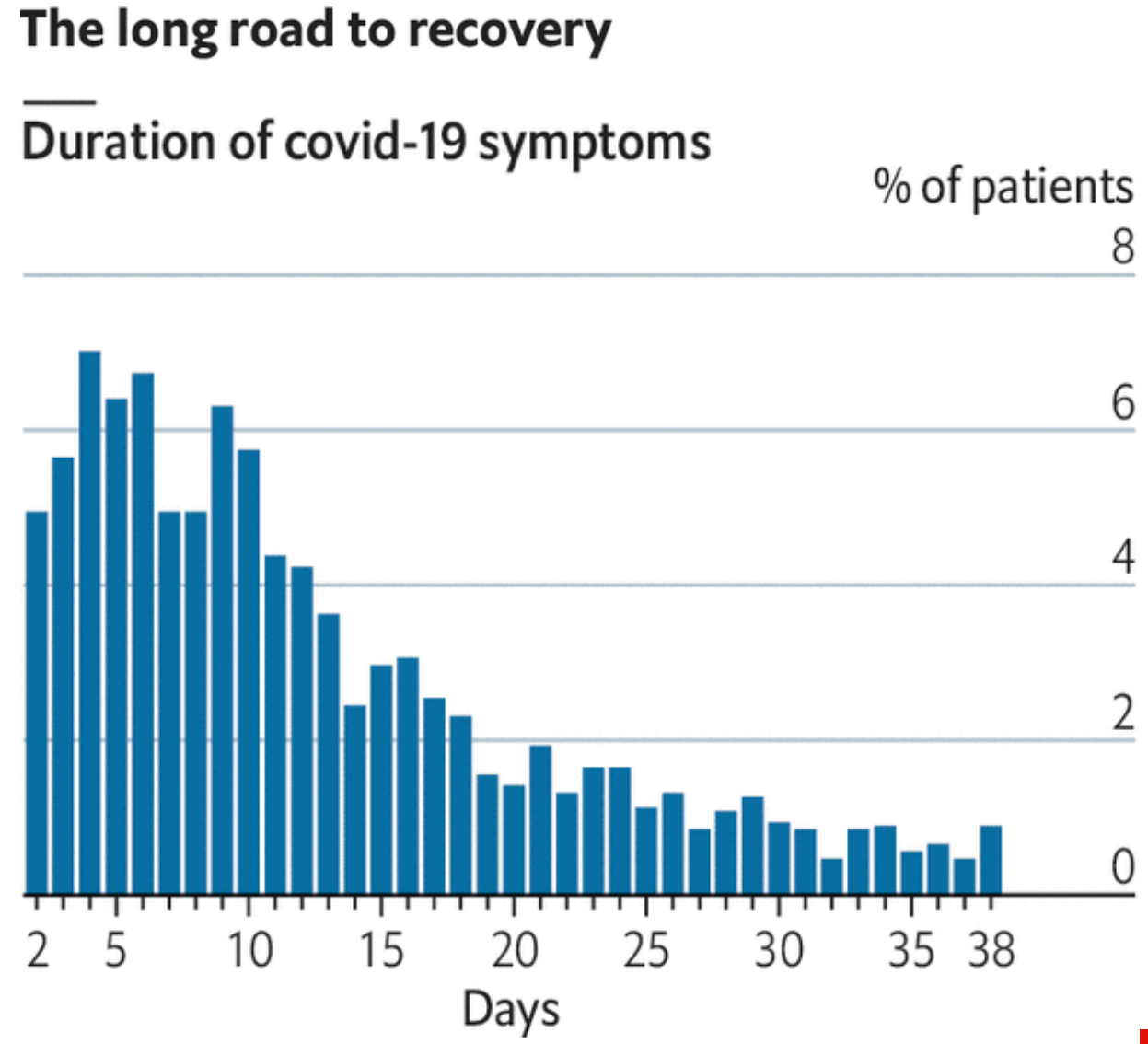
Visualise the location, the spread, modality, and symmetry for the distribution of a numerical measure.



2014: A year in review with iPhone pedometer data Geoffrey Litt

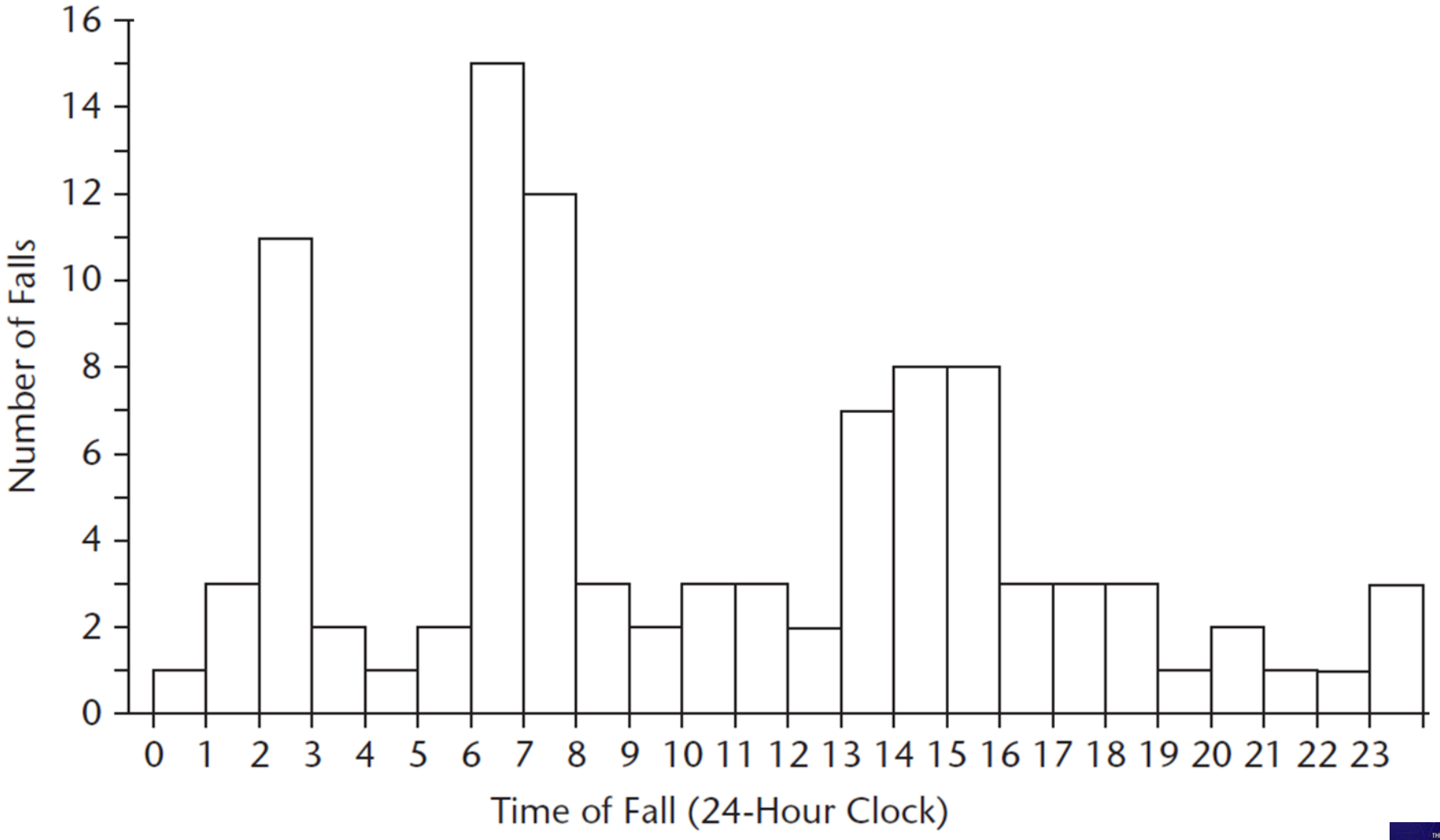
Relative Frequency Plot

Displayed here are the *percentages* of observations that fall into each range rather than the counts.



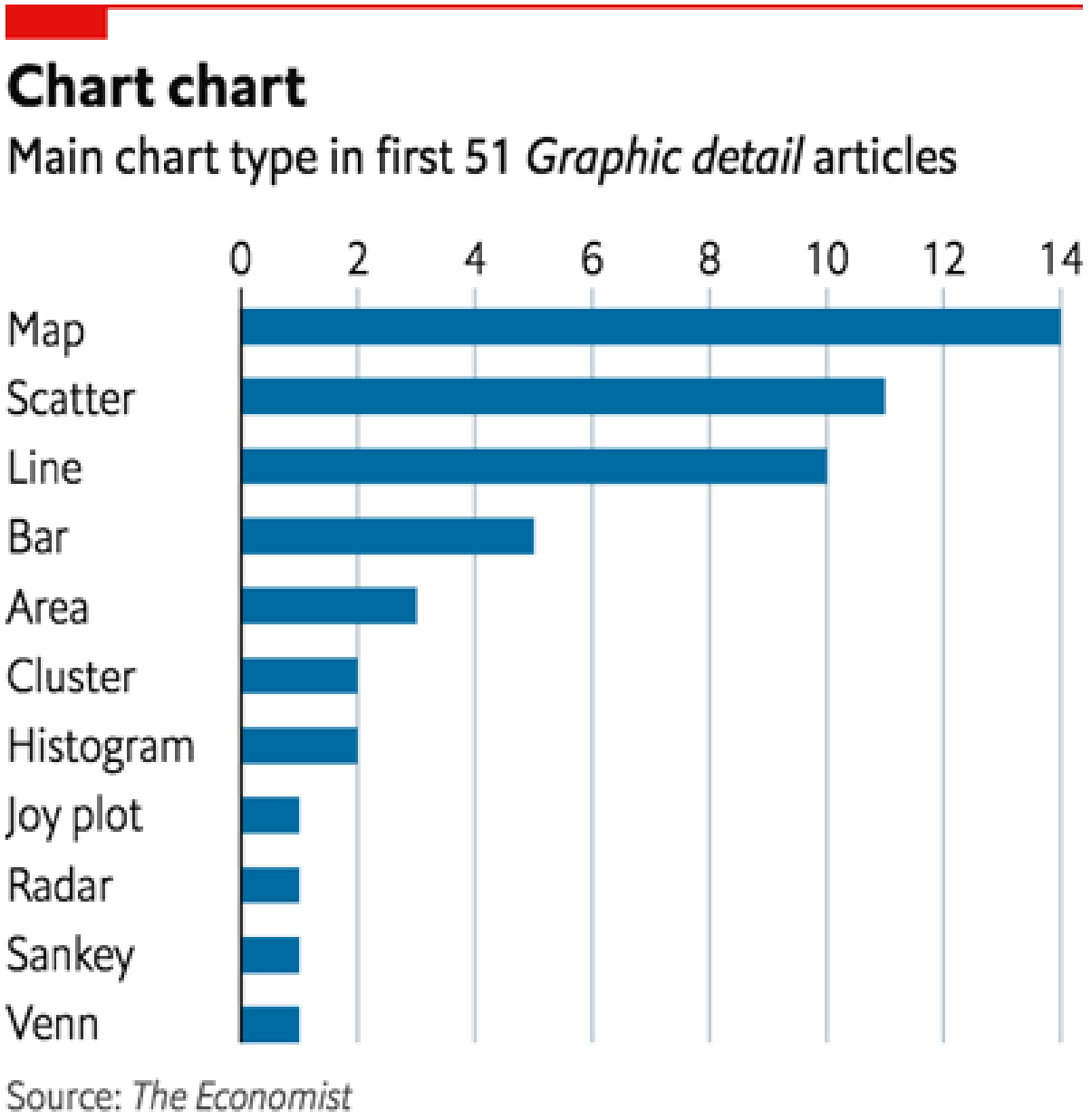
Frequency Plot of patient falls by time of day $(n = 100)$

This display can provide ideas for testing changes that result in fewer patient falls.



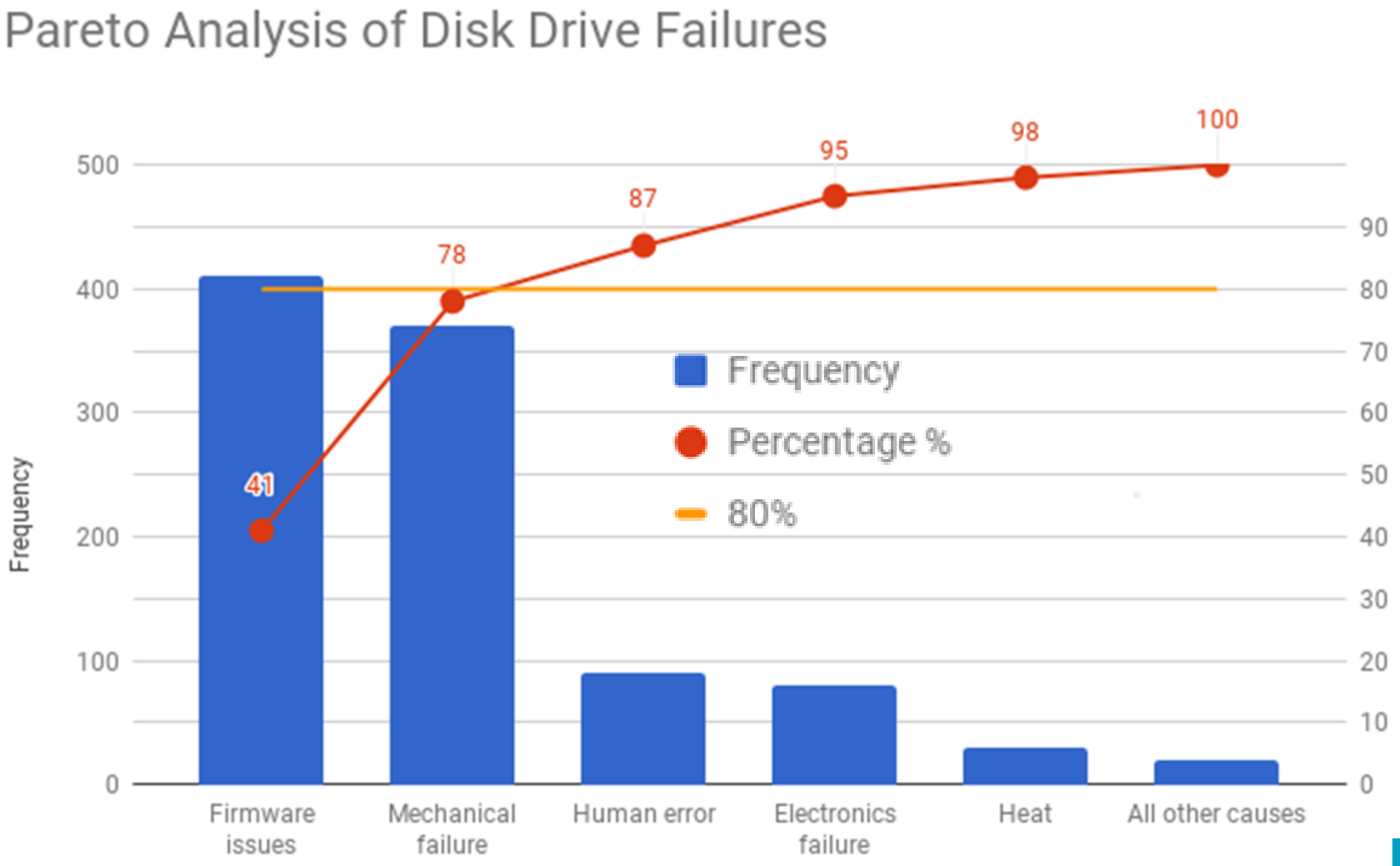
Pareto Chart

The Pareto Chart is like a “frequency plot” for categorical data.



These charts exemplify (and are named for) Vilfredo Pareto's 80/20 rule.

Problems, errors, defects, adverse drug events, patient complaints, and other data can often be organised into categories or classifications.



Descriptive Statistics

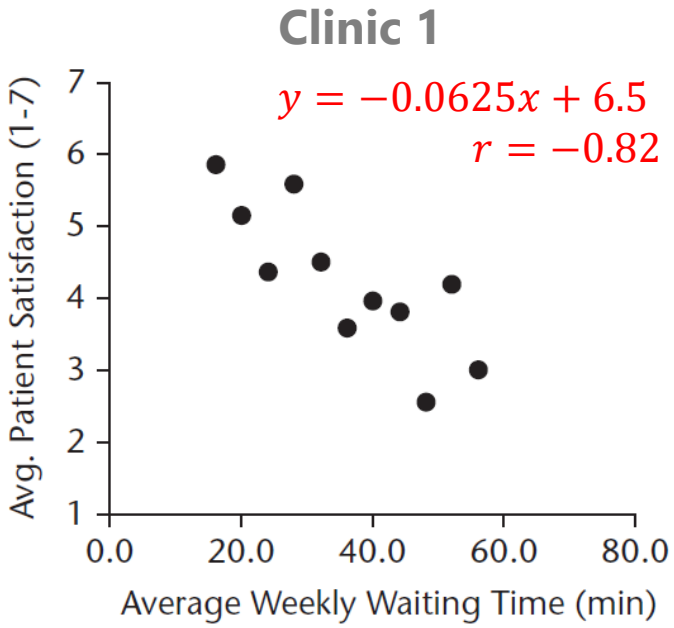
Table 4.1 Wait Time and Satisfaction Data from Four Clinics

	Clinic 1		Clinic 2		Clinic 3		Clinic 4	
Week	Average wait time (minutes)	Average patient rating	Average wait time (minutes)	Average patient rating	Average wait time (minutes)	Average patient rating	Average wait time (minutes)	Average patient rating
1	40.0	3.98	40.0	3.43	40.0	4.27	32.0	4.71
2	32.0	4.53	32.0	3.93	32.0	4.62	32.0	5.12
3	52.0	4.21	52.0	3.63	52.0	1.63	32.0	4.15
4	36.0	3.60	36.0	3.62	36.0	4.45	32.0	3.58
5	44.0	3.84	44.0	3.37	44.0	4.10	32.0	3.77
6	56.0	3.02	56.0	3.95	56.0	3.58	32.0	4.48
7	24.0	4.38	24.0	4.94	24.0	4.96	32.0	5.38
8	16.0	5.87	16.0	6.45	16.0	5.31	76.0	1.75
9	48.0	2.58	48.0	3.44	48.0	3.93	32.0	5.22
10	28.0	5.59	28.0	4.37	28.0	4.79	32.0	4.05
11	20.0	5.16	20.0	5.63	20.0	5.14	32.0	4.56
Number of weeks	11	11	11	11	11	11	11	11
Overall average	36.00	4.25	36.00	4.25	36.00	4.25	36.00	4.25
Standard deviation	13.27	1.02	13.27	1.02	13.27	1.02	13.27	1.02
Correlation: (r statistic)	0.82		0.82		0.82		0.82	
Regression: intercept/slope	6.50	–0.062	6.50	–0.062	6.50	–0.062	6.50	–0.062
Regression standard error	0.62		0.62		0.62		0.62	
P-value for regression	0.0022		0.0022		0.0022		0.0022	

Healthcare Data Guide, 2nd ed. Jossey Bass, 2022, adapted from:

Anscombe, F. J., "Graphs in Statistical Analysis," *American Statistician* 1973, *27*, 17–21.

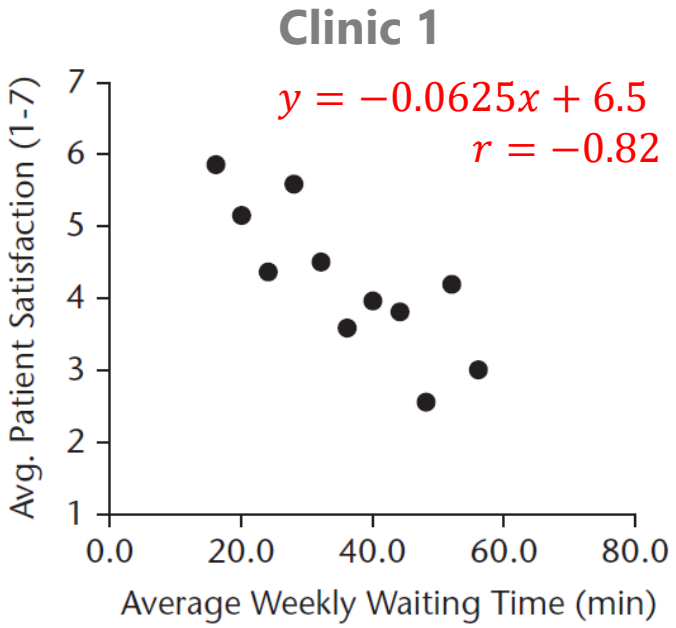
Thinking of making decisions without first displaying the data?

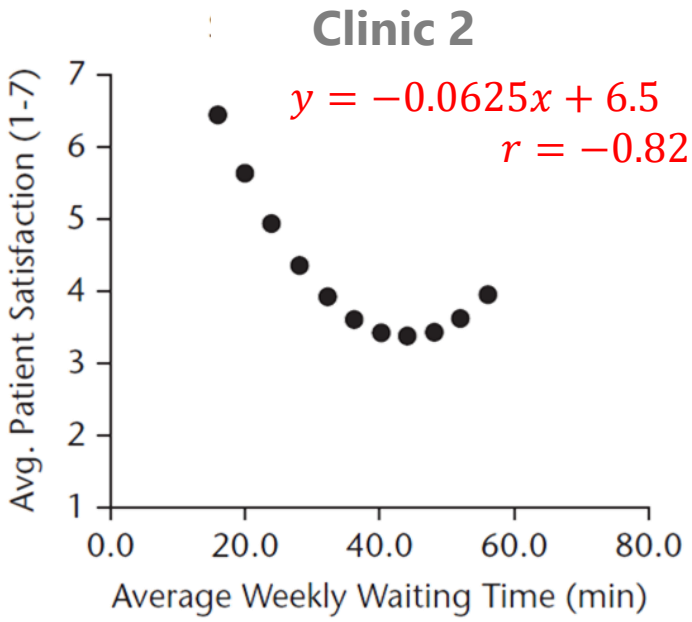


> *...make **both** calculations **and** graphs. Both sorts of output should be studied; each will contribute to understanding.*
>
> *- F. J. Anscombe, 1973*

Anscombe, F. J., "Graphs in Statistical Analysis," *American Statistician* 1973, *27*, 17–21.

Thinking of making decisions without first displaying the data?



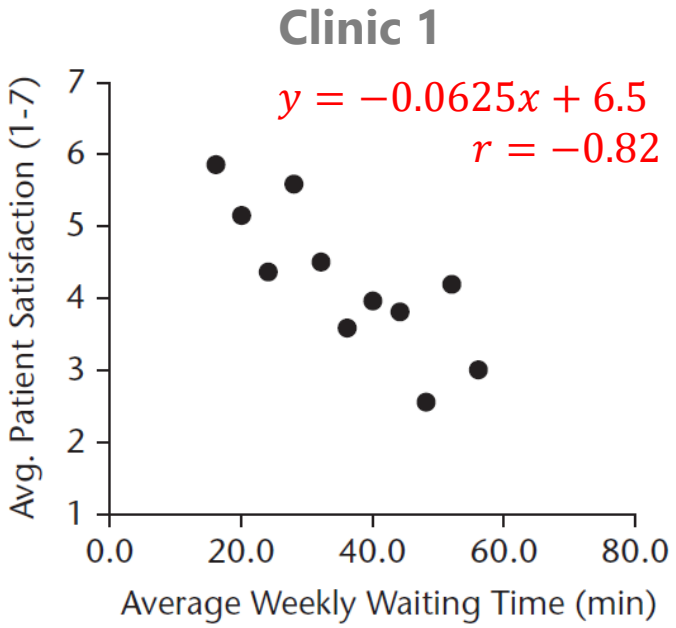


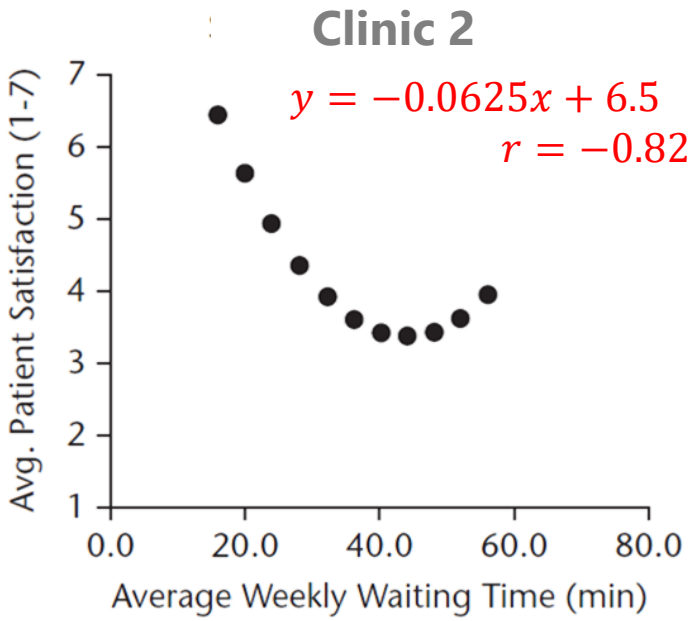
> *...make **both** calculations **and** graphs. Both sorts of output should be studied; each will contribute to understanding.*
>
> *- F. J. Anscombe, 1973*

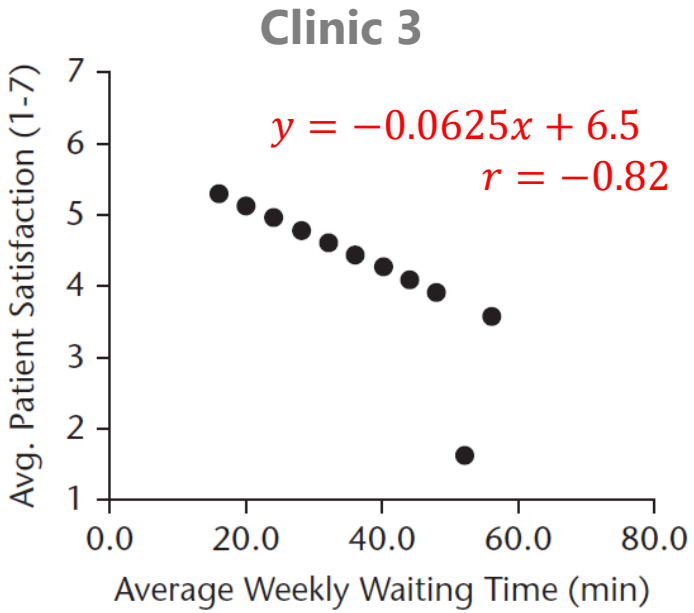
Anscombe, F. J., "Graphs in Statistical Analysis," *American Statistician* 1973, *27*, 17–21.

Thinking of making decisions without first displaying the data?

> *...make **both** calculations **and** graphs. Both sorts of output should be studied; each will contribute to understanding.*
>
> *- F. J. Anscombe, 1973*







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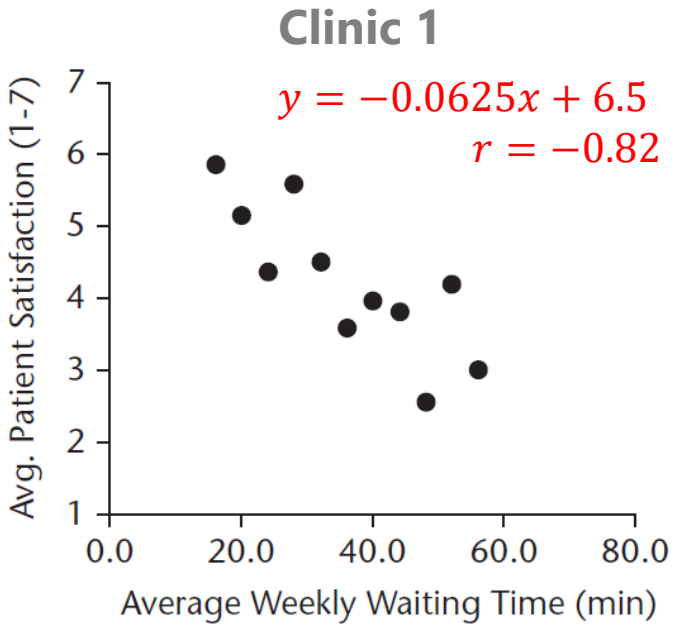
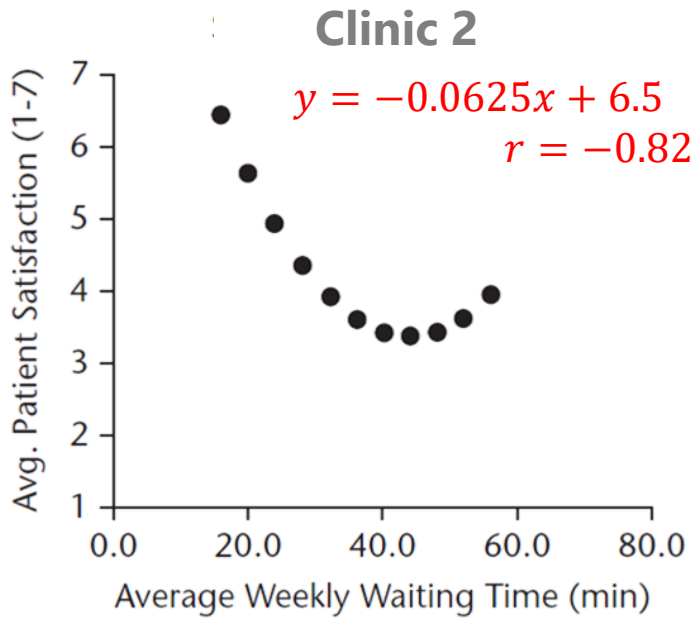
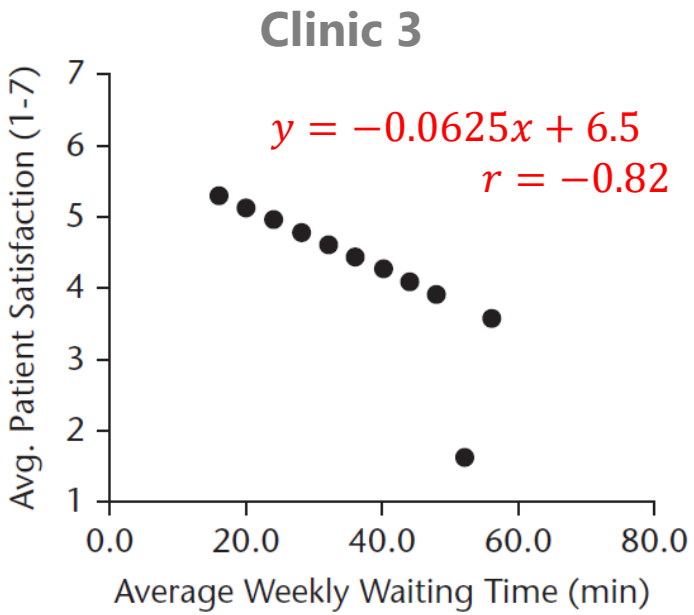
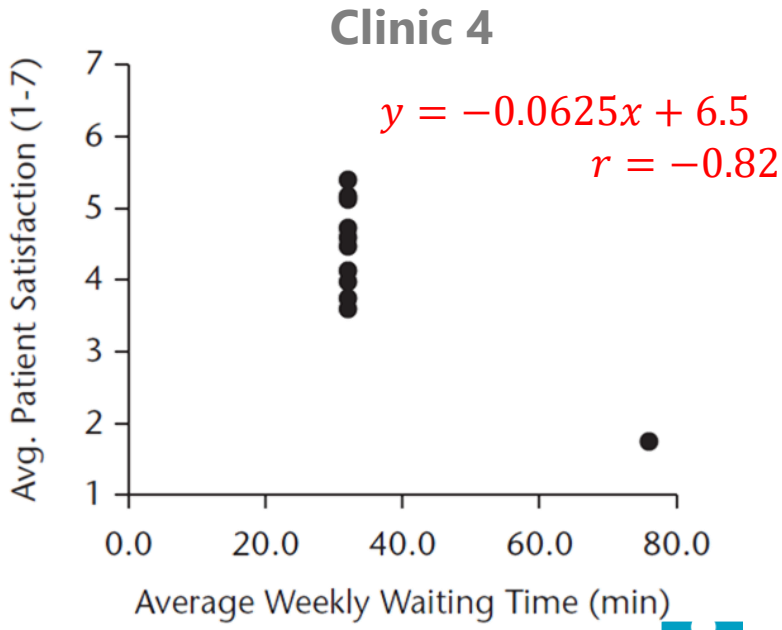






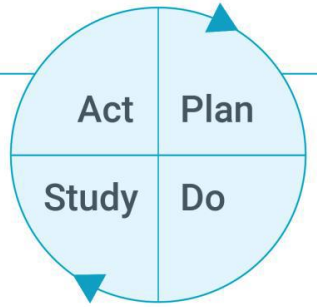


Anscombe, F. J., "Graphs in Statistical Analysis," *American Statistician* 1973, *27*, 17–21.

Making Successful Improvements

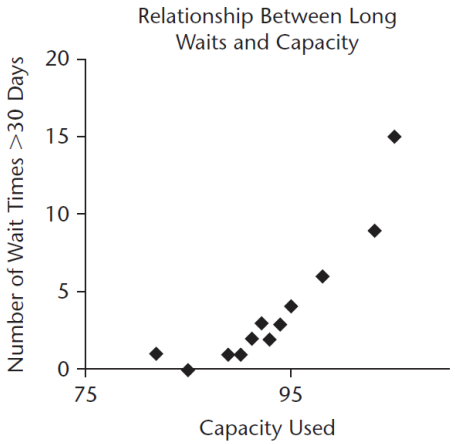
Model for Improvement

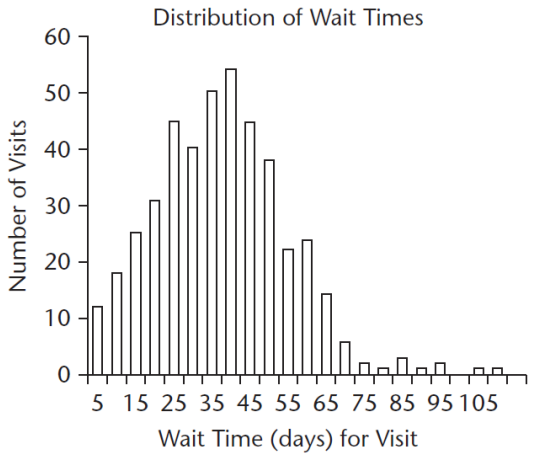
Aim	Measures	Changes
What are we trying to accomplish?	How will we know that a change is an improvement?	What change can we make that will result in improvement?

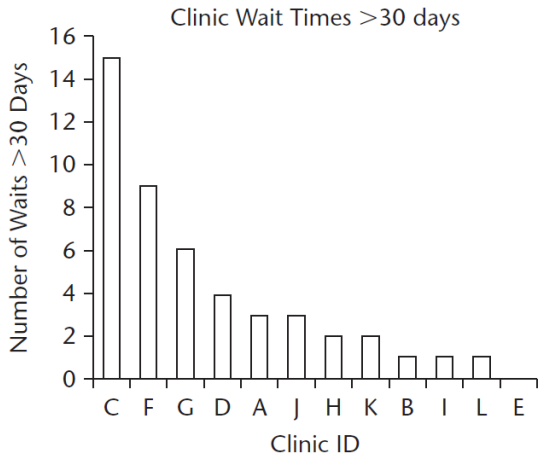


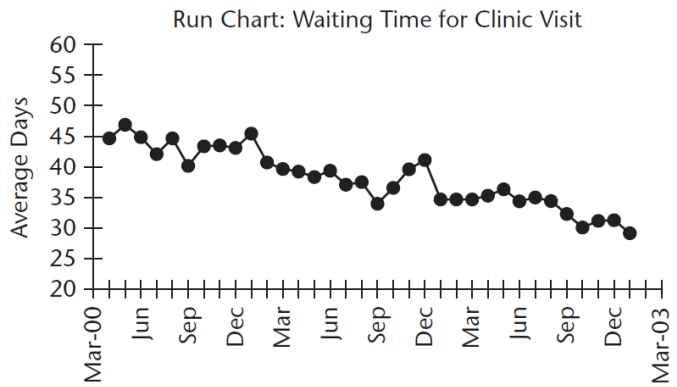
Source: Adapted from *The Improvement Guide* (2009)

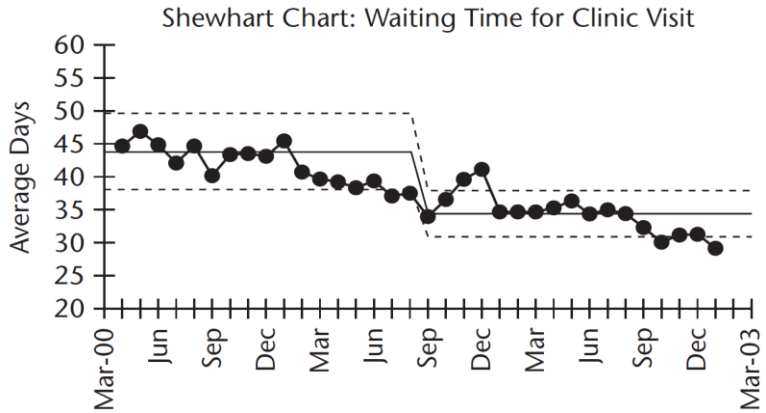
Tools to Learn from Variation in Data











HC Data Guide, p. 65, P. 136-146

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- Call 1 – 25th March 2025
- Call 2 – 1st April 2025
- Call 3 – 23rd April 2025
- Call 4 – 30th April 2025

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