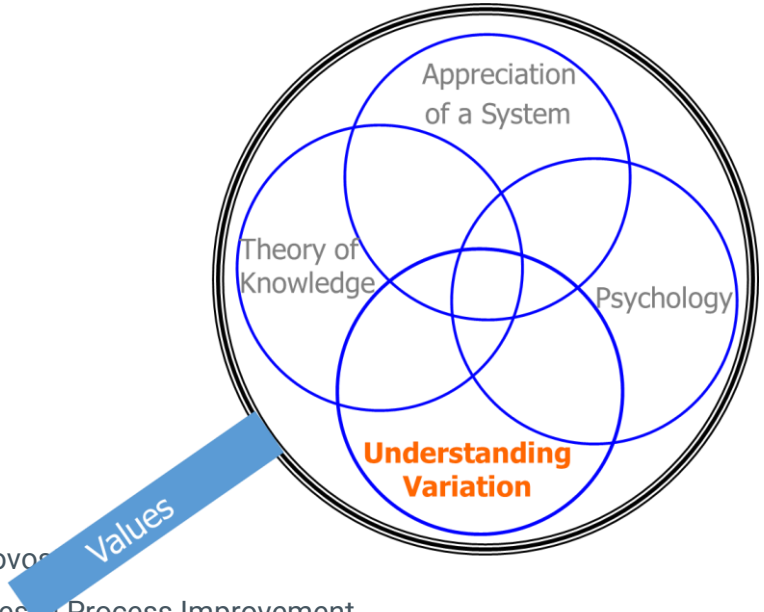
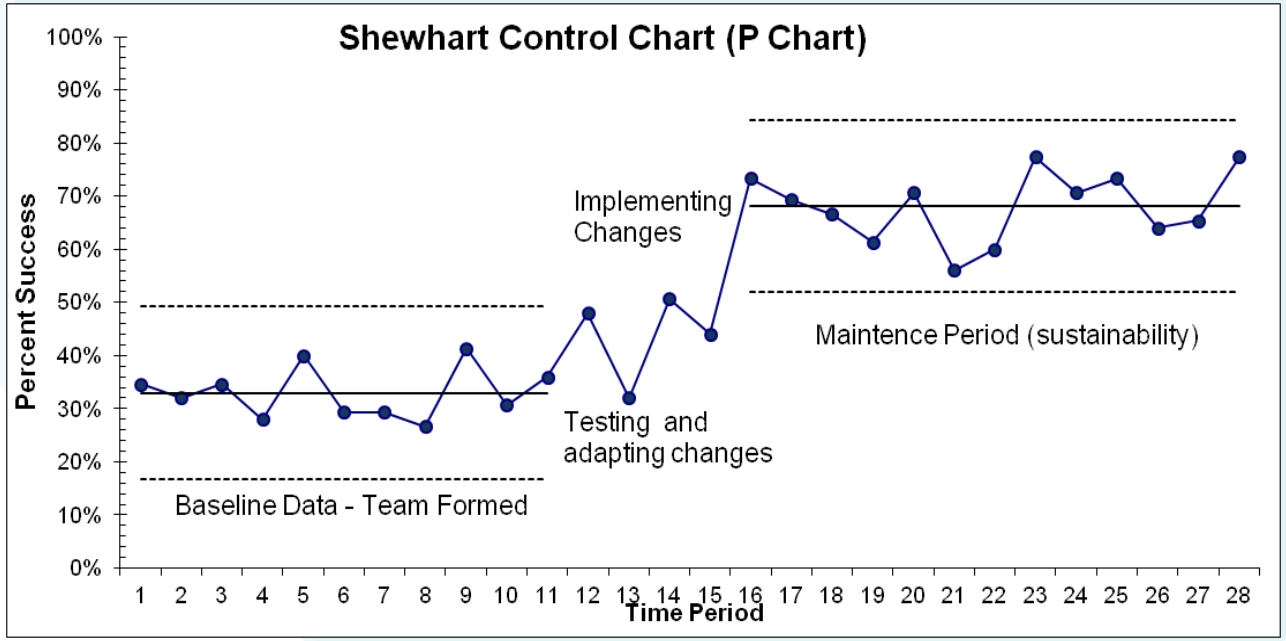
Institute *for* Healthcare Improvement

Judgement or Improvement?

Understanding variation





Lloyd Provost
Associates in Process Improvement
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Judgement or Improvement? Understanding variation

Data provides the insights to understand how systems are performing, develop improvement strategies, build energy to keep improvement efforts going, and evaluate the impact of the improvement work.

But often data are not presented in a way to promote the greatest understanding. This session will explore effective data analysis and graphical methods to present the story that you want to tell.

Australian Government
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Table 4: Participation in the National Bowel Cancer Screening Program, by Primary Health Network area

			2014–2015	
State/territory	PHN code	PHN name	Participated	Invited
NSW	PHN101	Central and Eastern Sydney	52,039	157,280
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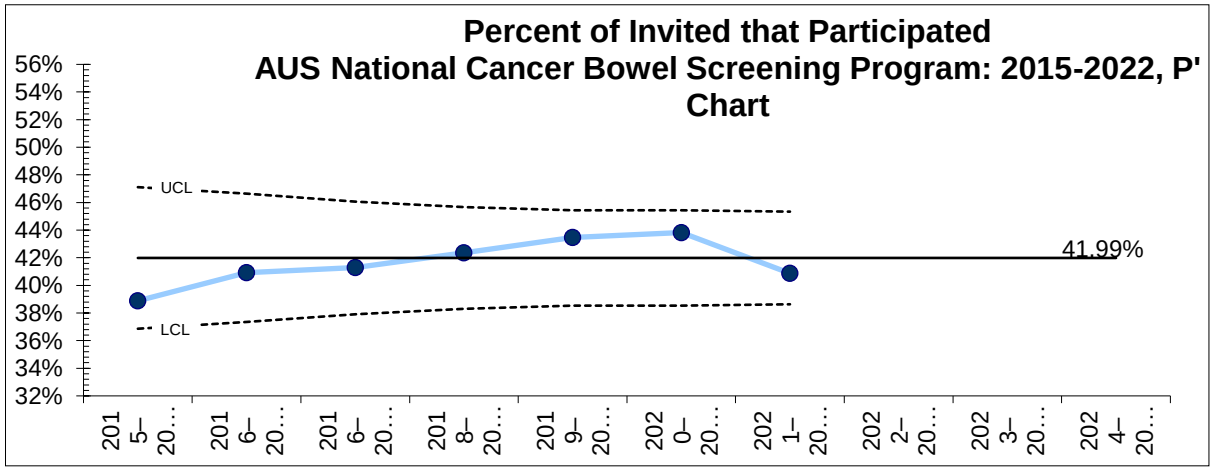
NSW	PHN103	Western Sydney	30,122	92,220
NSW	PHN104	Nepean Blue Mountains	14,430	42,331
NSW	PHN105	South Western Sydney	33,877	103,647
NSW	PHN106	South Eastern NSW	29,569	74,364
NSW	PHN107	Western NSW	12,443	34,380
NSW	PHN108	Hunter New England and Central Coast	56,464	146,725
NSW	PHN109	North Coast	27,751	70,087
NSW	PHN110	Murrumbidgee	10,365	27,588
Vic	PHN201	North Western Melbourne	54,838	149,429
Vic	PHN202	Eastern Melbourne	68,706	167,111



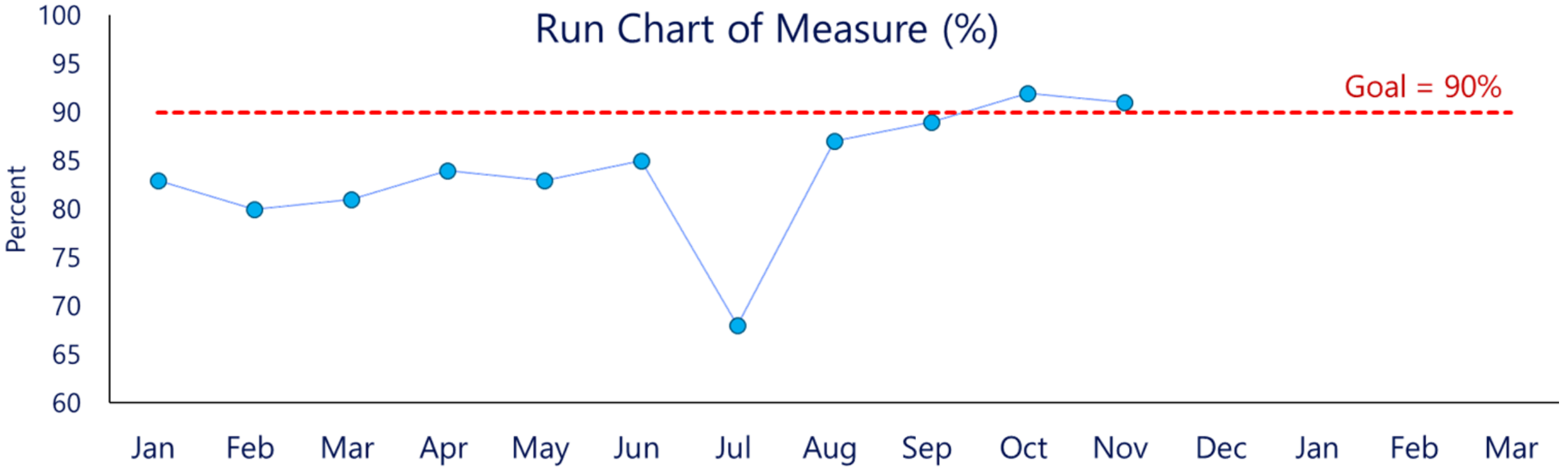
Session Objectives

- Describe Shewhart's theory of variation
- Identify data reports that should incorporate the use of Shewhart charts
- Commit to using Shewhart's method to promote **learning** and effective **decision-making** from data and reports

I hope to extend the application of Shewhart's methods presented in to data sets across a range of publically available sources used to assess conditions and make decisions based on them. The scale of these data sets makes the failure to understand and apply Shewhart's theory even more important than data from individual organisations.

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

Stages of Facing Reality: Reaction to Data

- “The data are wrong”
- “The data are right, but it’s not a problem”
- “The data are right; it is a problem; but it is not my problem.”
- “I accept the burden of improvement”

from *Escape Fire*, Don Berwick, (2002 Forum Speech), page 287-288

THE JOINT COMMISSION JOURNAL ON QUALITY IMPROVEMENT

MARCH 1997 VOLUME 23 NUMBER 3

LEIF I. SOLBERG, MD
GORDON MOSSER, MD
SHARON MCDONALD, RN, PHD

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	Judgment or Accountability	Clinical Research
Aim	Improvement of care delivery process, system, and outcomes	Judgment, choice, reassurance, spur for change	New generalizable knowledge
Test observability	Test observable	No test, evaluate current performance	Test blinded
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 and relevant data	"Just in case" data
Flexibility of hypothesis	Hypothesis flexible; changes as learning takes place	No hypothesis	Fixed hypothesis
Testing strategy	Sequential tests	No tests	One large test
Determining if change is improvement	Run charts or Shewhart charts	No focus on change. May monitor with time series charts.	Hypothesis tests (T-tests, F-tests, Chi-square), p-value
Confidentiality of data	Data used only by those involved in the improvement	Data available for public consumption	Research subjects' identities protected
Frequency of Data Feedback to User	Daily, weekly, monthly	Quarterly, semi-annually, annually	At end of research project

Table 2.1, HC Data Guide, p. 29

Are We Working with Data for Accountability?

Tip-Offs that we are working with accountability data:

- Data not viewed over time
- Data expressed as a percentile
- A measure that yields nearly all 0s or all 100%
- Case-mix adjusted or indexed data

Difference between measurement for judgment and improvement is important to consider when developing measures for your improvement project

Figure 2.2: Measurement for Accountability Vs. Improvement

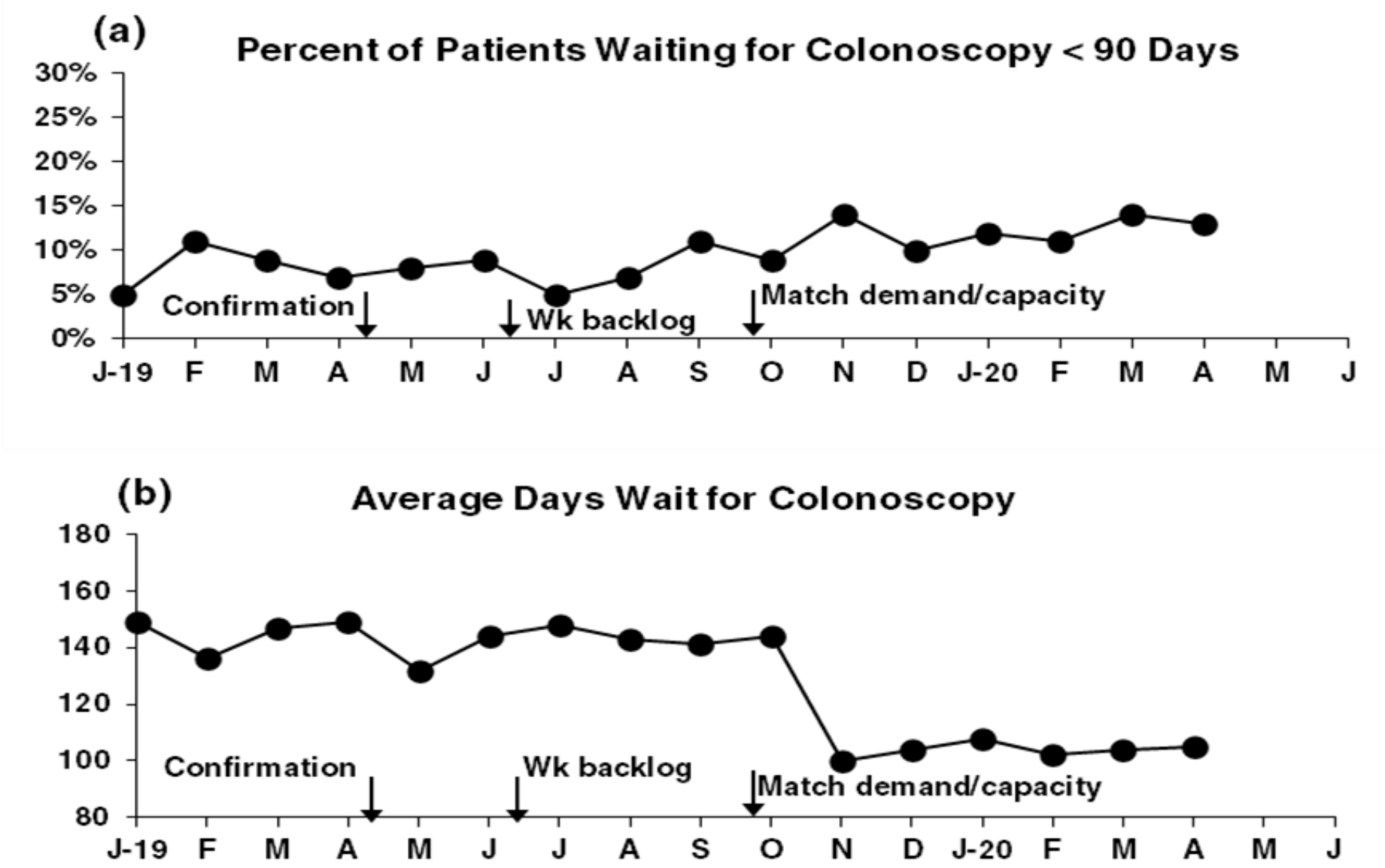


Figure 2.3: Moving from Judgement to Improvement Measures

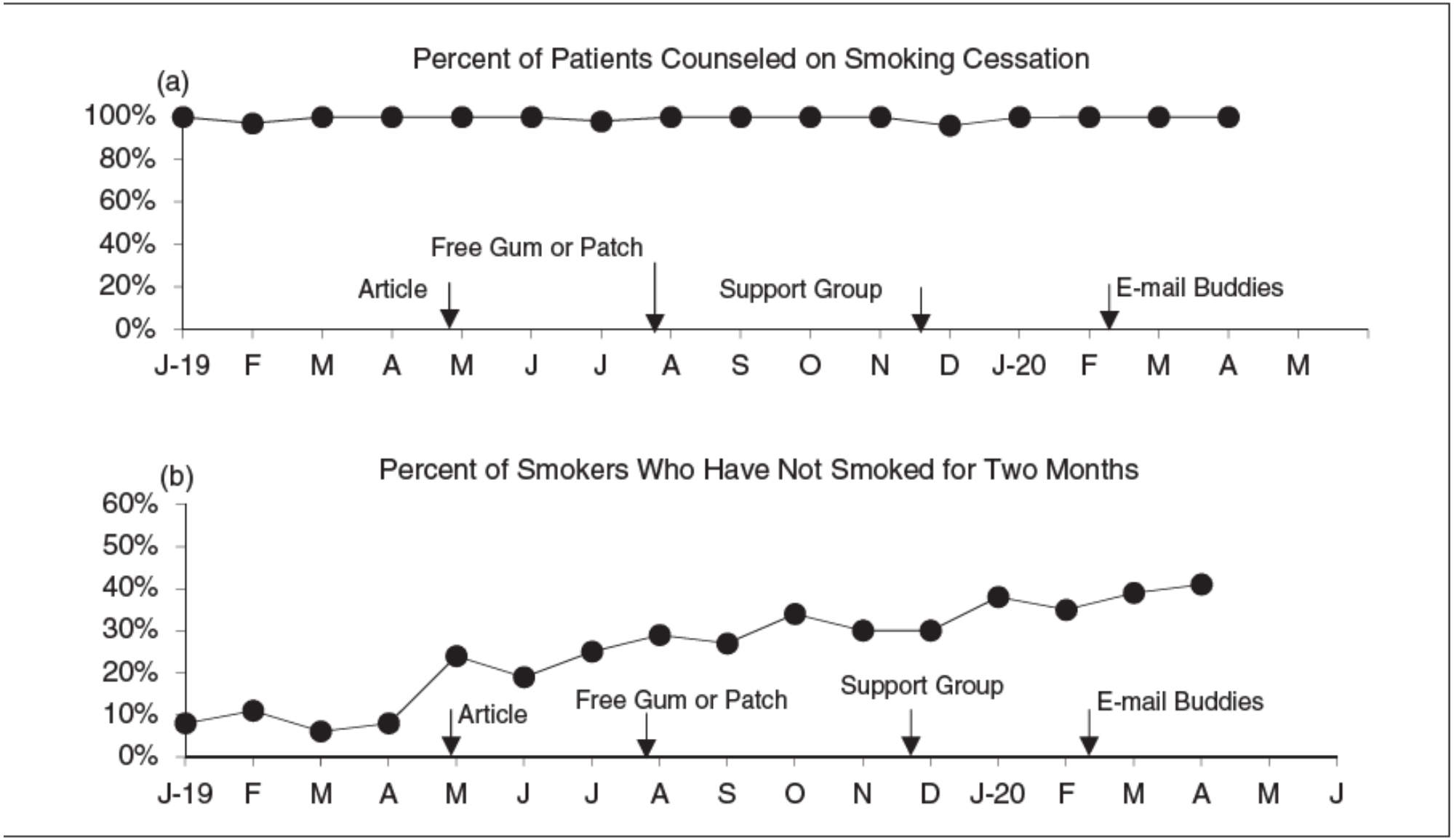
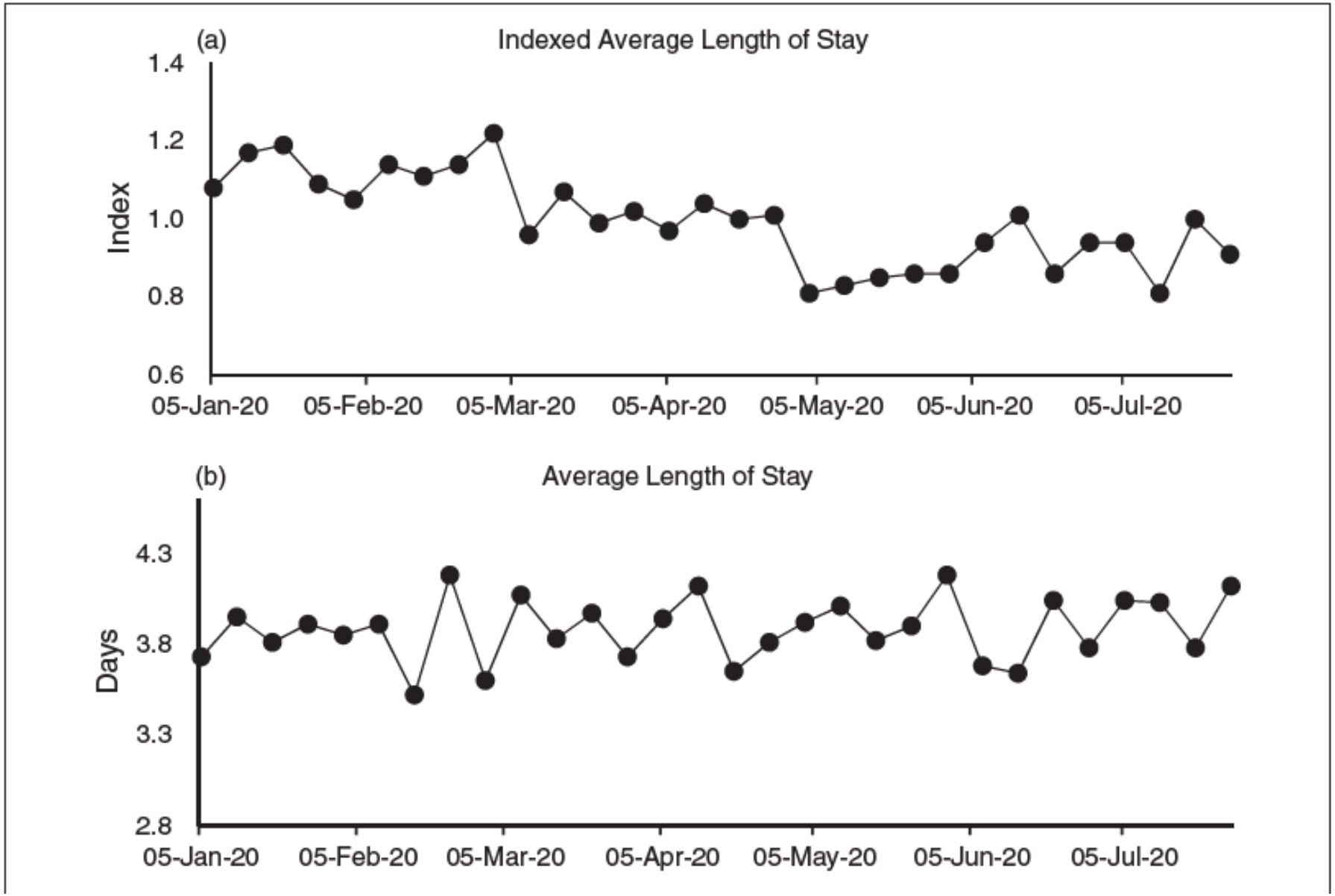


FIGURE 2.5 Measure Based on an Index Instead of Actual Units



Manager: "congratulations on the nice decrease in LOS.

Team's actual LOS data (they had not started improvement work yet)

the index is useful for comparison or judgment, but, in improvement work, it should not replace the actual measurement of LOS.

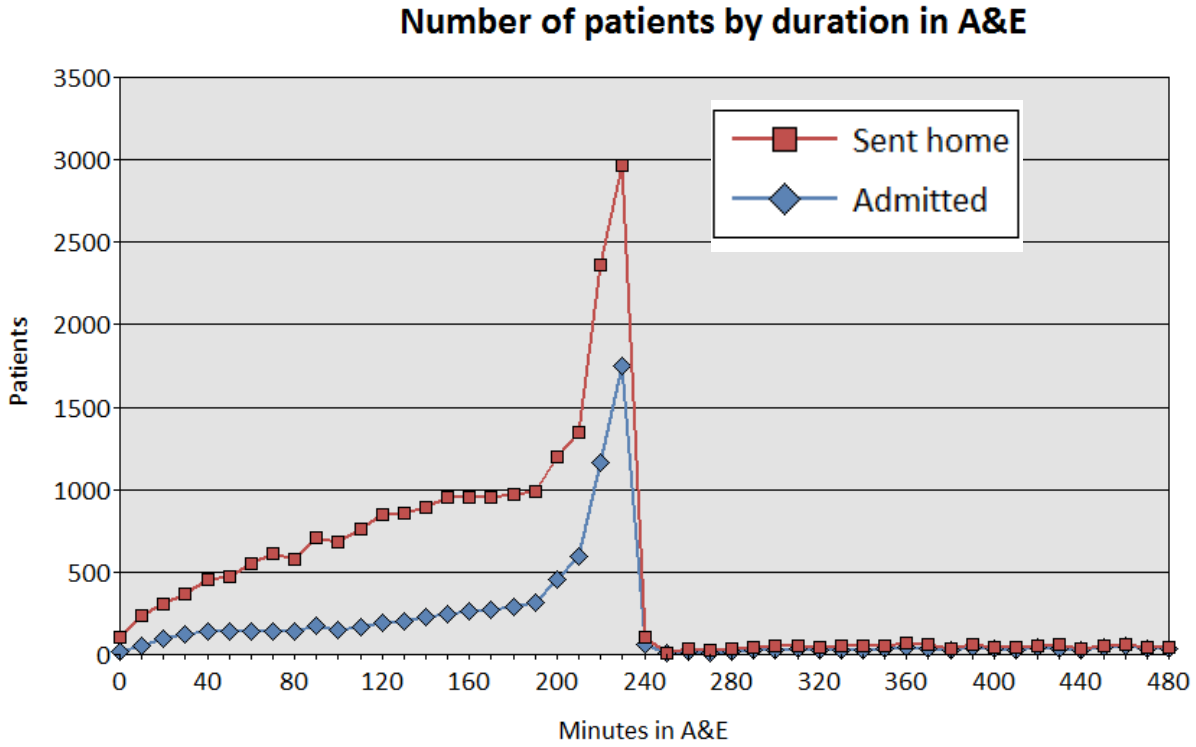
Setting Goals and Targets for Measures

- Be very careful in setting a target until **the capability of the system** is understood.
- Need to have **stable systems** (eliminate unnatural variation) before determining capability.
- **Goodhart's Rule:** "When a measure becomes a target, it ceases to be a good measure." Charles Goodhart (1975).
- **From W. E. Deming's 14 points:**

#10. Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the work force.

NHS 4-hour A&E Target

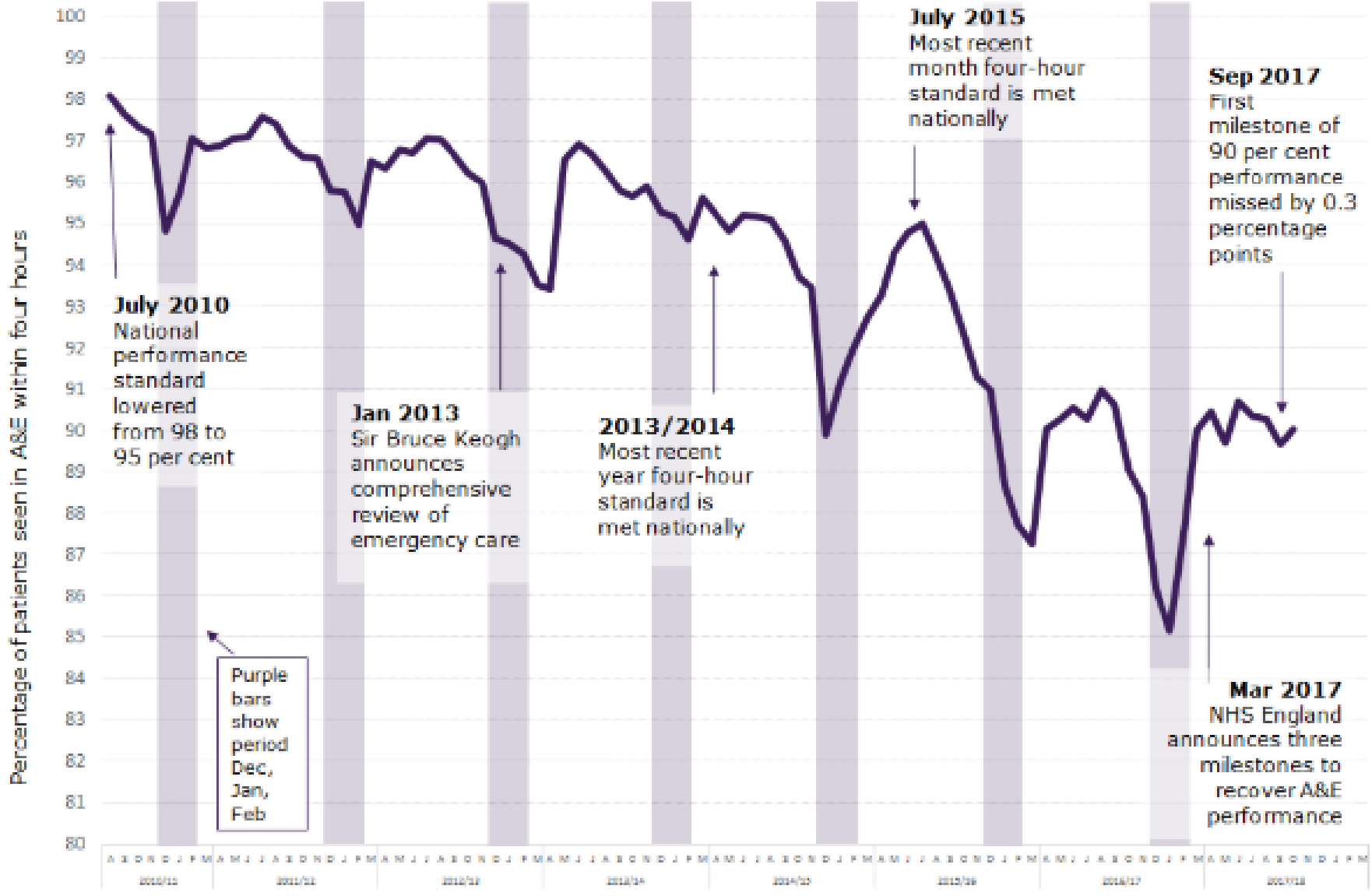
Nationally, hospital A&E departments are measured on 95% compliance with the "4 hour target".



- **What does the target mean for patients?** Frequency distribution of recorded arrival to discharge or admission shows powerful effect at 230 minutes.
- Evidence shows many decisions are made close to 4 hours.
- Only one hospital in England shows no evidence of distortion or fear in A&E figures near 4 hour target. Performance is lowest decile on % inside 4 hour target at 86%, vs pass rate of 95%.

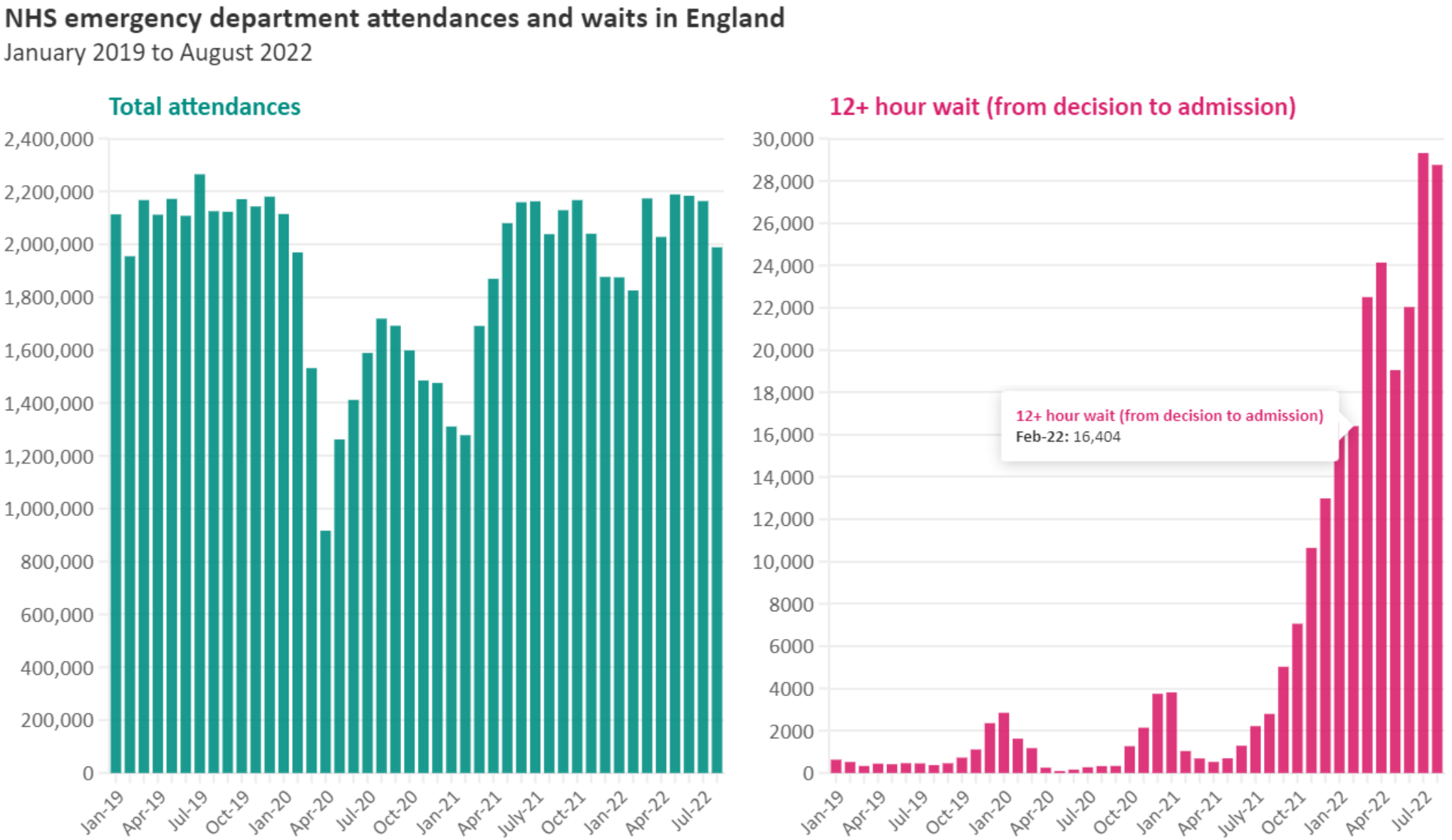
How has the system performed since setting the 4-hour standard?

Figure 2: Performance against the four-hour standard, all types of A&E, by month, England



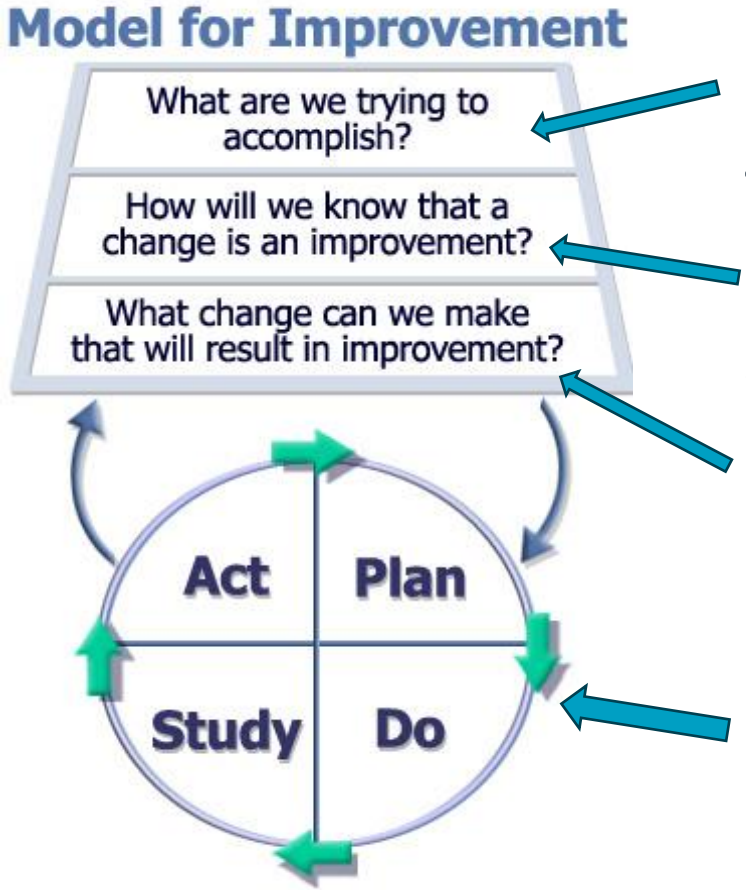
Source: [A&E Attendances and Emergency Admissions 2017-18](#).

Recent Reports (less focus on 4-hour target



Source: NHS England A&E Attendances and Emergency Admissions statistics

Using Data for Improvement



- Using outcome measures to assess progress towards the project's aim
- Using process and 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

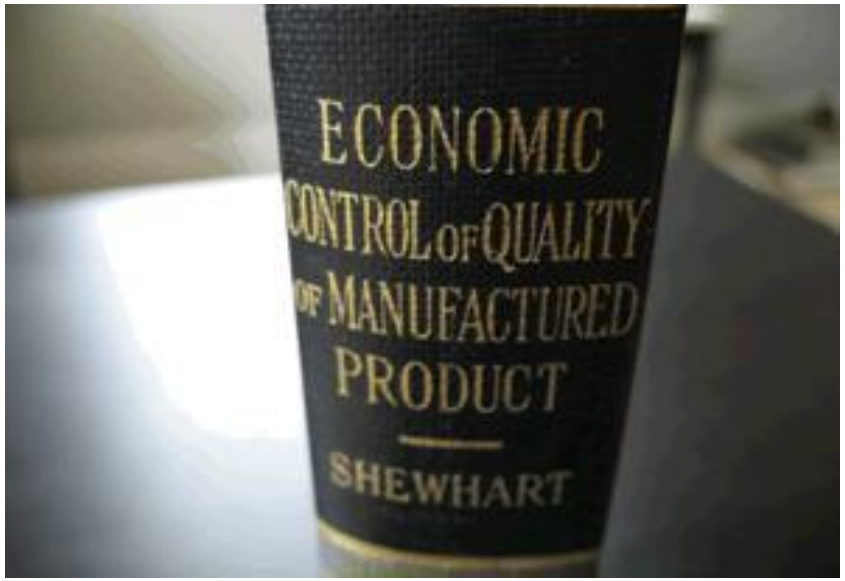
HC Data Guide, p 25

Walter Shewhart, 1931, E*conomic Control of Quality of Manufactured Product*

Theory of Common and Special Causes of Variation

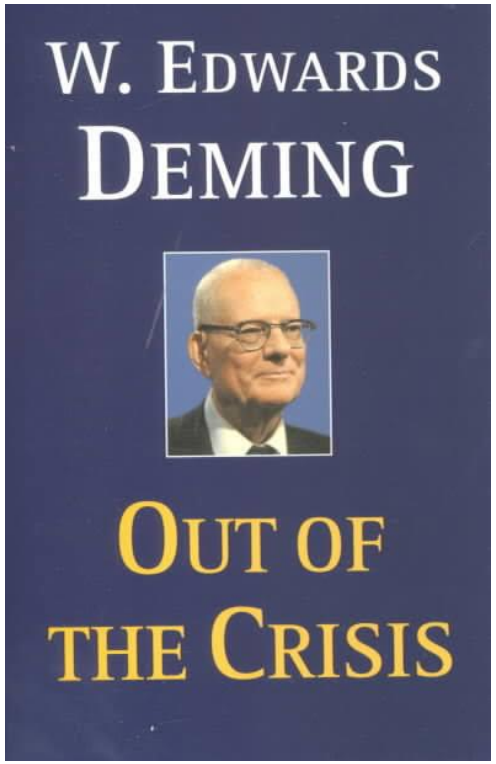
Application of Control Charts to Manufacturing

“We are sold on the idea of applying scientific principles. However, a change is coming about in the principles themselves and this change gives us a new concept of control.”



W. E. Deming, *Out of the Crisis*, 1986 (and other publications)

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



CHAPTER 11: Common Causes and Special Causes of Improvement. Stable System.

The central problem in management and in leadership, in the words of my colleague Lloyd S. Nelson, is failure to understand the information in variation. (p. 309)

Only information from a stable system tells us about the process.

94% of variation belongs to the system (management's responsibility). 6% is special or unique to individuals.

No amount of care or skill in workmanship can overcome fundamental faults in the system. (p. 315)

Adjustments based on variations within a stable system augment the problems.

T. Nolan and L. Provost, 1990, *Understanding Variation*, ASQ Quality Progress

Examined how Walter Shewhart's theory of variation could be used in decision making by individuals and organisations in non-manufacturing situations. The paper included examples of the economic and psychological losses associated with inappropriate reaction to variation in data.

Figure 7. Control charts for sales figures.

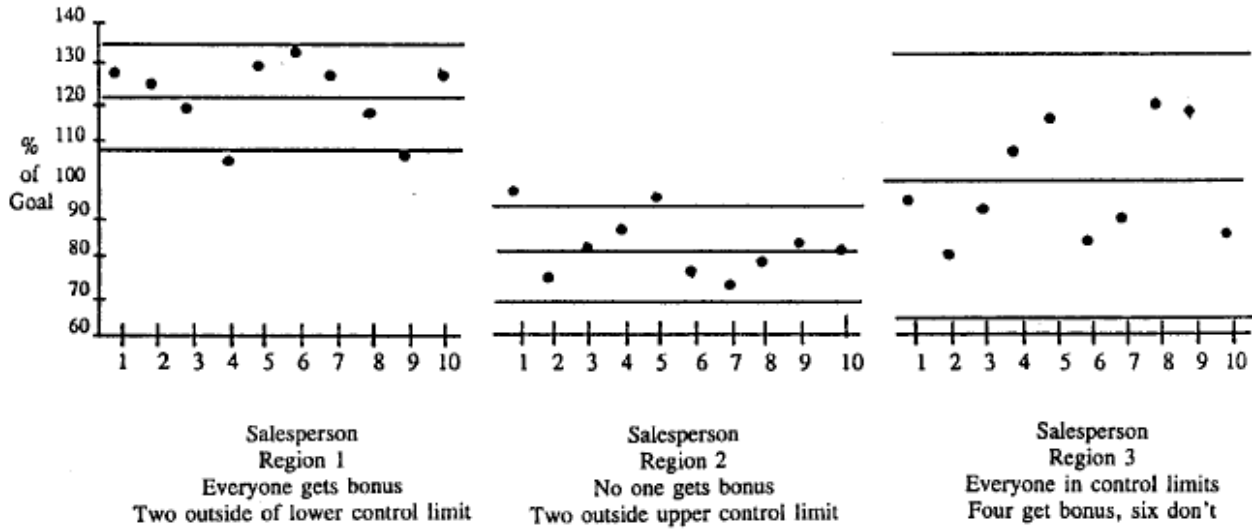
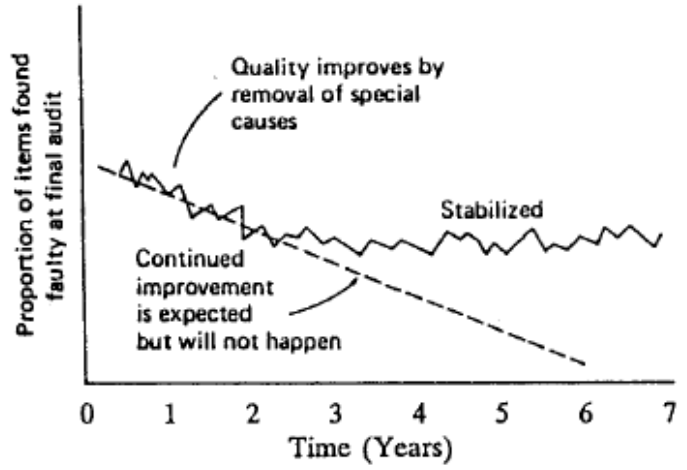
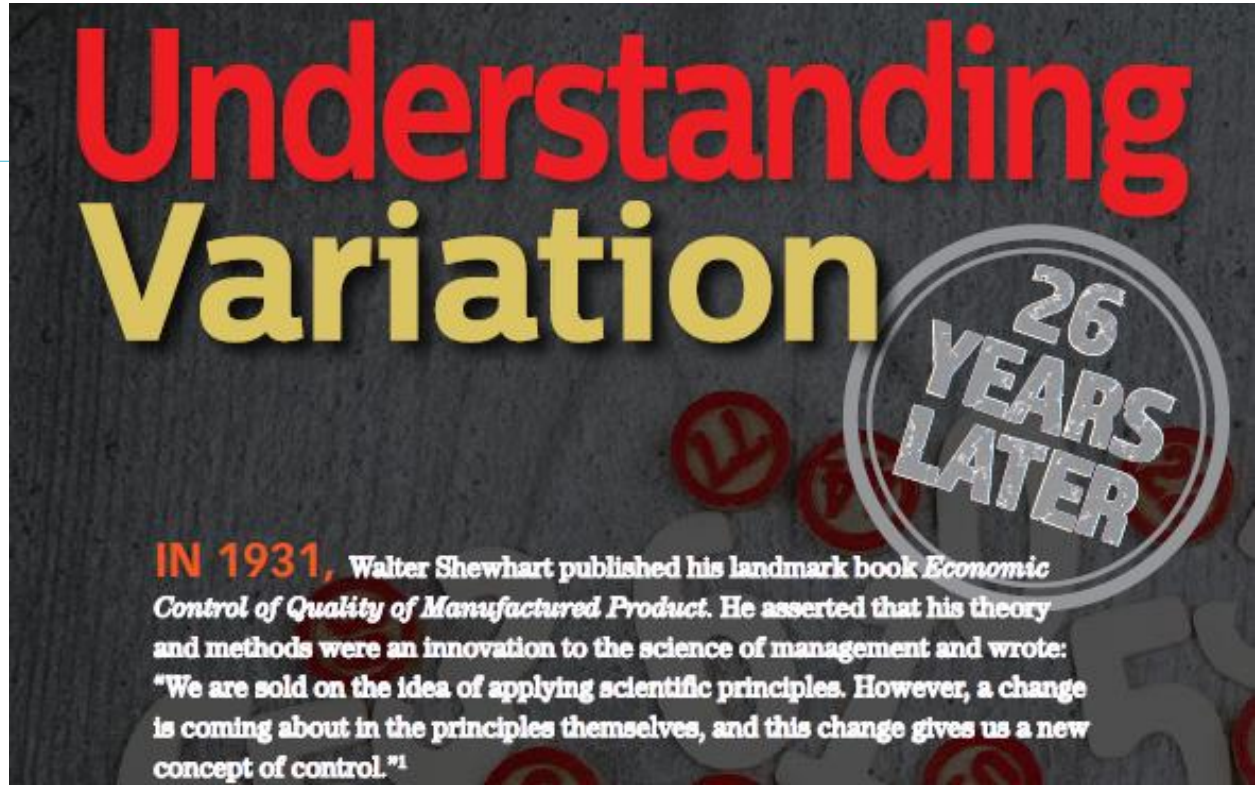


Figure 8. Typical path of frustration.



Used with permission of W. Edwards Deming.

November, 2016 Issue of ASQ *Quality Progress*



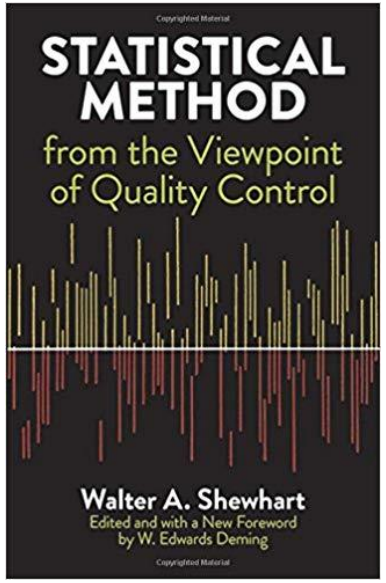
We want to extend the application of Shewhart's methods presented in our 1990 article to data sets across a range of publicly available sources—sources that are used by and the basis for the U.S. government and other organisations to assess conditions and make decisions.

In 50 Words Or Less

- Decisions made without knowledge of common and special causes often lead to increased variation, poor performance and misattributed credit or blame.
- Extending the application of Walter Shewhart's approach to variation to datasets across a range of publicly available sources is an opportunity to improve decision making and learning from reported data.

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

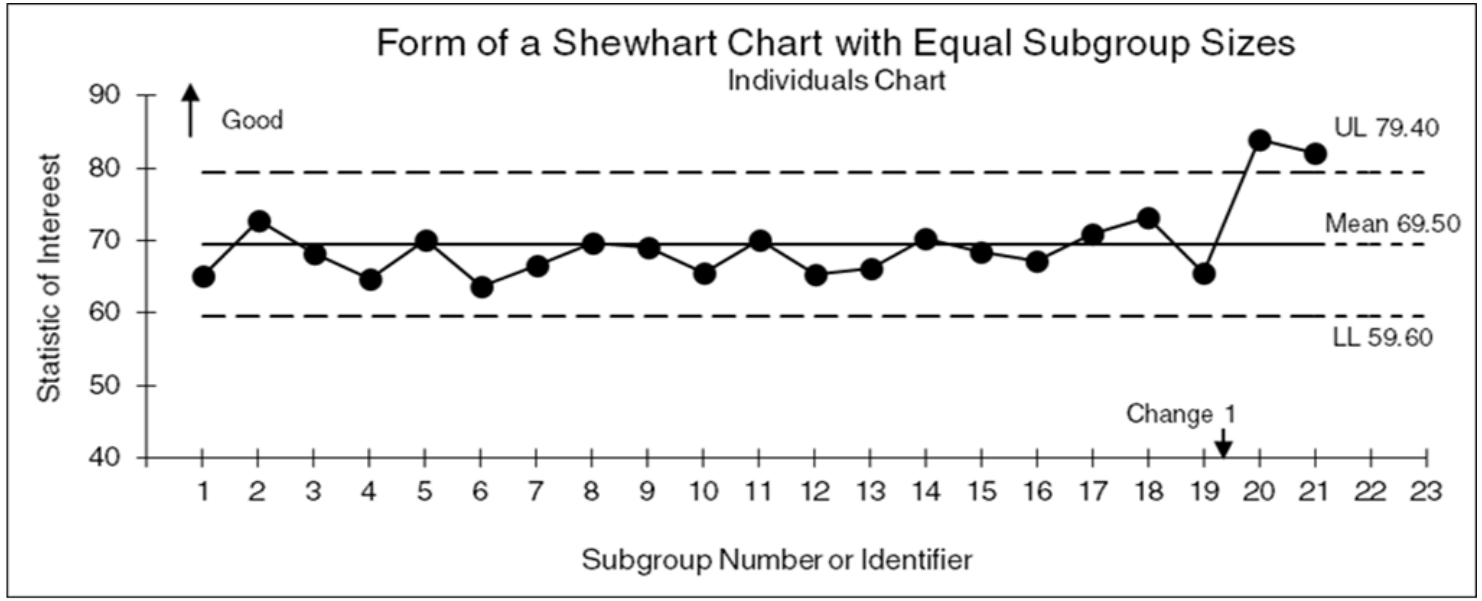
Common Causes are inherent in the system over time, affecting everyone working in the system and all system outcomes.

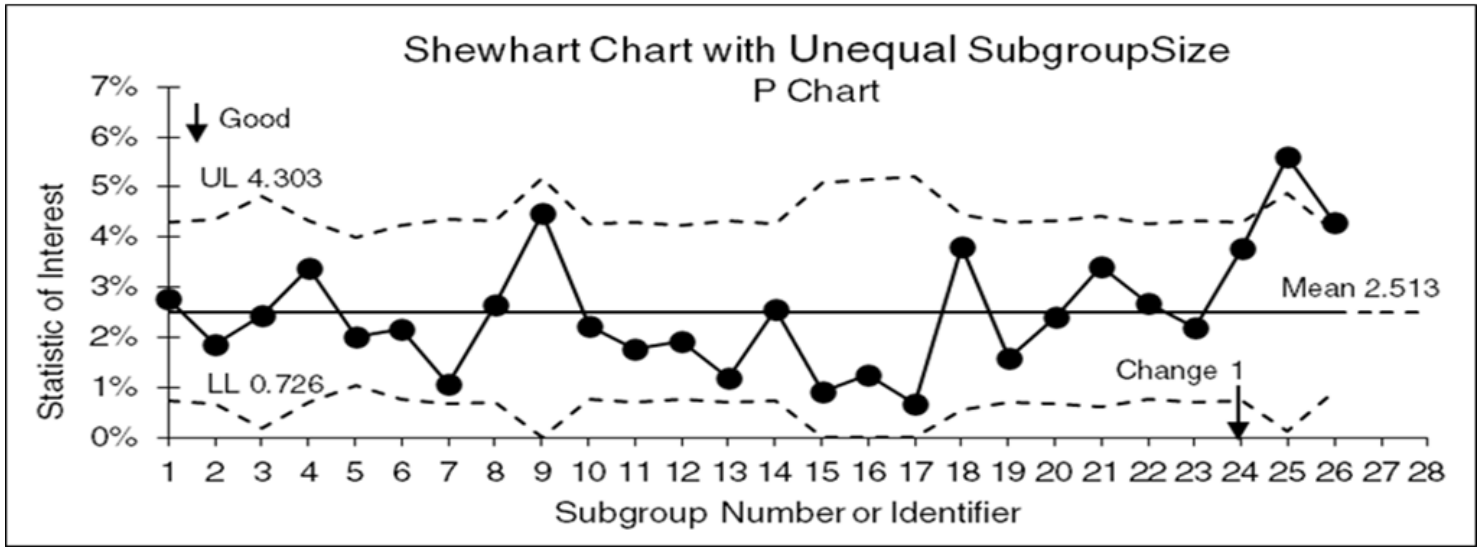
Special Causes are not part of the regular system but arise because of particular circumstances or some "special" source of variation that can be assigned to some identifiable cause

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

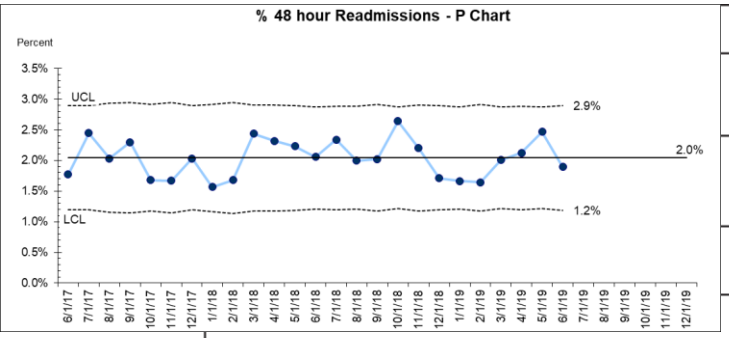


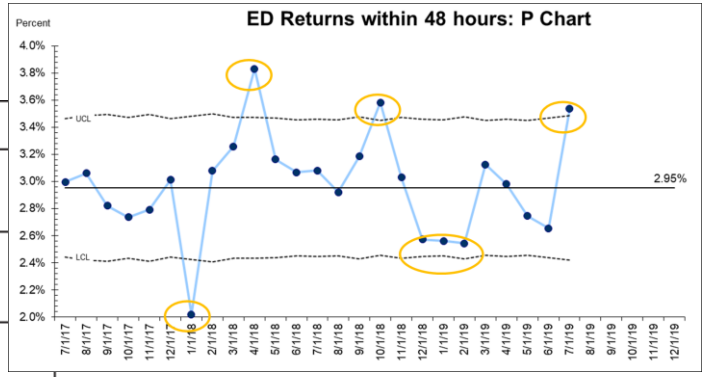


(Most common name is a control chart, more descriptive is learning charts or system performance charts)

HC Data Guide, p. 130-131

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

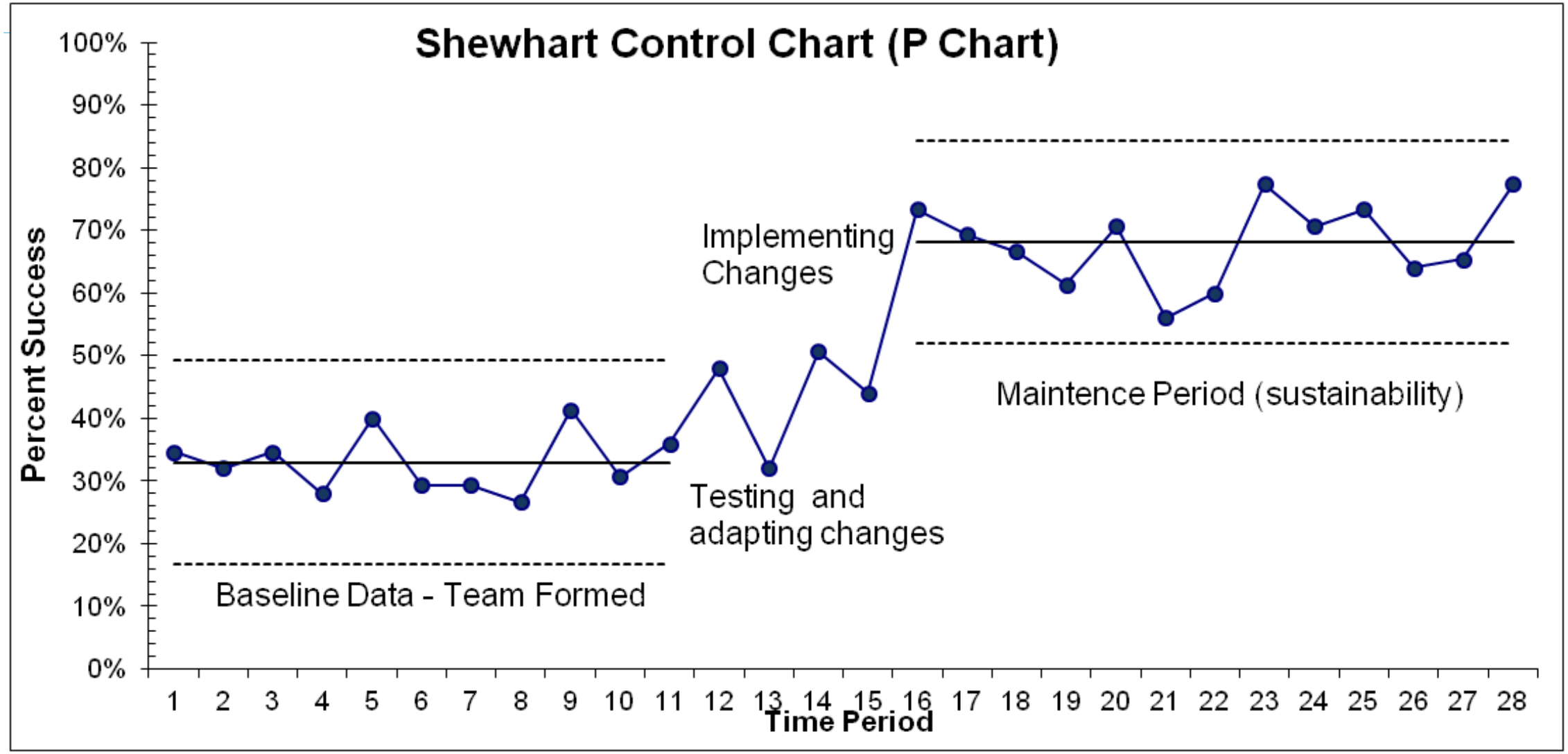
Learrn from and Act on Special Cause(s)

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

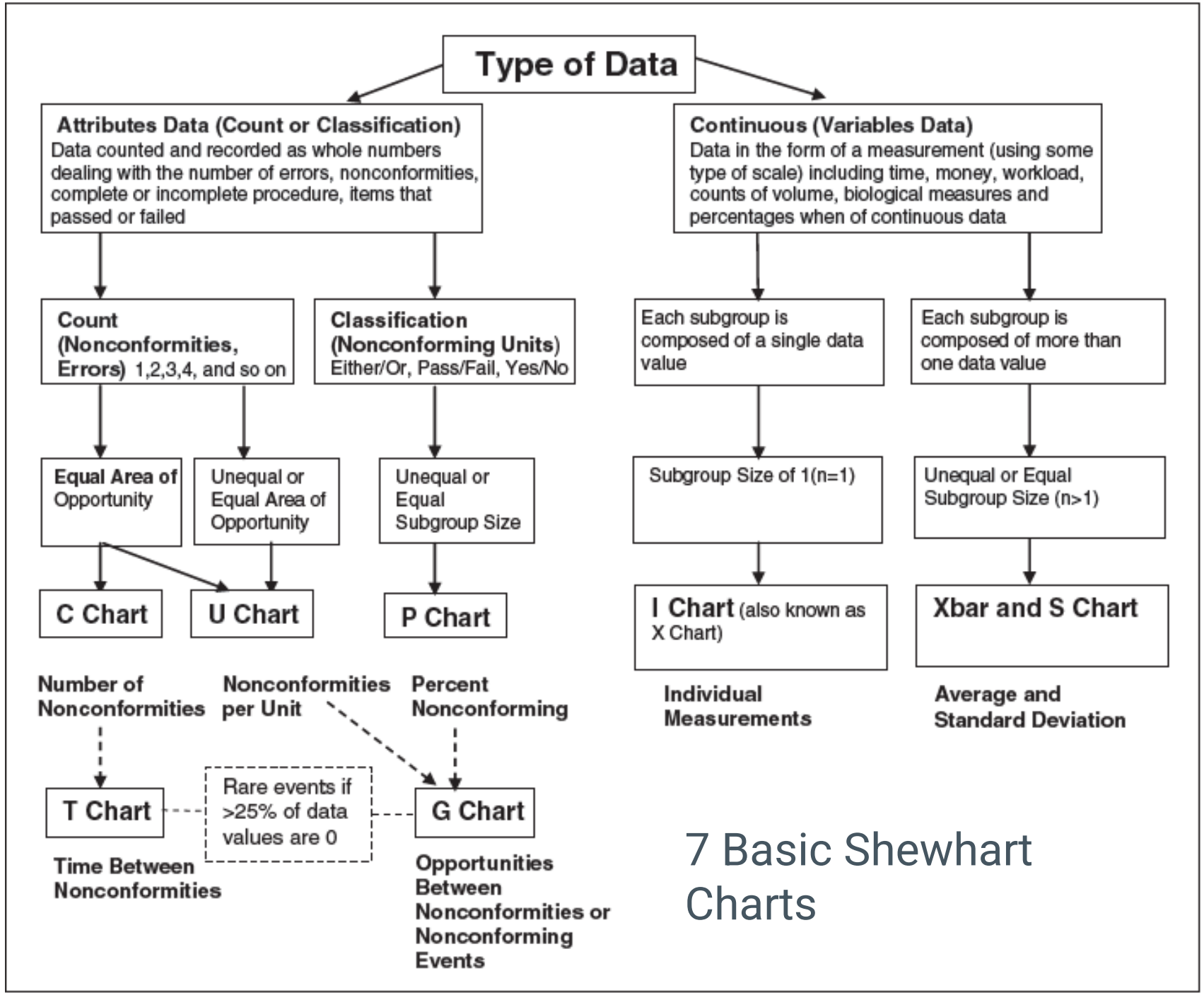
Updating Limits after Improvements



Shewhart Chart Selection Guide

Which chart should I use for my measure?

What kind of data do I have?



7 Basic Shewhart Charts

HC Data Guide p. 163

Background

In Health Care Systems around the world, we see:

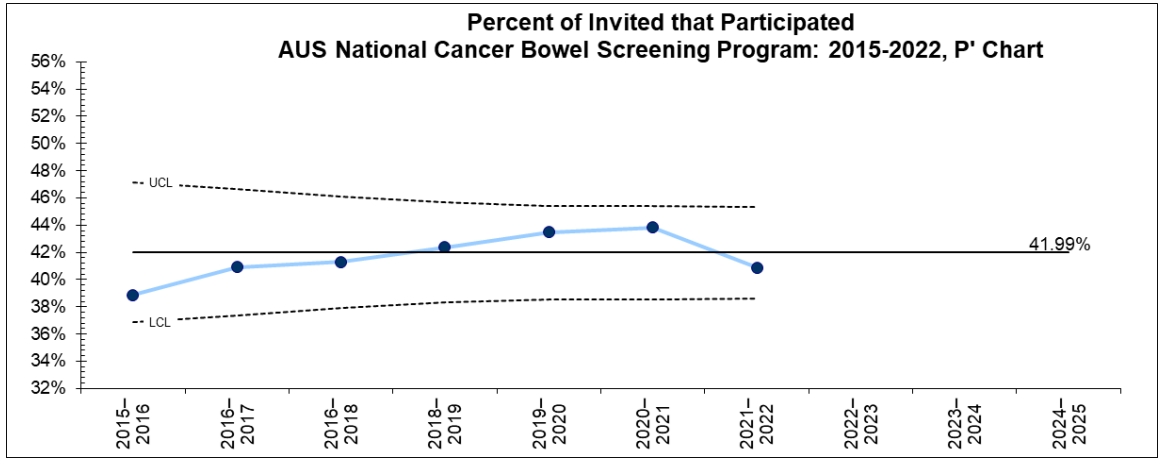
- Massive increases in publicly available data and data repositories
- Desire to use data to make good decisions and identify trends and patterns
- Public would like to know if interventions and policies are having their intended impact.

Australian Government
Australian Institute of Health and Welfare

AIHW

Click to return to TOC

Table 4: Participation in the National Bowel Cancer Screening Program, by Primary Health Network



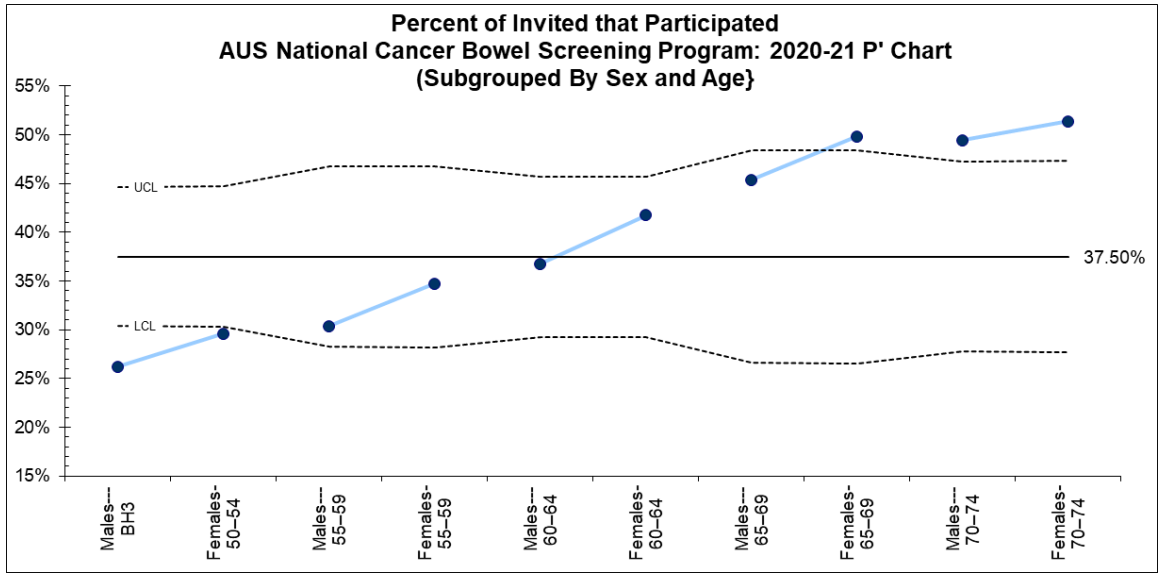
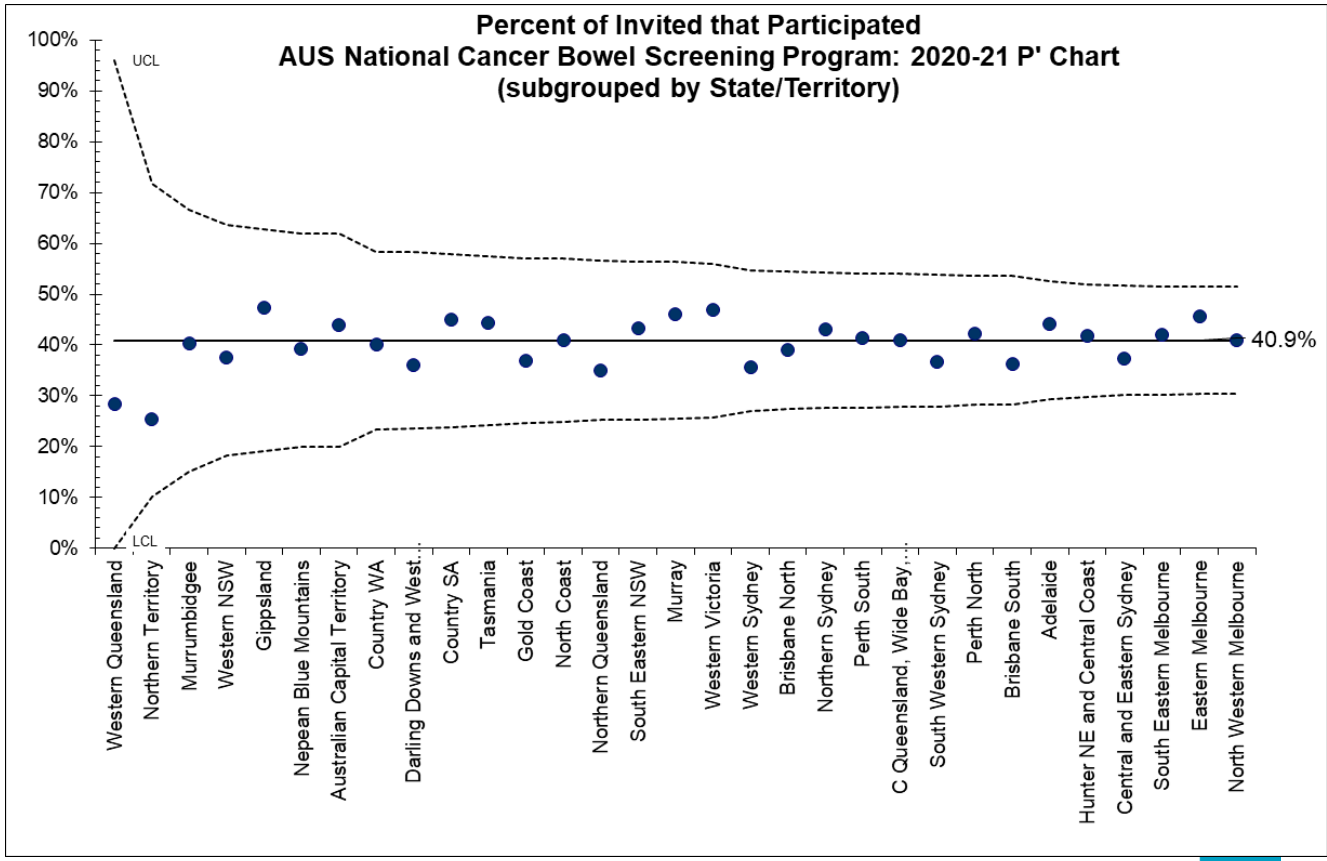


Table 4: Participation in the National Bowel Cancer Screening Program, by Primary Health Network area, people aged 50–74, 2014–2015 to 2020–2021

			2014–2015			2015–2016	
State/territory	PHN code	PHN name	Participated	Invited	Participation (%)	Participated	Invited
NSW	PHN101	Central and Eastern Sydney	52,039	157,280	33.1	64,863	186,508
NSW	PHN102	Northern Sydney	39,723	103,788	38.3	49,568	123,424
NSW	PHN103	Western Sydney	30,122	92,220	32.7	37,526	109,418
NSW	PHN104	Nepean Blue Mountains	14,430	42,331	34.1	18,077	49,414
NSW	PHN105	South Western Sydney	33,877	103,647	32.7	41,807	122,019
NSW	PHN106	South Eastern NSW	29,569	74,364	39.8	38,472	91,471
NSW	PHN107	Western NSW	12,443	34,380	36.2	16,633	43,264
NSW	PHN108	Hunter New England and Central Coast	56,464	146,725	38.5	74,962	181,236
NSW	PHN109	North Coast	27,751	70,087	39.6	36,056	85,942
NSW	PHN110	Murrumbidgee	10,365	27,588	37.6	13,980	34,607
Vic	PHN201	North Western Melbourne	54,838	149,429	36.7	69,028	180,693
Vic	PHN202	Eastern Melbourne	68,706	167,111	41.1	87,394	202,167



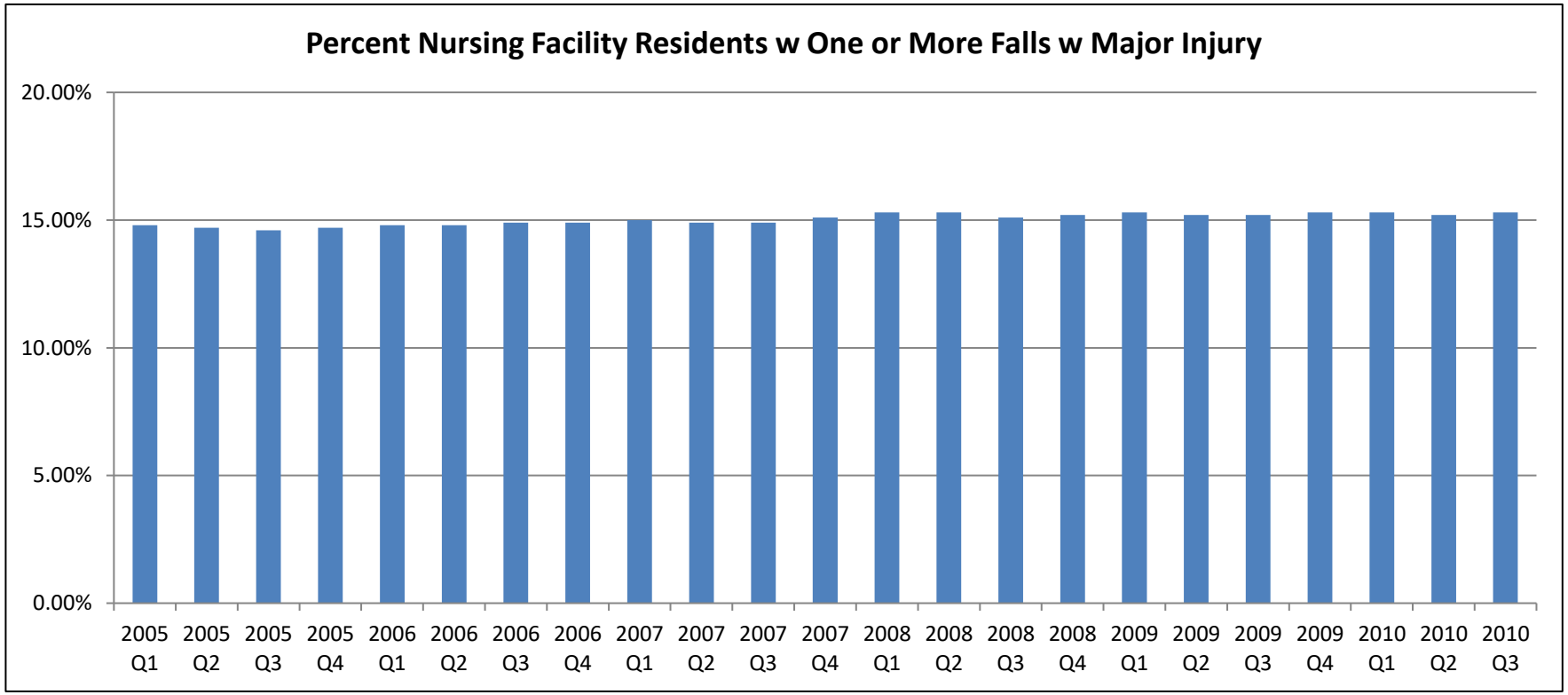
Case: Assistant Secretary for Planning & Evaluation: Health System Measurement Project

- Publically available (Open Source)
- Tracks gov't data on critical U.S. health system indicators
- Presents national trend data in different formats
- 10 main categories

HHS's Office of the Assistant Secretary for Planning and Evaluation has developed the Health System Measurement Project to ensure a robust monitoring system through which people inside and outside government can **assess how the system is doing and identify areas that need improvement**.

Quality Category

Measure: Percentage of NH residents experiencing one or more falls with major injury in the past 30 days – *CMS Minimum Data Set*

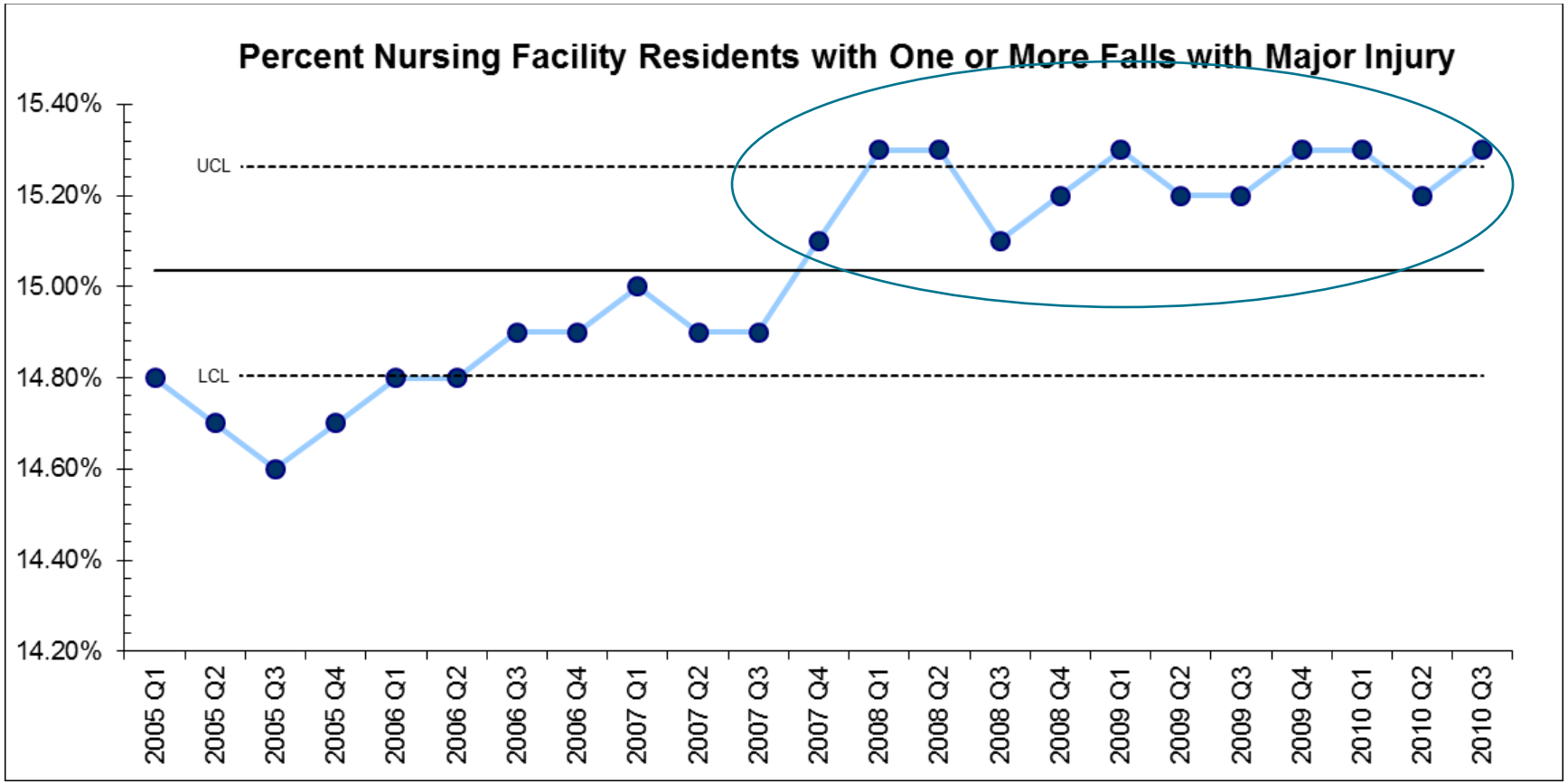


Question: Are we getting better or worse?

"When taking this scale of scored values into account…it is easy to see that they are not changing very much from quarter to quarter." *Final Analytic Report as summarised for CMS*

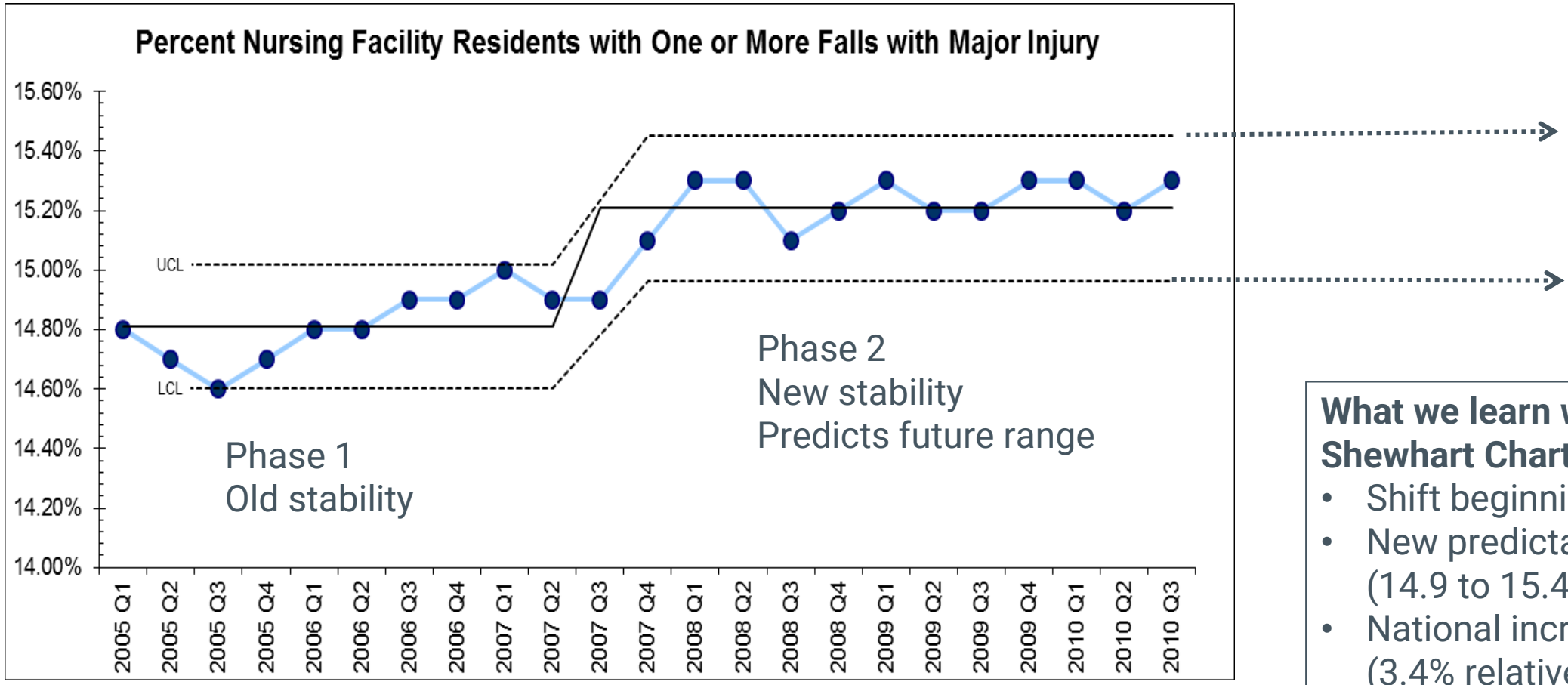
Shewhart I chart - with shift detected

data points below and above limits, ≥ 8 points below and above center line



Process is not stable and has fundamentally changed in a negative direction. We can now separate pre and post shift phase.

I Chart with Phase Separation



What we learn with Shewhart Chart:

- Shift beginning 2007 Q4
- New predictable range (14.9 to 15.4%)
- National increase 0.5% (3.4% relative increase)
- 9 additional annual deaths in Phase 2

What might explain this shift, what can we learn?

Case: Centers for Disease Control and Prevention: Infant Mortality

- Publically available (Open Source)
- Tracks infant mortality in U.S. over time
- Presents national trend data in different formats
- Includes annual breakdown by state

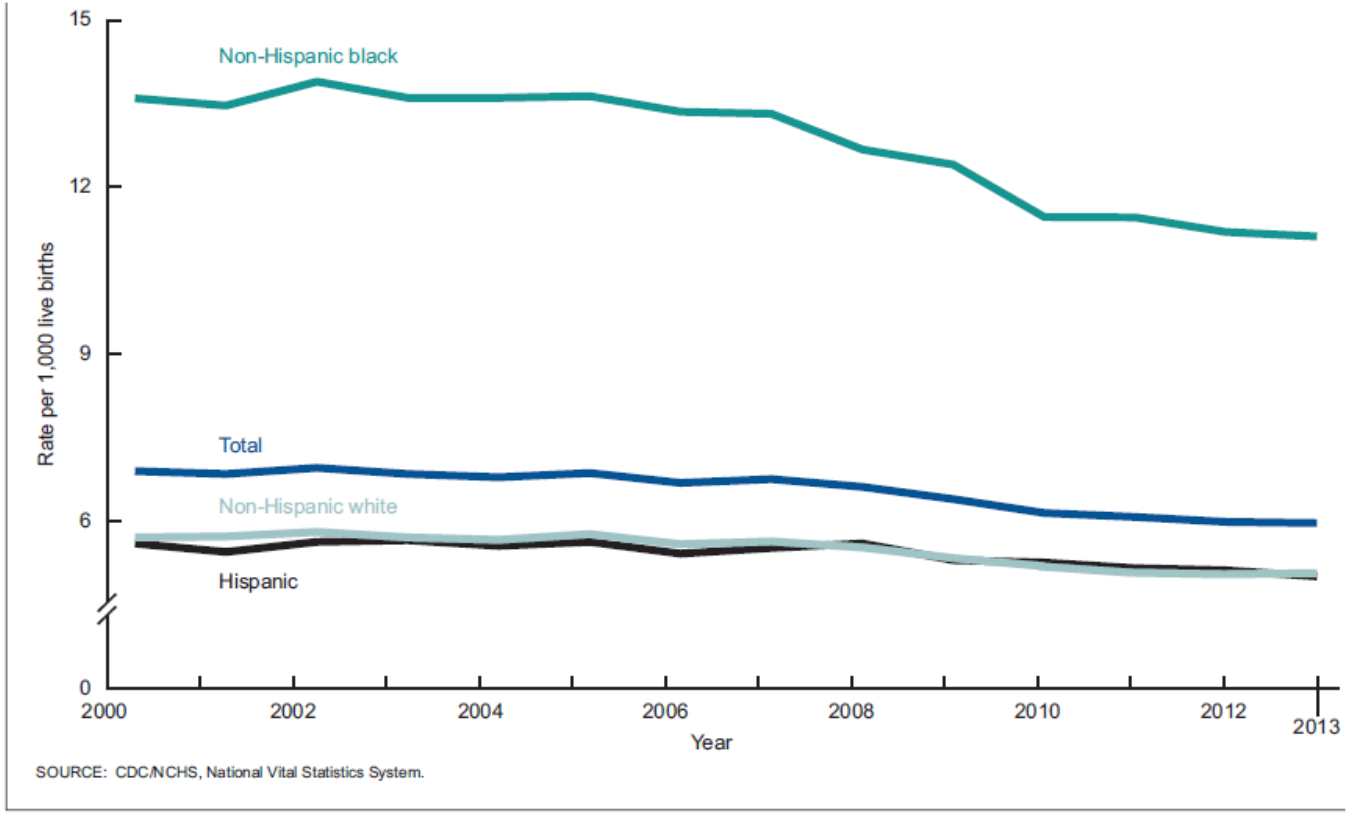
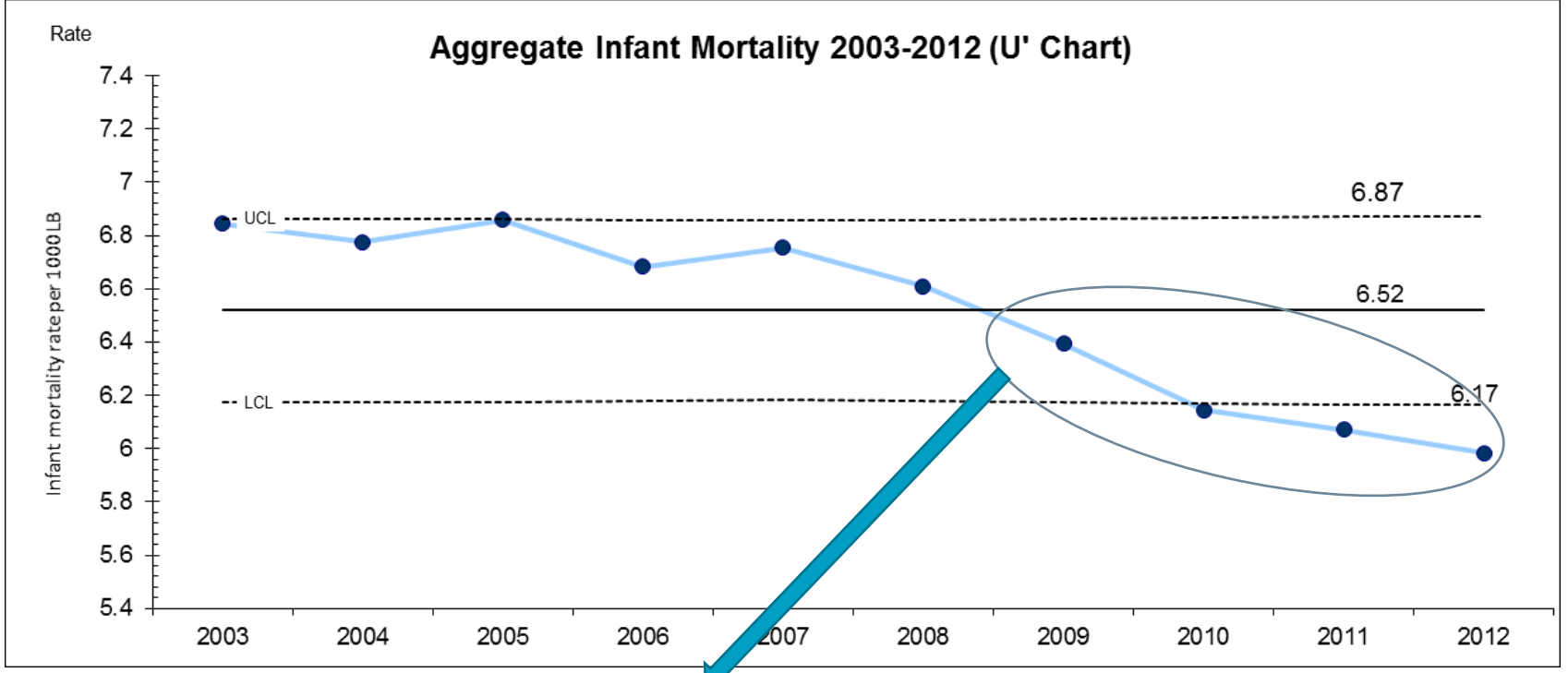
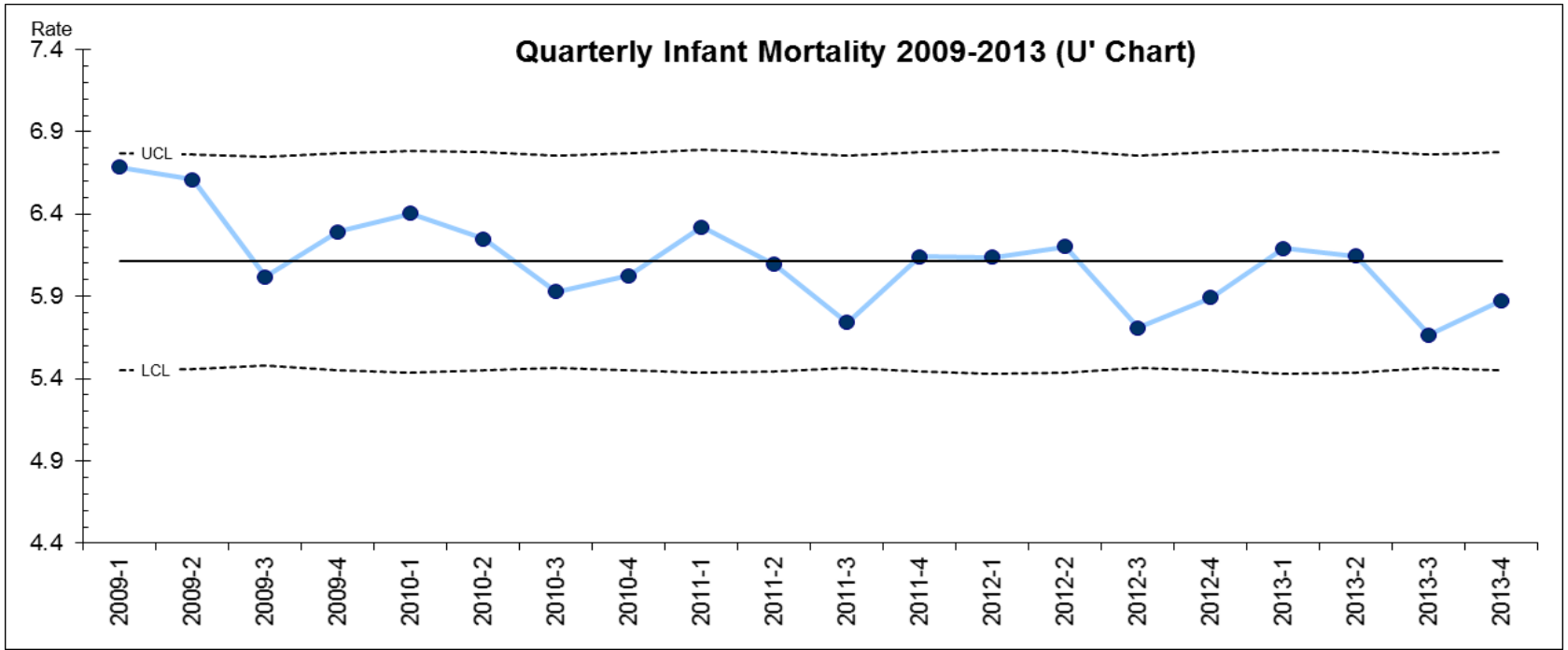


Figure 1. Infant mortality rates, by race and Hispanic origin of mother: United States, 2000–2013

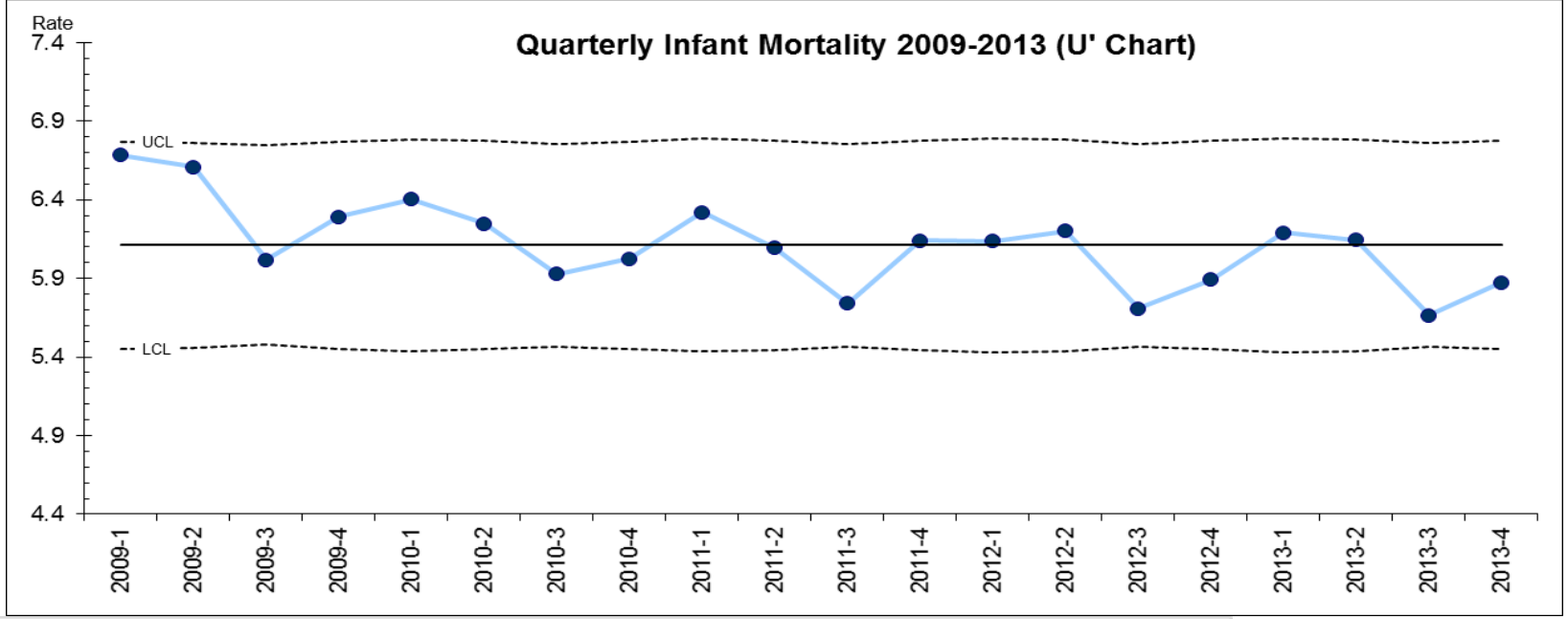
Shewhart Charts for Infant Mortality

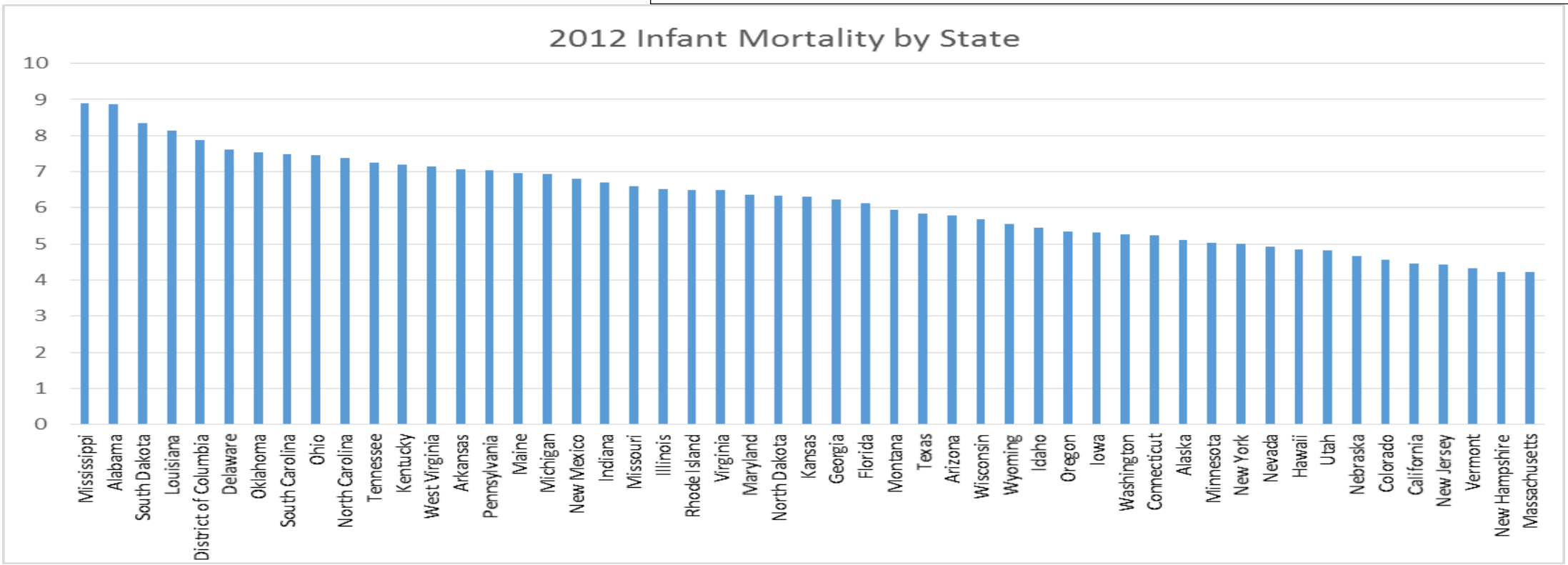




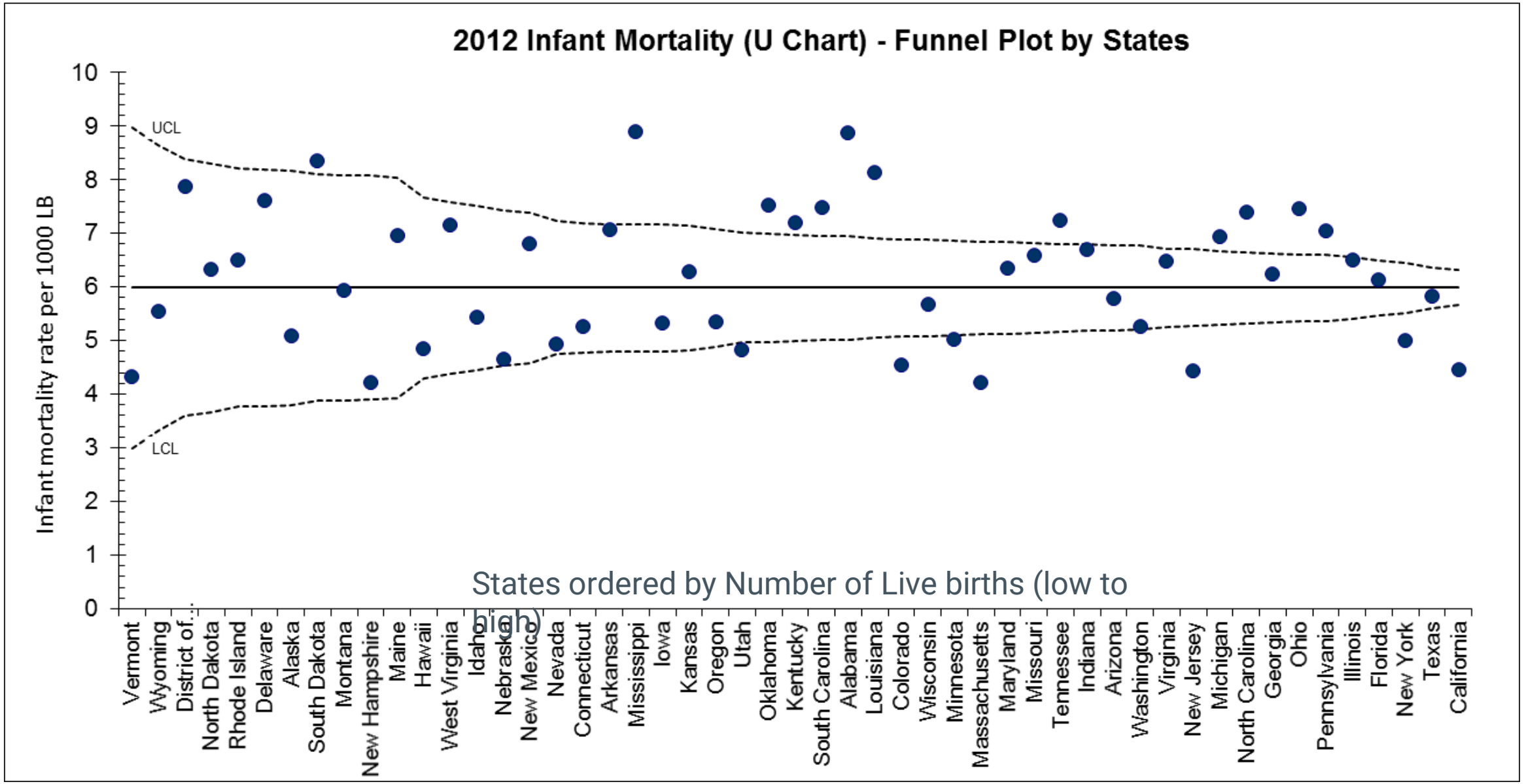
Shewhart Charts for Infant Mortality in US

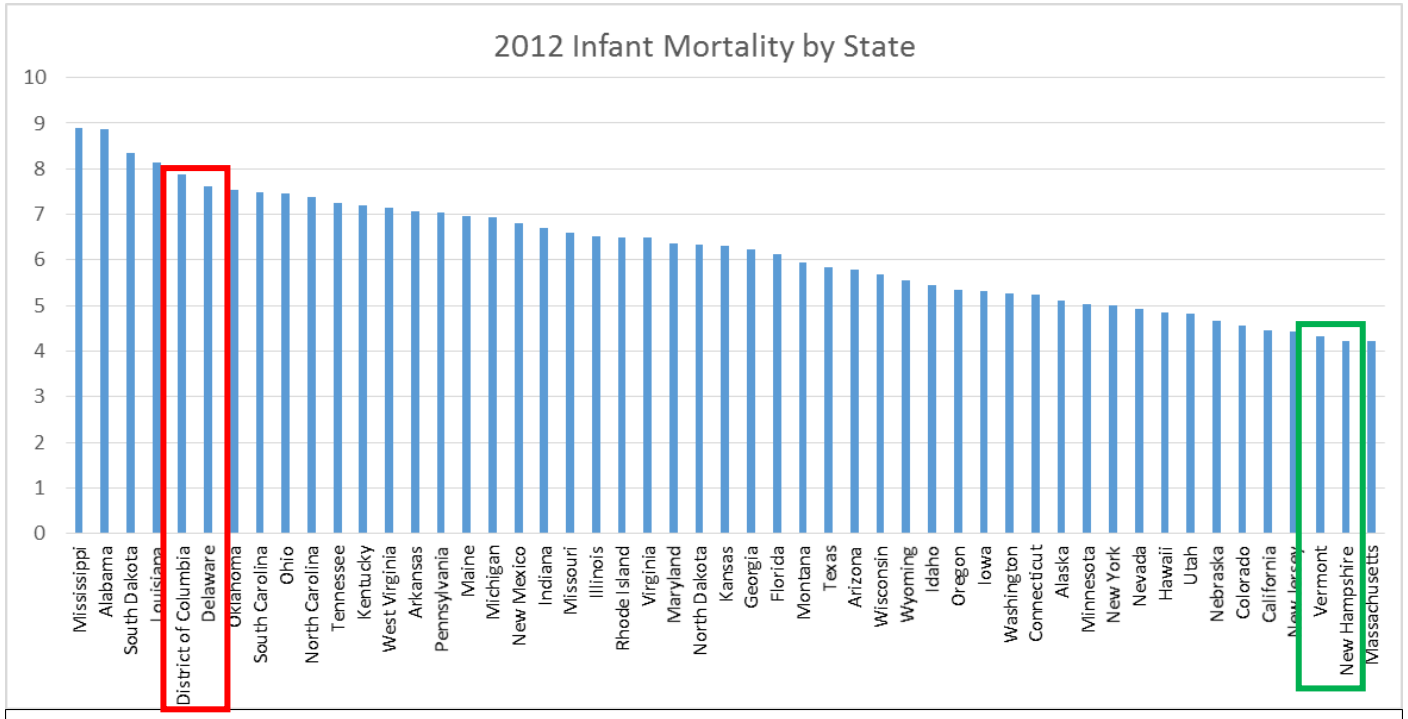
Do any states demonstrate special Cause variation?

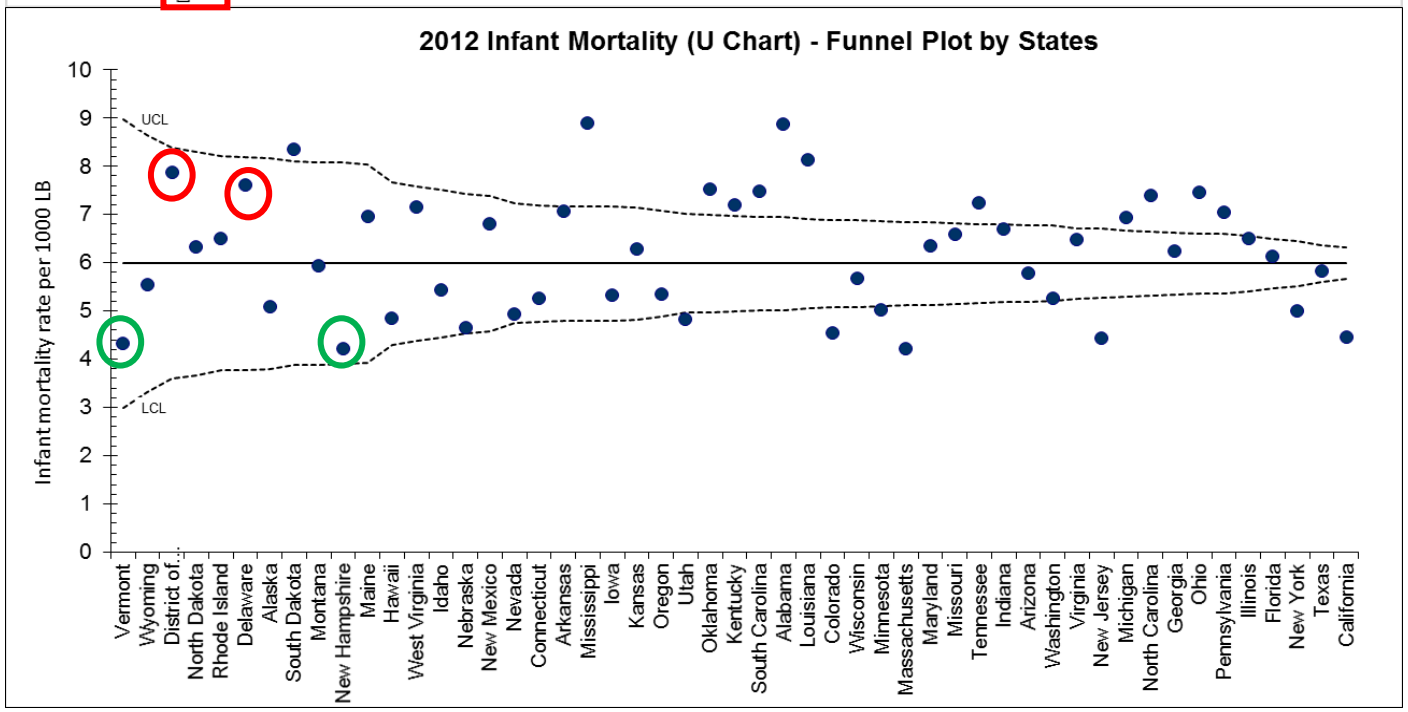




Shewhart Funnel Plot of 2012 US Infant Mortality Rates by State







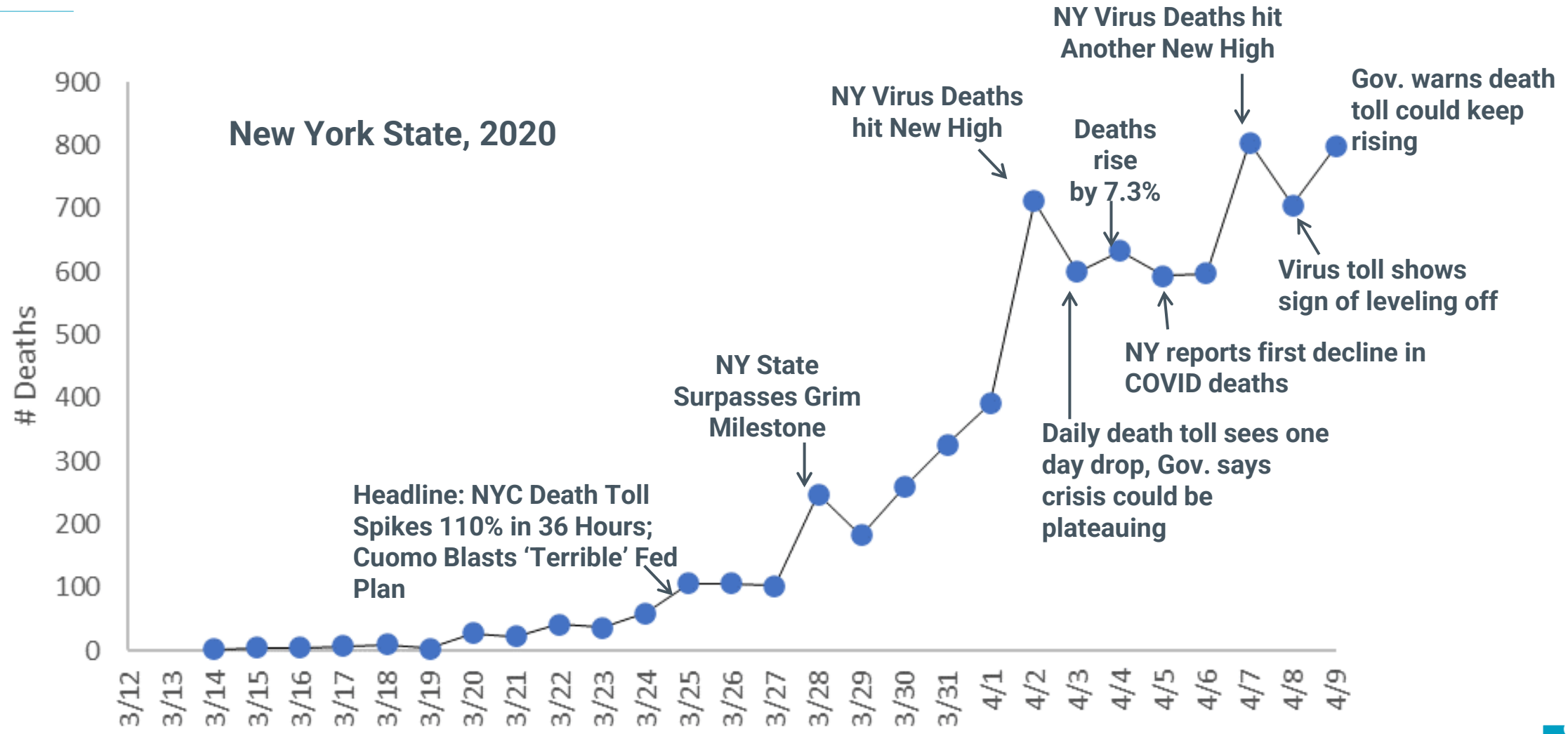
Use of bar chart increases risk of **tampering** – acting on data based on the belief that the variation is a special cause.

The Effects include:

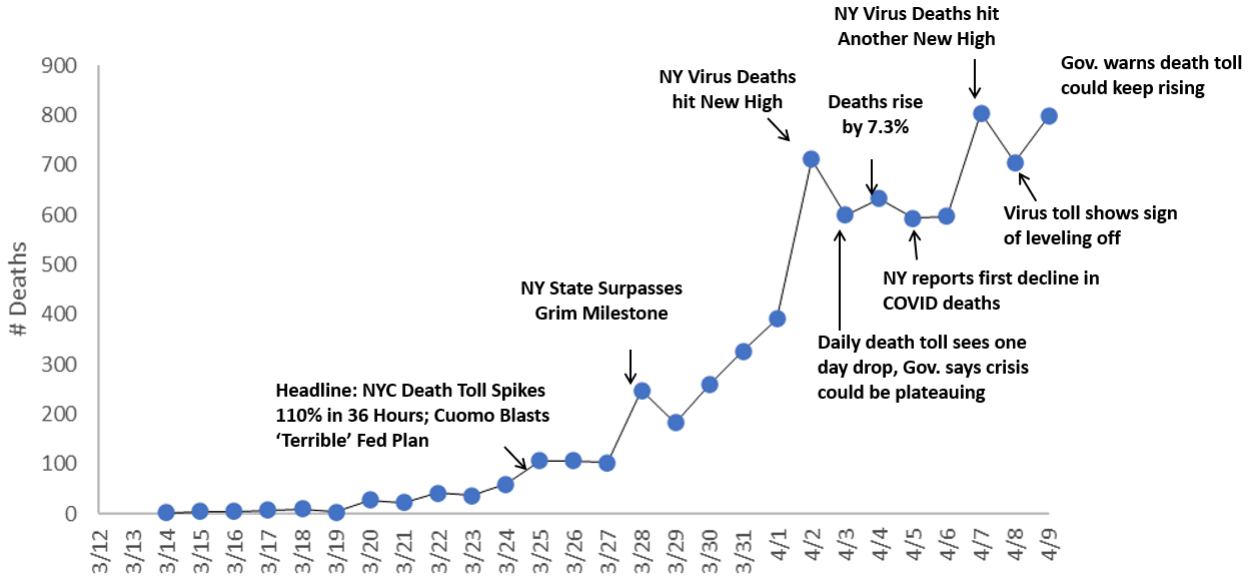
1. Compromised learning
2. Increased variation
3. Demoralising those improperly signaled out.

Case Study: COVID Response to Variation:

Every day is a new story; Reason to panic or be hopeful



The public, policy makers and politicians react to what they think is happening in real time (no system view)



Pressed on whether the state was at an apex of coronavirus fatalities, Cuomo emphasized that he can't be sure.

"The statisticians will not give you a straight answer on anything," he responded. "At first, it was straight up and straight down, or a total V. Or maybe it's up with a plateau and we're somewhere on the plateau. They don't know."

New York Governor, Andrew Cuomo

A Hybrid Shewhart Chart for Covid-19 Deaths

International Journal for Quality in Health Care, 2020, 1–8
doi: 10.1093/intqhc/mzaa069
Methodology Article

ISQua
International Society for Quality in Health Care

Methodology Article

Understanding variation in reported covid-19 deaths with a novel Shewhart chart application

ROCCO J. PERLA[1], SHANNON M. PROVOST[2], GARETH J. PARRY[3], KEVIN LITTLE[4], and LLOYD P. PROVOST[5]

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Editorial Decision 10 June 2020; Accepted 16 June 2020

2020 Paper on Initial Method Applied to Covid deaths

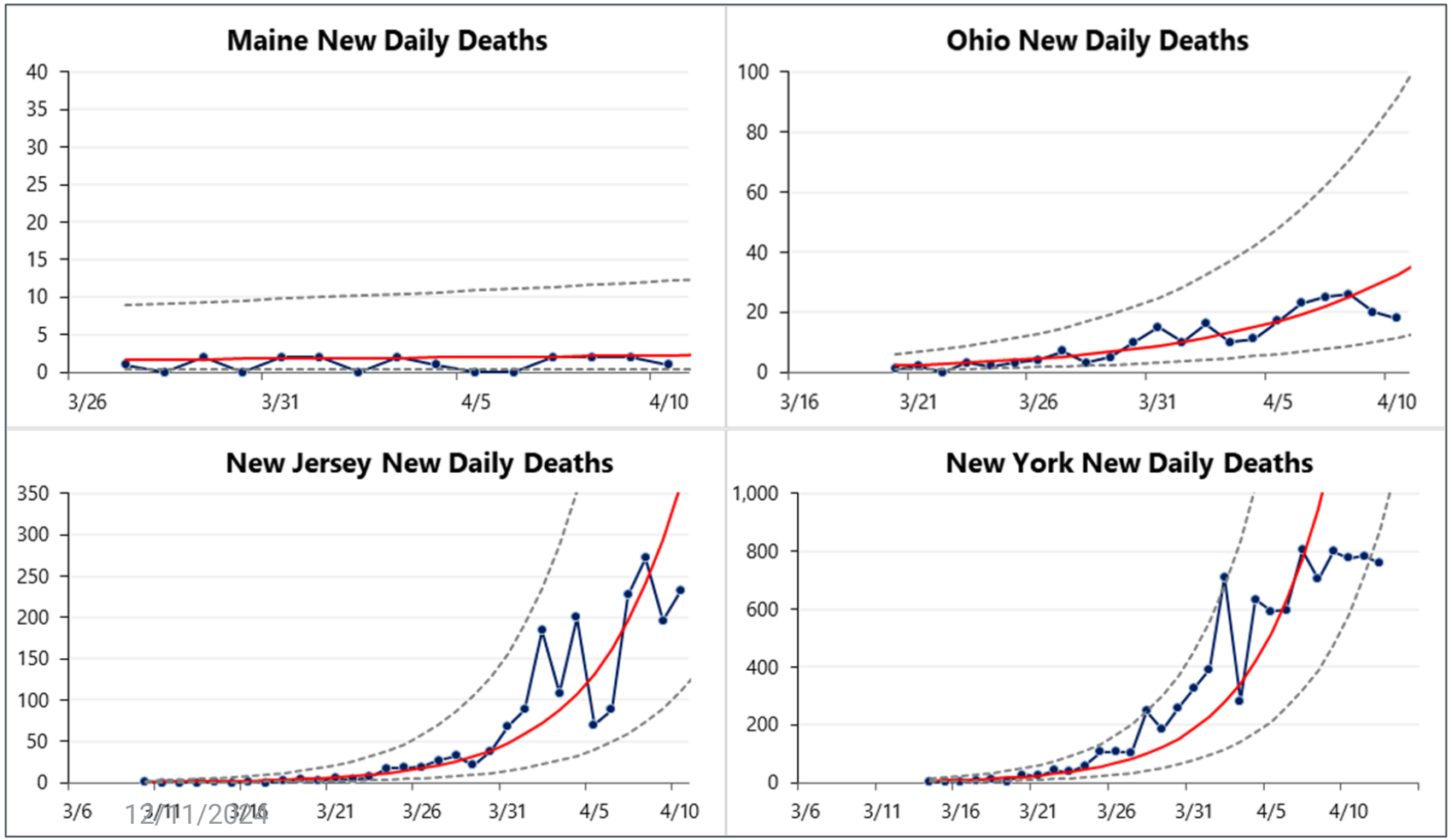
April, 2020

U.S.News NEWS » News Best Countries Best States Healthiest Communities Cities The Report Photos Events

HOME / NEWS / HEALTHIEST COMMUNITIES

U.S. News Analysis: Coronavirus Outbreak Hitting States in Waves

New York has borne the brunt of the country's COVID-19 crisis so far, but other states are on the brink of mounting death tolls.



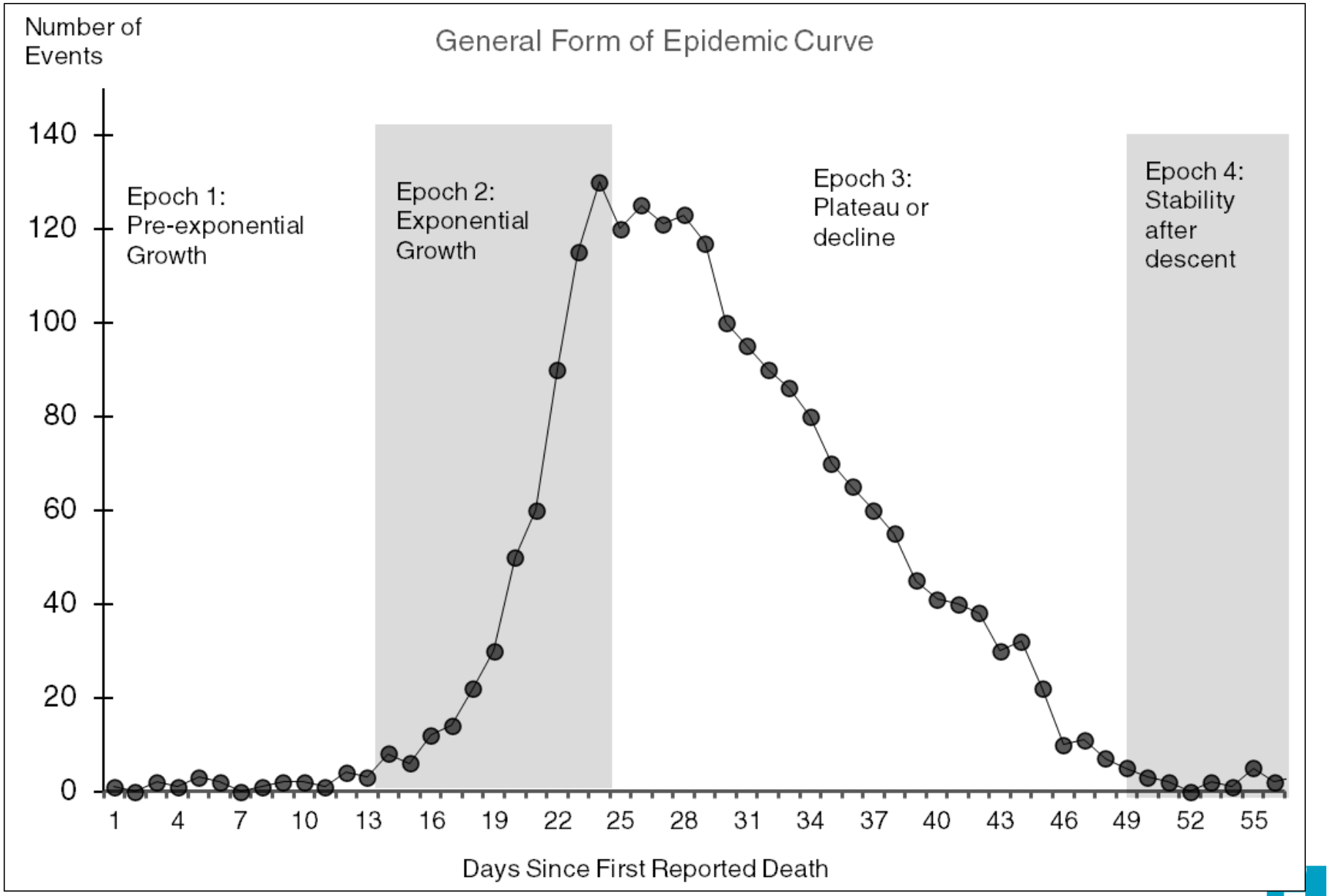
Key Observations:

1. State were in different phases of growth
2. Many (but not all) were progressing

FIGURE 14.1 Example of Typical Epidemiological Curve with Four Epochs

The Shewhart chart for epidemic data was based on the theoretical epidemic trajectory.

The "four-epoch" framework in this figure to characterise the specific type of Shewhart chart and the special cause signals that suggest the beginning or ending of an epoch



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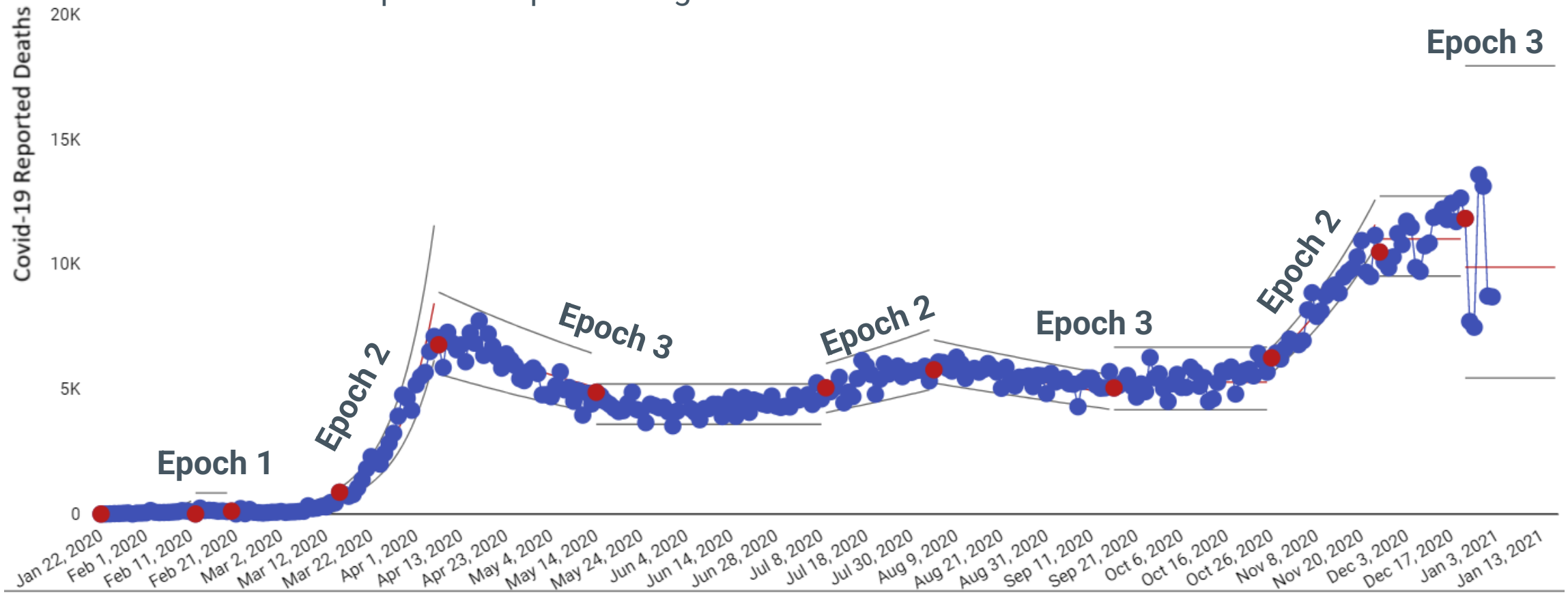
World – Covid-19 Deaths by Epochs Over Time

Epoch 1: Pre-exponential growth
Epoch 2: Exponential growth
Epoch 3: Decline or plateau
Epoch 4: Stability after descent



Red dots = statistical signal of changing conditions

International Journal for Quality in Health Care, 2021, **33(4)**, 1–10
DOI: https://doi.org/10.1093/intqhc/mzab151
Advance Access Publication Date: 19 November 2021
Original Research Article

OXFORD

A hybrid Shewhart chart for visualizing and learning from epidemic data

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[6]Department of Population and Quantitative Health Sciences, University of Massachusetts Medical School, 368 Plantation Street, Worcester, MA 01605, USA

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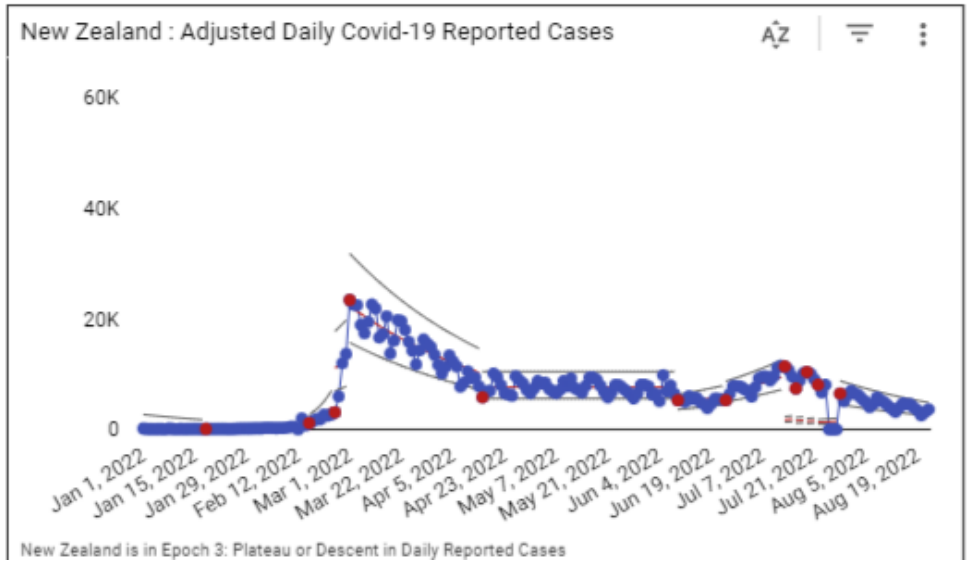
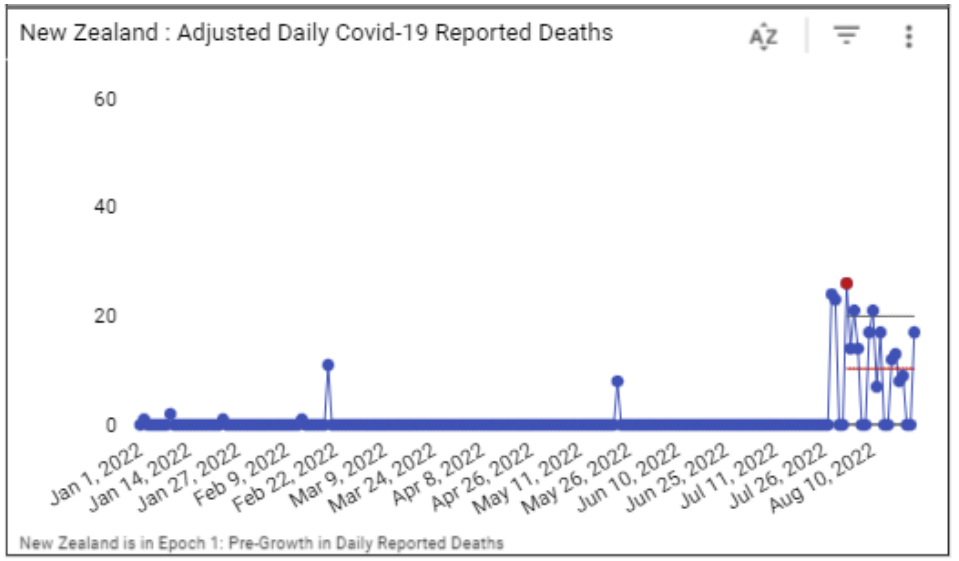
2021 Paper on Final Method applied to Covid cases, hospitalizations, ICU admissions, and deaths

US and International Websites present daily updates of the charts for cases and deaths for countries

and States in some countries





Select date range: Jan 1, 2022 - Aug 22, 2022

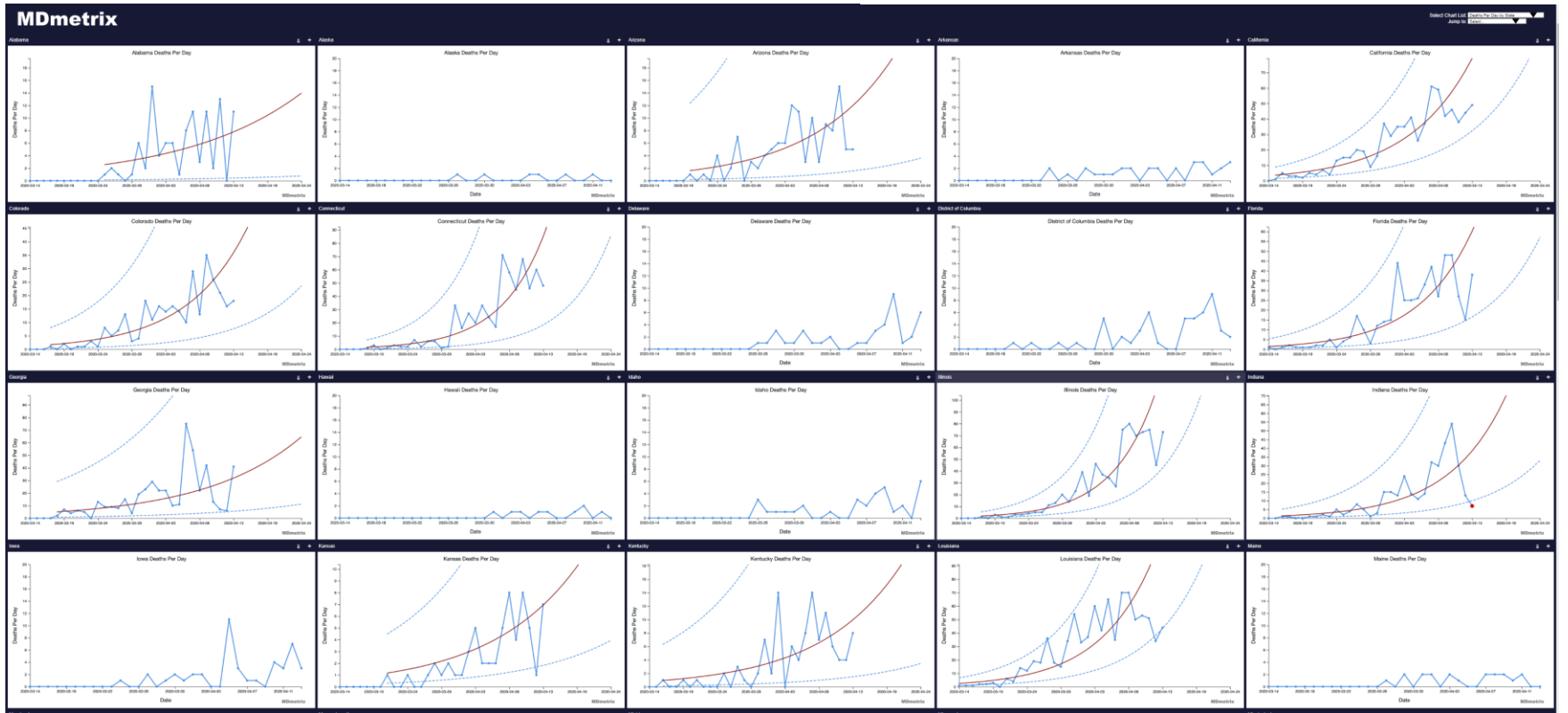
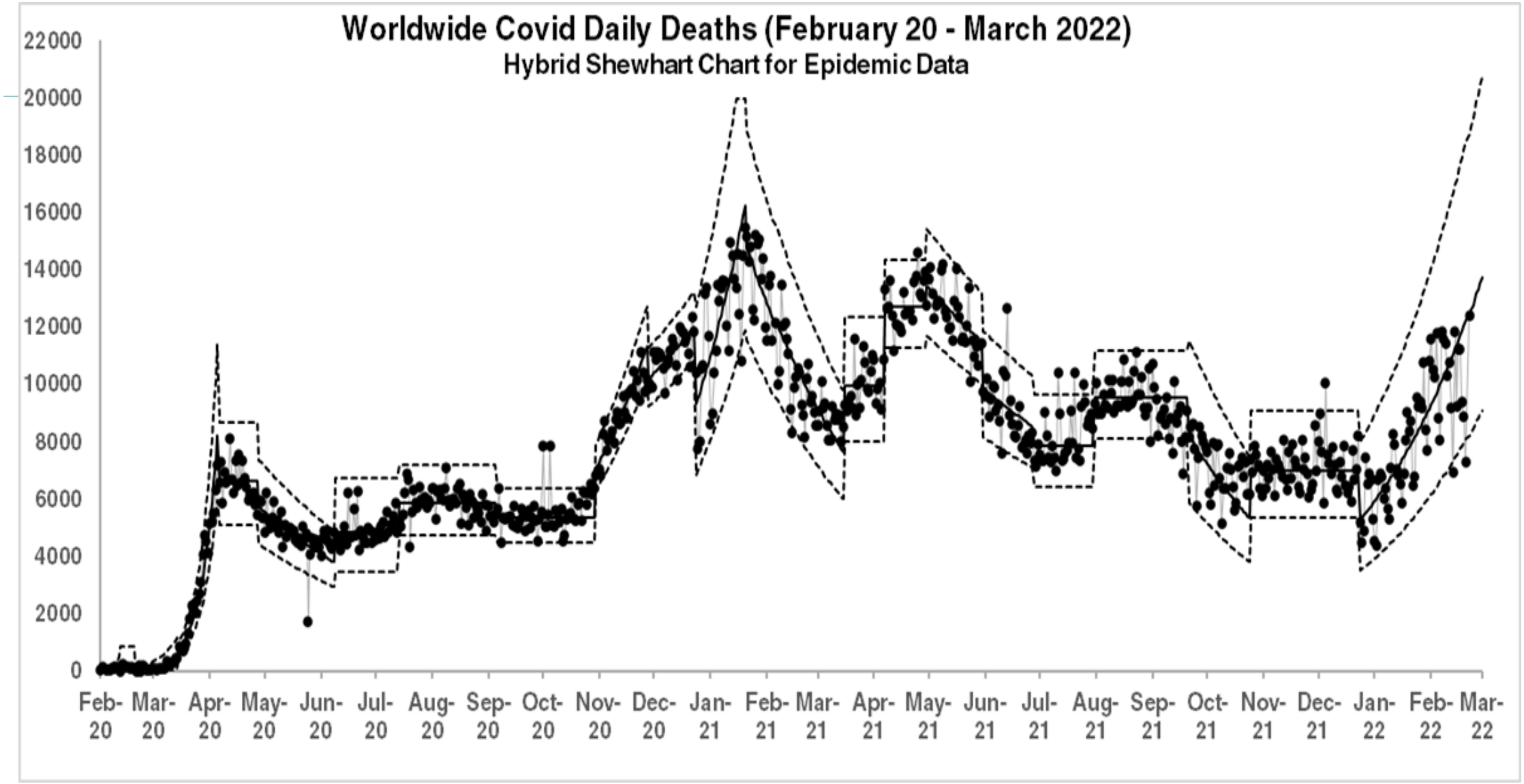


FIGURE 14.2 Example of Hybrid-Shewhart Chart for Epidemic Data



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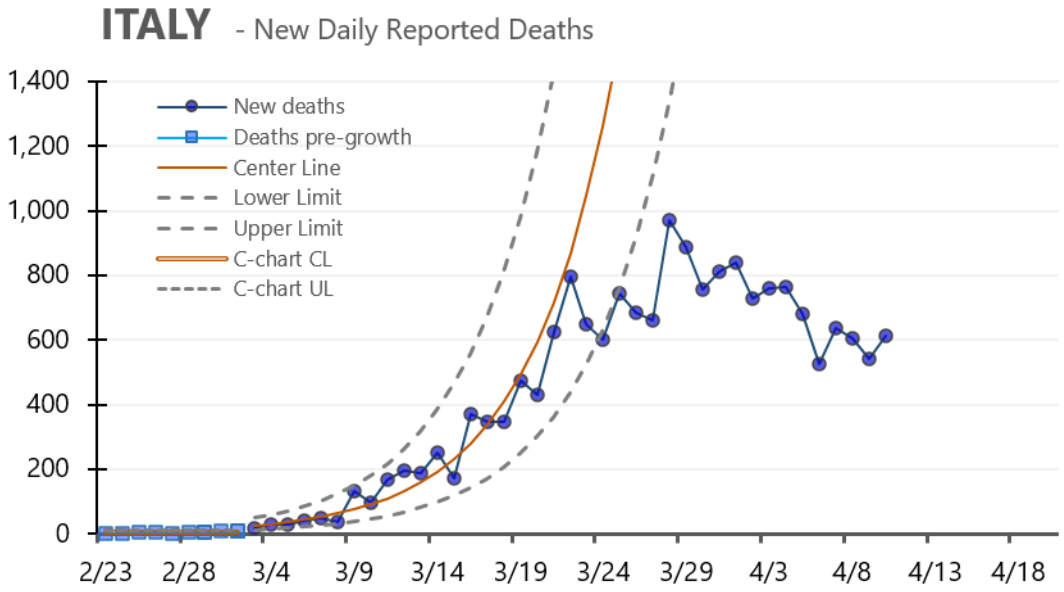
Use of Shewhart chart method with pandemic data

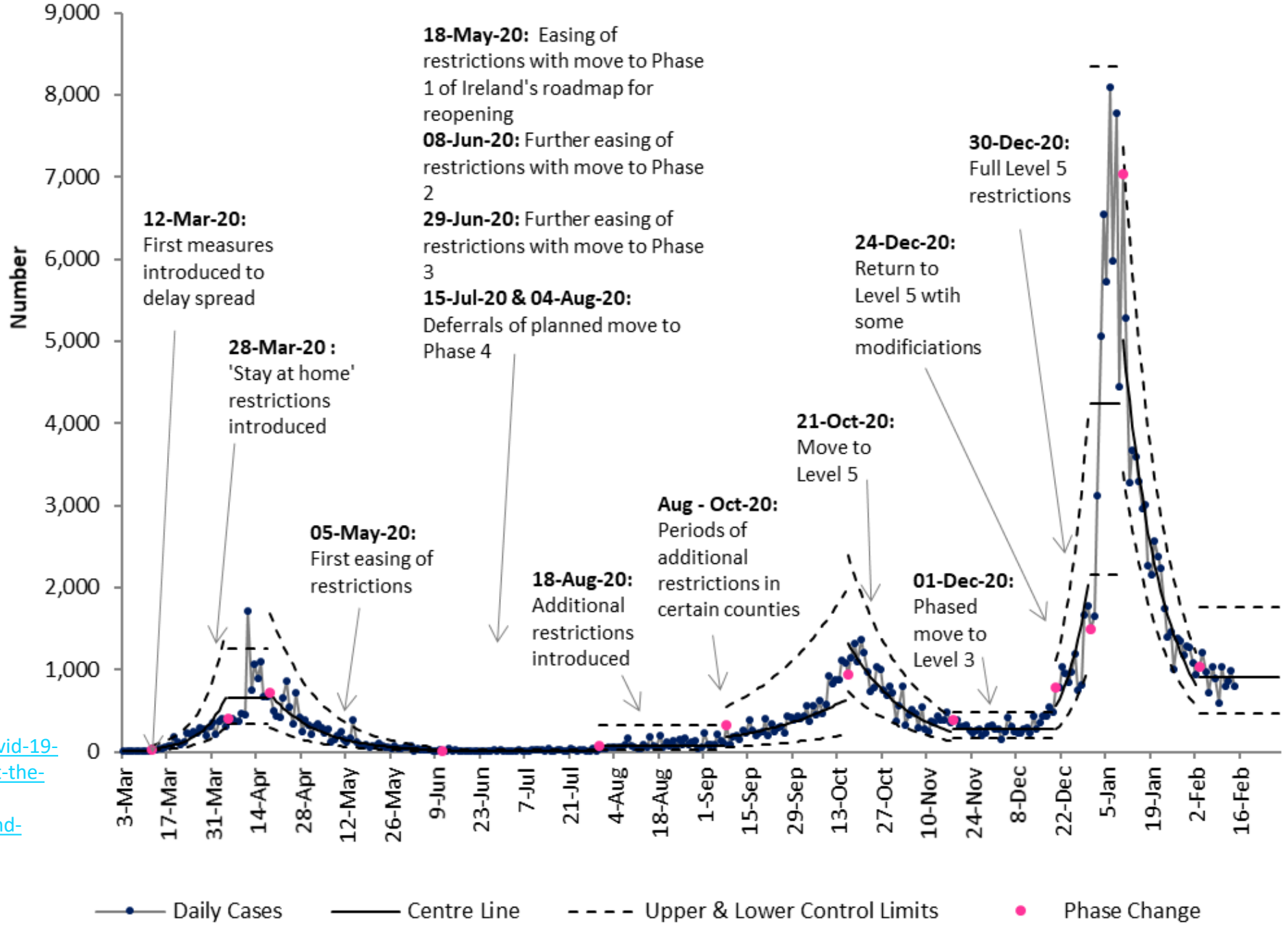
1. Minimising the risk and psychological toil of reacting to every data point as if it is a meaningful signal of changing conditions

2. Identifying precisely the day when the number of epidemic events in a geographic region (county, state, country) have begun to grow exponentially

3. Identifying precisely the day at which the number of daily deaths in an area has peaked and is entering the flat part of the epidemiologic curve.



Daily reported Covid Cases in Ireland



https://www.hse.ie/eng/about/who/qid/covid-19-qi-learning/resources-developed-to-support-the-national-covid19-response/understanding-variation-in-key-covid-19-indicators-in-ireland-using-statistical-process-control-shewhart-charts.pdf

Summary

How can we improve our learning from variation in health care?
Any time that data is presented, we recommend asking two questions: Is the process currently stable (are there special causes we can learn from)? And based on this knowledge, what type of action makes sense?

When presenting public data:

- Make data available over time.
- Provide data in formats that allow for construction of Shewhart charts.
- Determine whether a process is stable before drawing conclusions or making decisions.
- Think carefully and creatively about how to stratify data.

Key strategies for leaders to encourage learning from data

- Use data to create light, not heat
- Use targets and goals carefully. Use them to set priorities but don't make them the focus for learning.
- Aways insist on seeing data as a time series (Shewhart charts, run charts).
- Study multiple measures (at the same time) to appreciate performance in complex health systems.
- Minimise complexity of plotted data values (e. g. stay away from moving averages).
- Be cautious when using data adjustments and transformations. Do not lose knowledge about the base data. (Example, graphing "expected vs actual")
- Make your intent to move to complete transparency in sharing data for learning.
- Minimise judgement and optimise learning when studying variation from different care sites.

HC Data Guide, 2nd edition, Chapter 13

Better Measurement: Data for Improvement: Asia-Pacific Region

IHI Online Course with Coaching
Begins 19 February 2025
$650 USD ($995 AUD)

Learning Goals:

Through this online course, you will:

- Master the ability to understand variation and data trends over time, revealing crucial patterns in care delivery
- Learn to identify the limitations of static data, Red/Amber/Green reporting, and aggregated data and averages
- Gain hands-on experience with key tools for analysing safety and quality data

This program includes four dynamic live sessions, engaging asynchronous learning modules, and practical activities.

Key Dates:

- Orientation Call – 19th February 2025
- Call 1 – 25th March 2025
- Call 2 – 1st April 2025
- Call 3 – 23rd April 2025
- Call 4 – 30th April 2025

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