

# Understanding variation

“The central problem in management and leadership  
...is failure to understand the information in variation”

William E Deming  
Out of the Crisis (1986) MIT pg 309

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# Colorectal cancer

- McArdle & Hole (1991)
- Variation in outcomes by surgeon
- 1974-1979 study period

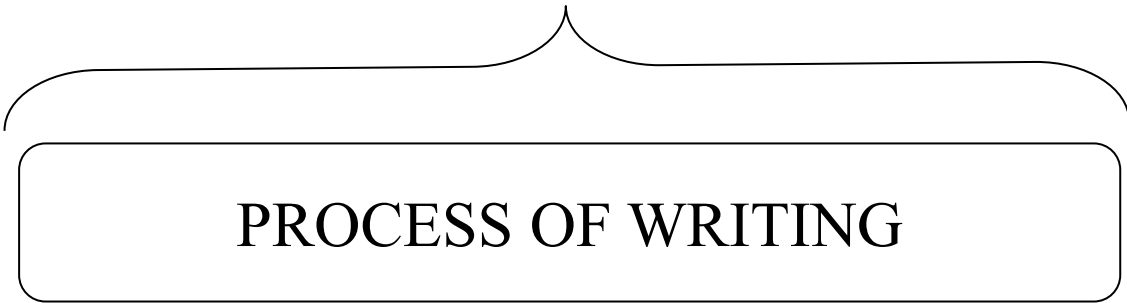
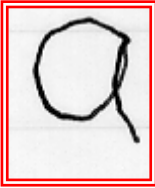
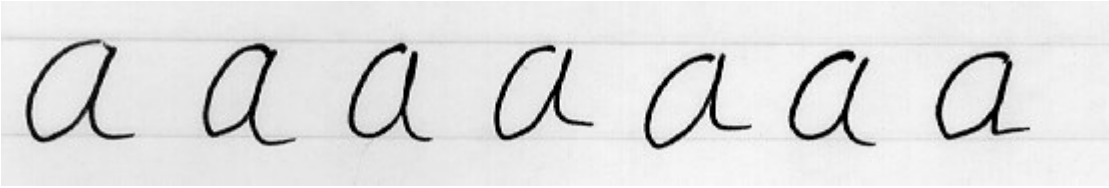
				Case Mix
• Surgeon	Survived	Died	%	Hazard Ratio
• A	82	16	16	1.10
• B	58	8	12	1.03
• C	49	9	16	0.87
• D	45	7	13	1.09
• E	37	15	29	1.09
• F	41	5	11	0.86
• G	35	3	8	0.86
• H	26	11	30	1.61
• I	31	5	14	0.91
• J	27	7	21	1.05
• K	28	4	13	0.59
• L	19	2	10	0.97
• M	18	3	14	0.79

*McArdle & Hole BMJ 1991;302:1501-5*

The conclusions are clear. Some surgeons perform less than optimal surgery; some are less competent technically than their colleagues...If by more meticulous attention to detail the results of surgery could be improved..

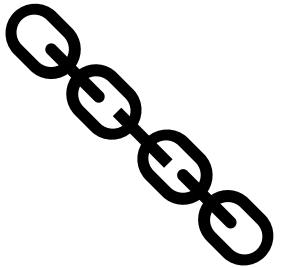
# Shewhart's Theory of Variation

- Letter **a**



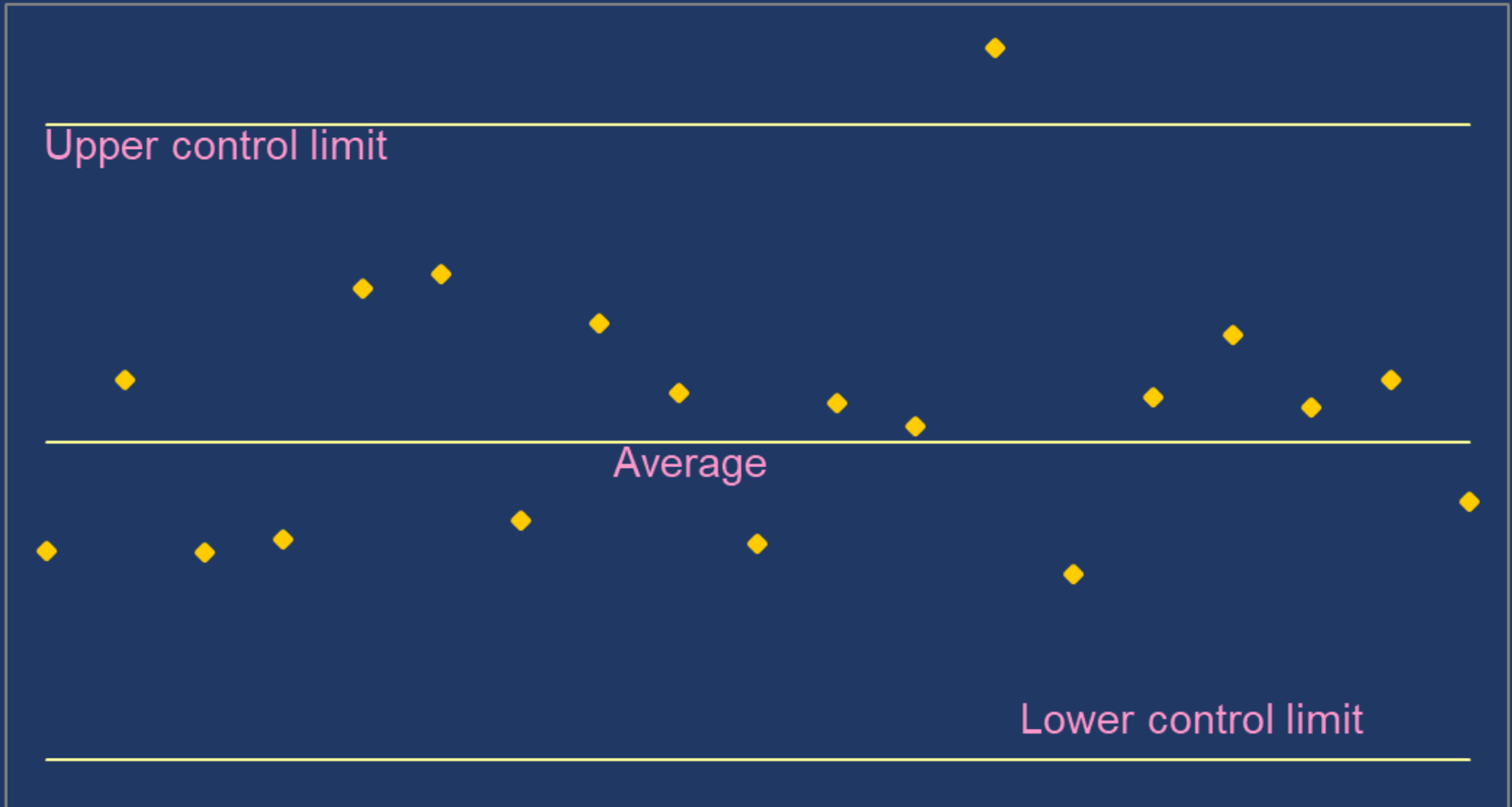
SPECIAL CAUSE  
ACTION:  
FIND (& ELIMINATE)

COMMON CAUSE  
(SYSTEM)  
ACTION: PROCESS



Every system is perfectly designed to produce the results it does

Y axis



X axis

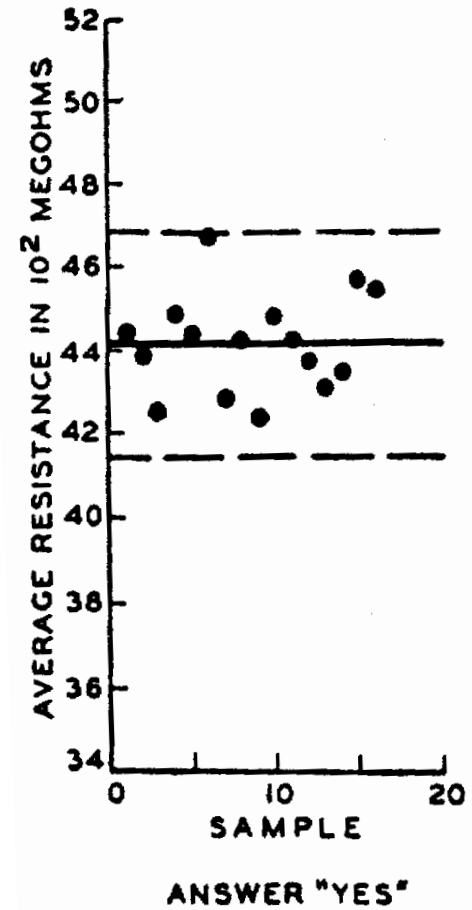
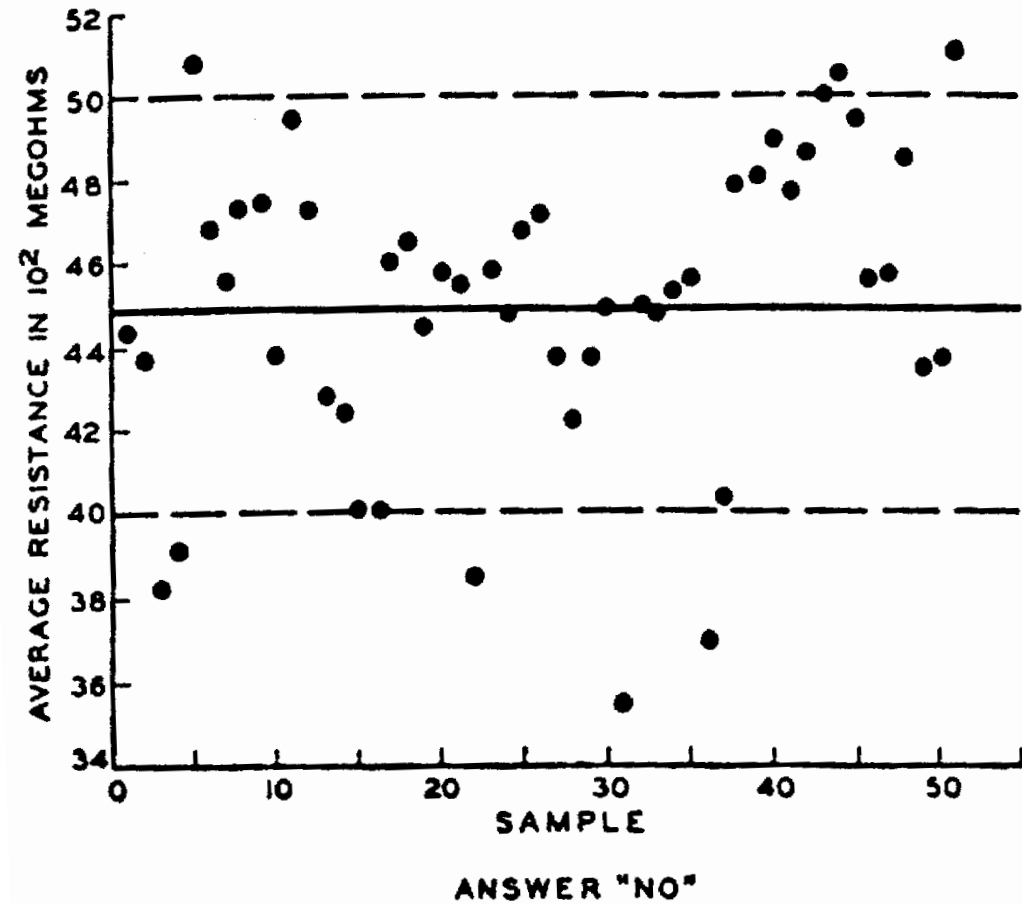
- Common Causes of variation
  - Those causes that are inherent in the system (or process), affecting everyone working in the system and affects all outcomes between people and over time.
- Special causes of variation
  - Those causes that are extrinsic to the system (or process), not affecting everyone, but arise from assignable "root" causes.



# Mistakes

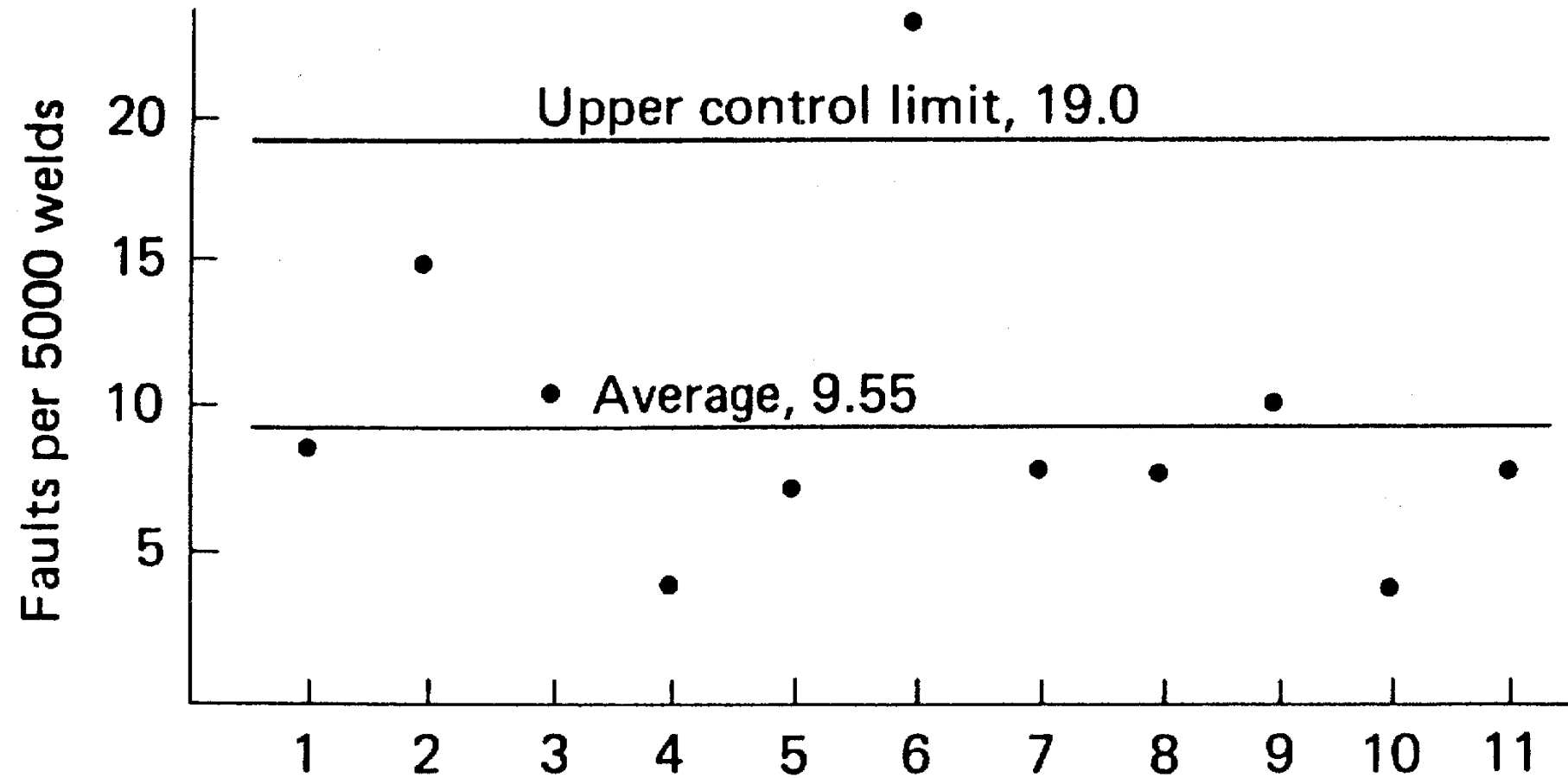
- Two types of mistakes
  - 1: Treat an outcome resulting from common cause as if it were special cause
  - 2: Treat an outcome resulting from special cause as if it were common cause
- 3 sigma
  - “minimise losses due to either mistake”

# Resistor Data



# Deming

- Management & leadership



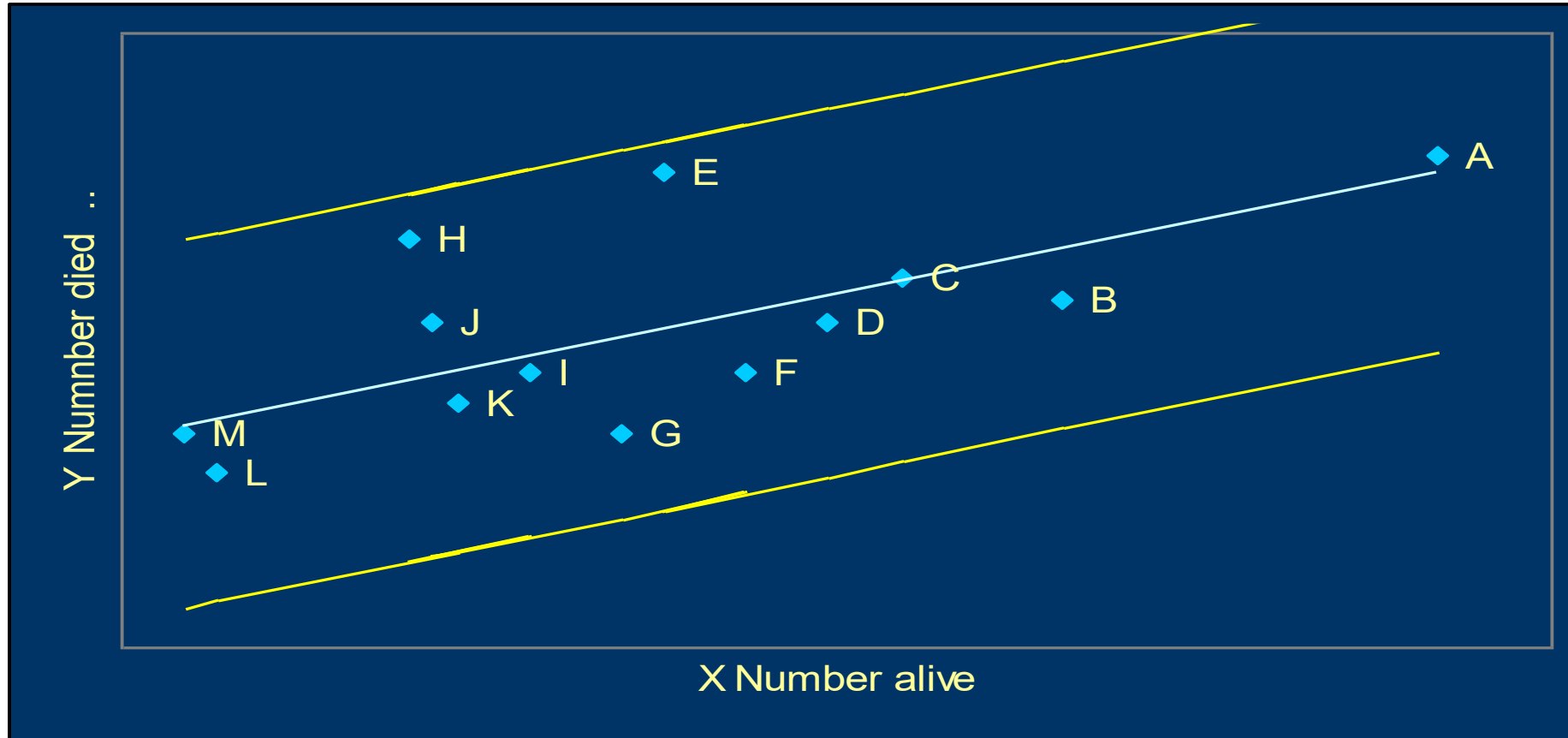
# Colorectal Cancer

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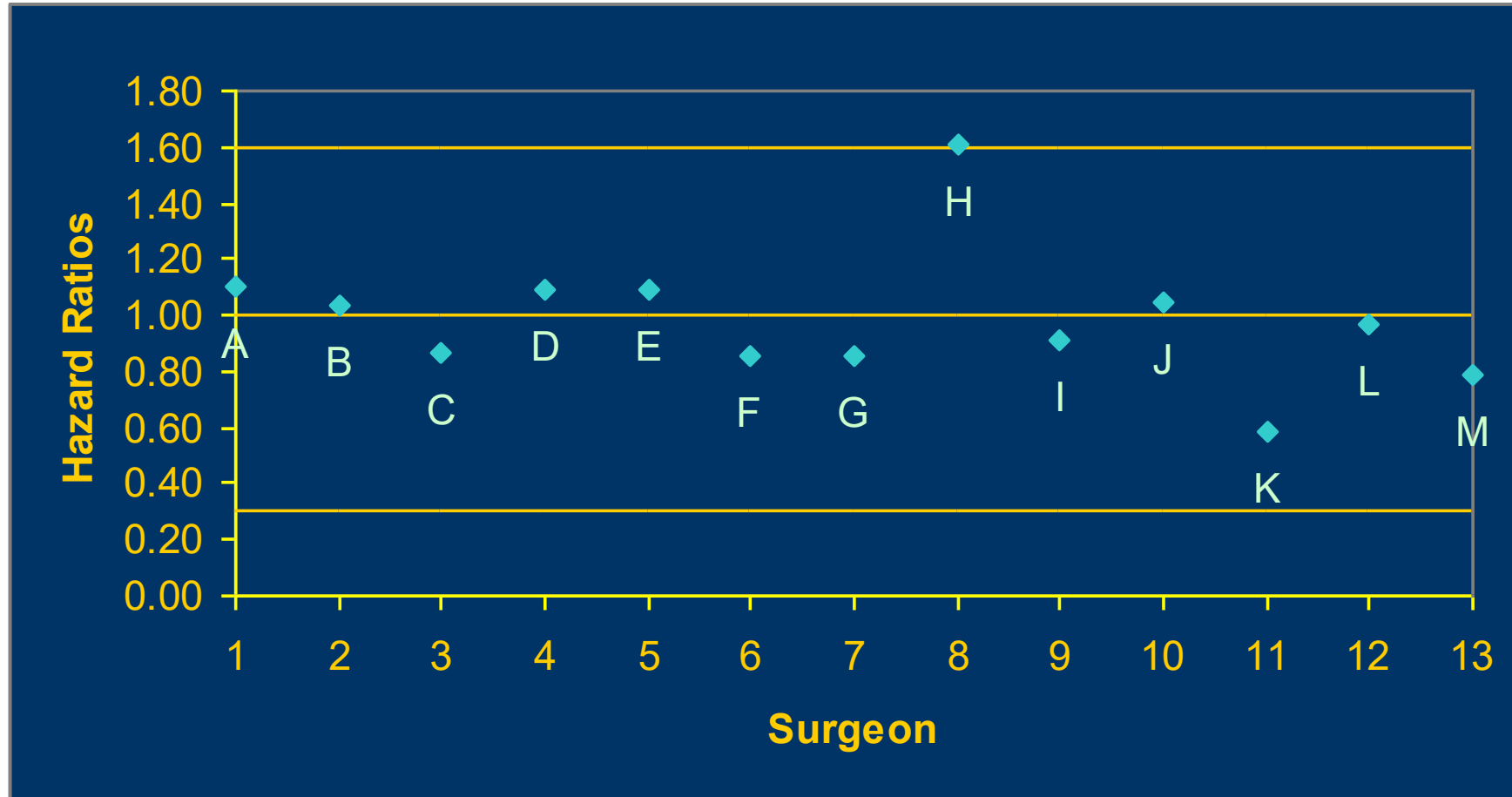
K	20	4	15	0.55
L	19	2	10	0.97
M	18	3	14	0.79

# Colorectal Cancer



*McArdle & Hole BMJ 1991;302:1501-5*

# Colorectal Cancer Case-mix Adjustment



*McArdle & Hole BMJ 1991;302:1501-5*

# Question

- How should we go about “investigating” special cause variation in healthcare?



# The scientific method

- Hypothesis-generation-testing cycle



Process  
of Care

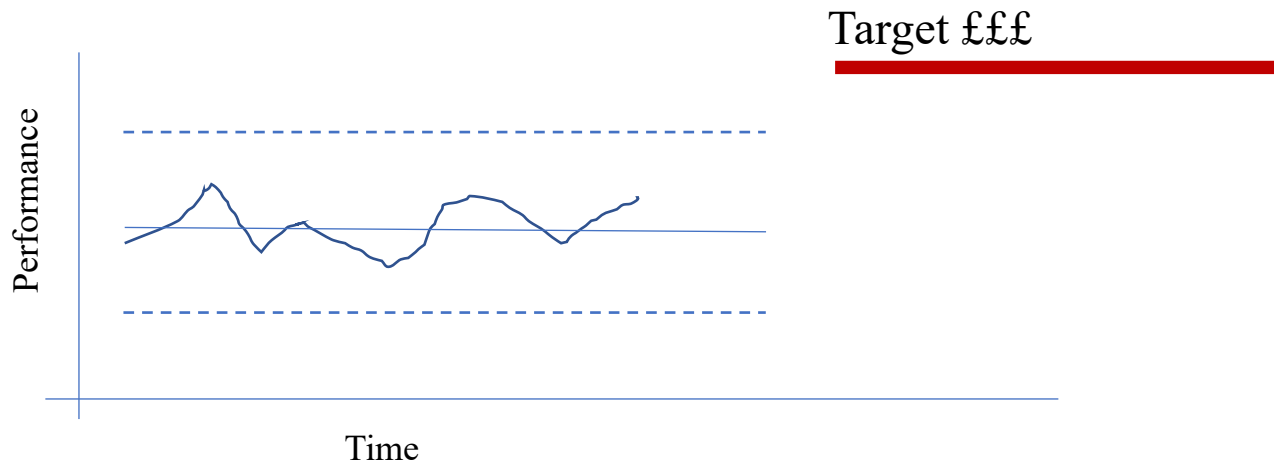
Structure/  
Resources

Case mix

Data

# Targets

- Why?
  - Targets motivate people
  - Targets make people accountable
  - The alternative to targets is fluff & anarchy
  - Impossible to run a system without targets
  - Targets enable comparison
  - Targets have unintended consequences
- “Targets ...make performance worse” John Sheddon 2008
  - They become the defacto purpose

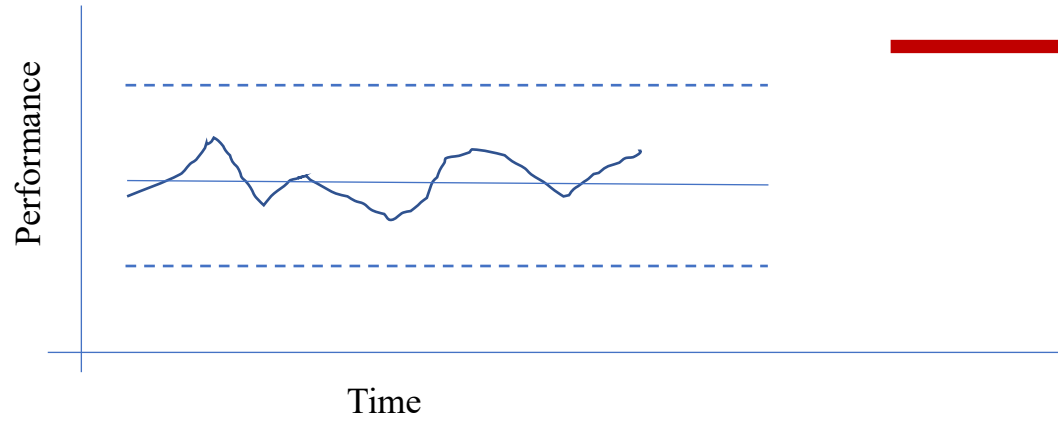


### Actions?

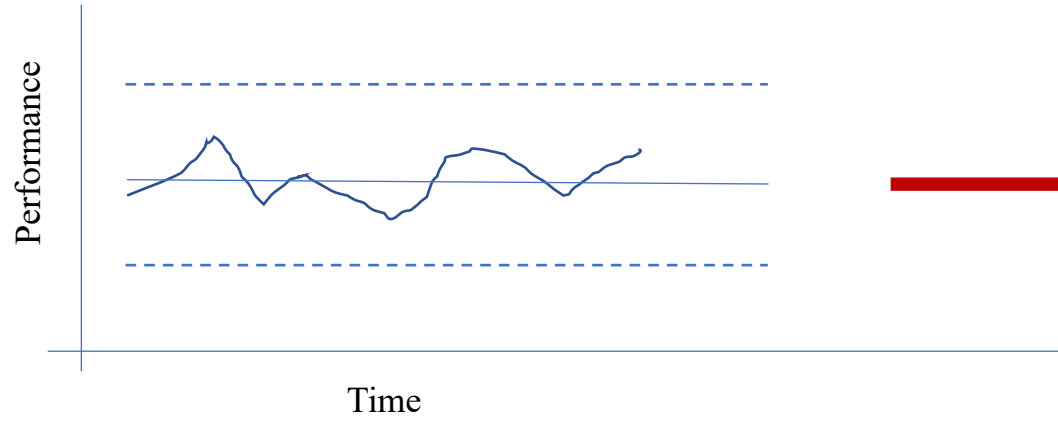
1. Change the underlying system
2. ? Distort the data
3. ? Distort the system
4. ? Distort the target

“If you have a stable system, then there is no use to specify a goal. You will get whatever the system will deliver. A goal beyond the **capability** of the system will not be reached. If you have not a stable system, then there is no point in setting a goal. There is no way to know what the system will produce: it has no capability.”

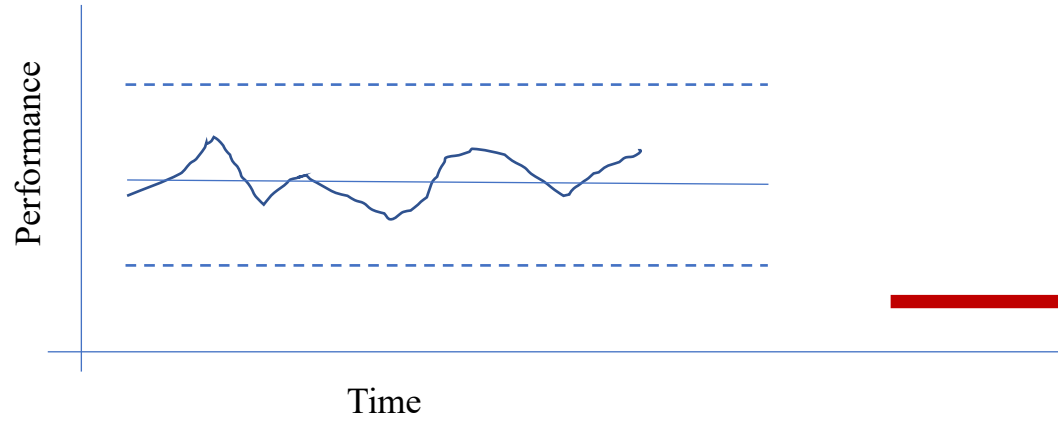
Shewhart



**Not capable**



**Capable half the  
time**



**Capable**

## Dialogue

# Targets and Terror: Government by Performance Indicators

ANDREW COULSON

College of Social Sciences, University of Birmingham, Birmingham, UK

*Deal or No Deal? Delivering LAA Success* (Brand, 2008) is a policy paper published by the New Local Government Network. It has the trappings of a UK Government White Paper: a foreword by the Minister for Local Government, extensive quotations of government policy papers but few from other sources, 21 policy-orientated recommendations (in a White Paper these would have been a set of questions for consultation), and an uncritical acceptance of the current government paradigm of management by targets, performance indicators and partnership working.

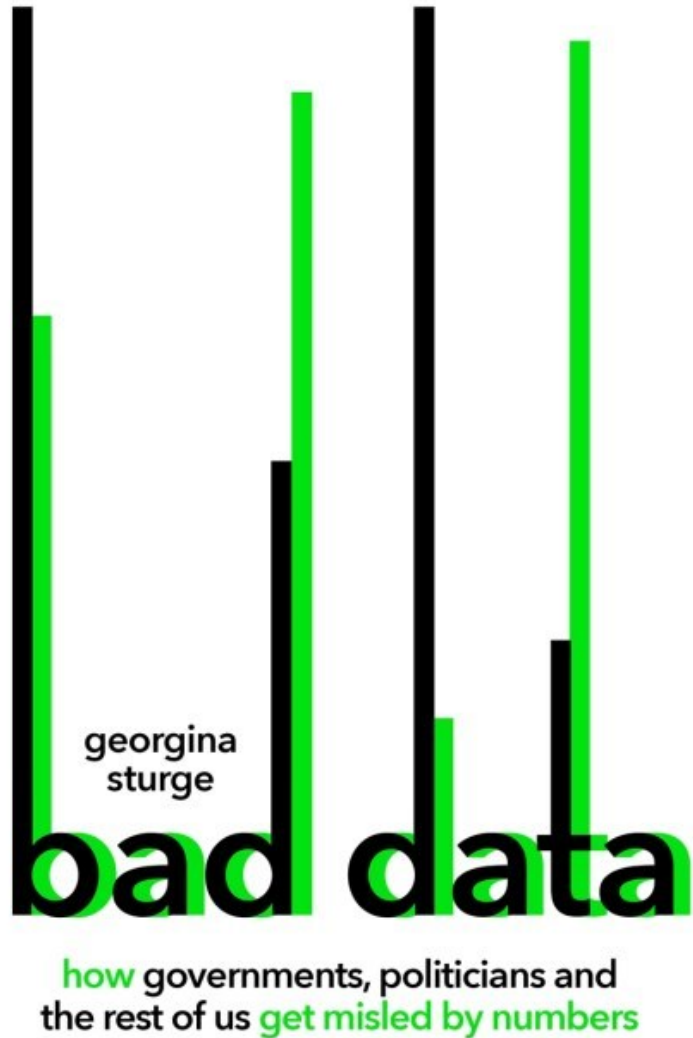
Jackson grouped gaming behaviours into a hierarchy:

- *Definitional gaming*, where the definition distorts what is being reported. For example, an agency supporting job creation claims a number of jobs created, when other agencies contributed to those jobs being created, and may claim to have created the same jobs.
- *Numerical gaming*, where organisations present data in a misleading form so as to exaggerate their performance to an external body. For example, police classify unsuccessful burglaries as criminal damage, thereby reducing the number of burglaries reported. Or, as already noted, where hospitals use a variety of devices to reduce the numbers reported by them as on their waiting lists.
- *Behavioural gaming*, where targets are met by changing behaviour with adverse effects on other parts of their work, such as by moving resources away from other areas of work, concentrating on easy wins and reducing resources concentrated on deeper or long-term problems, selecting cases which are relatively easy to solve (or children likely to do well in exams), cutting out riskier aspects, and concentrating on activities where information will be compiled.

She could have added a fourth form of gaming: *fraud*, where data are falsely reported, or figures altered.

# Targets and the defacto purpose

- **Police:**
  - “Police officers described a bullying culture where they were targeted on the number of arrests they made...”
  - “...the UK Statistics Authority withdrew the gold standard status from police figures for reasons of ‘accumulating evidence of unreliability’”
- **The Cobra Effect**
  - In British India a reward was offered for dead cobras in an attempt to reduce the danger to humans. It worked well for a period but then people started to breed cobras to kill then to collect the reward
  - <http://cognitive-edge.com/blog/of-effects-things/>



# Crime Figures

- 1997 UK Govt set targets for crime reduction –
  - one police force showed a 27% reduction in “theft from a motor vehicle” (for which there was a target and a 407% increase in “vehicle interference” for which there was no target.
- By 2014 – the reputation of crime statistics was in tatters – following 12 govt commissioned reports and a parliamentary inquiry which eventually led the UK Statistics Agency removing them from the national statistics
- (pg 61 Bad Data)

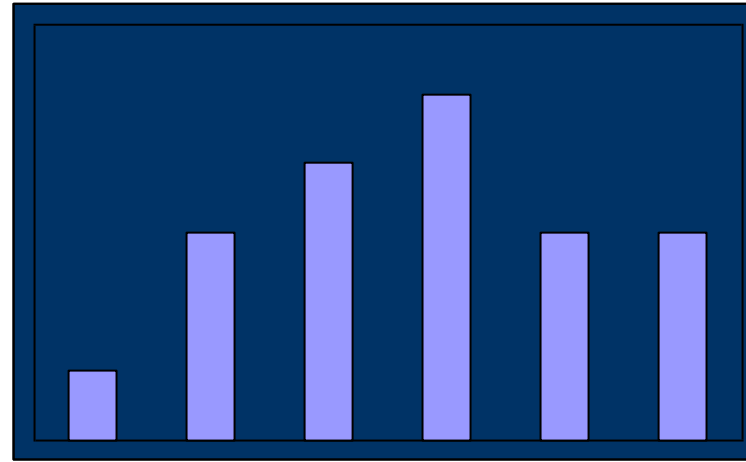


LOS

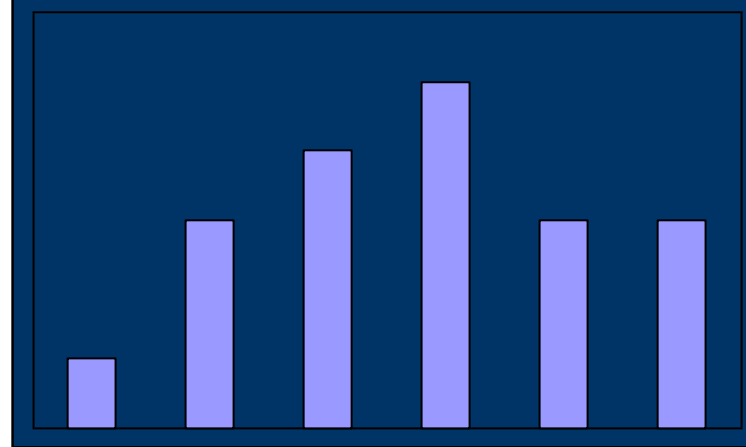
Avg 4 days

Stdev 1.3 days

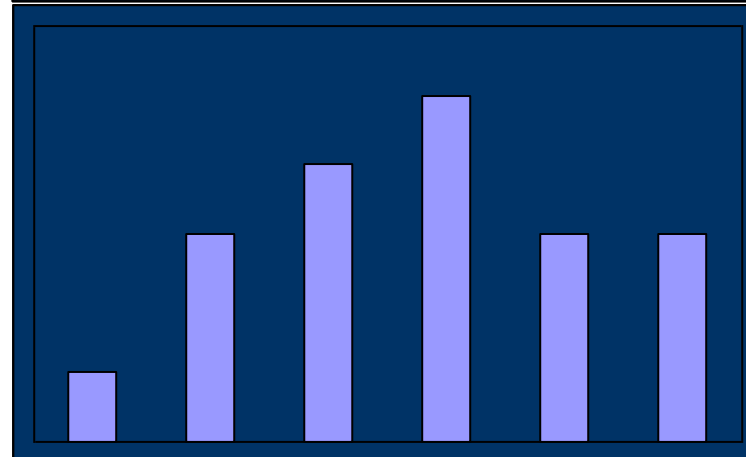
• Dr A



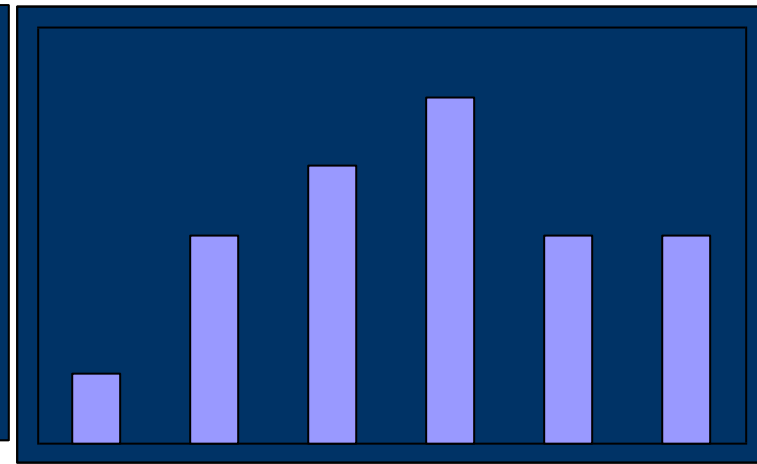
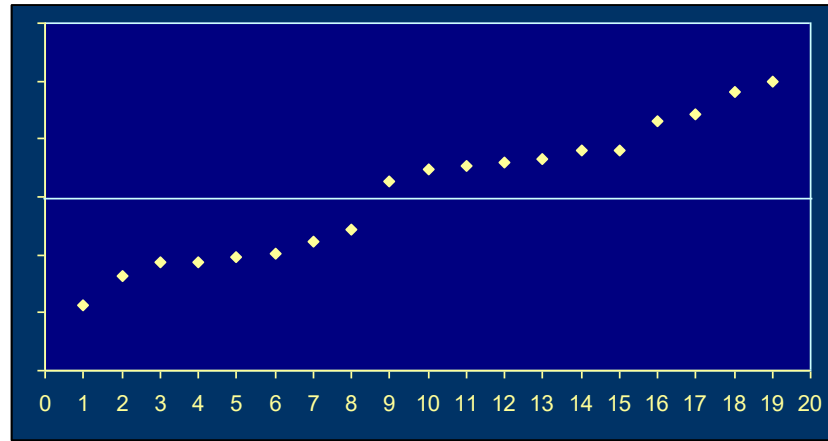
• Dr B



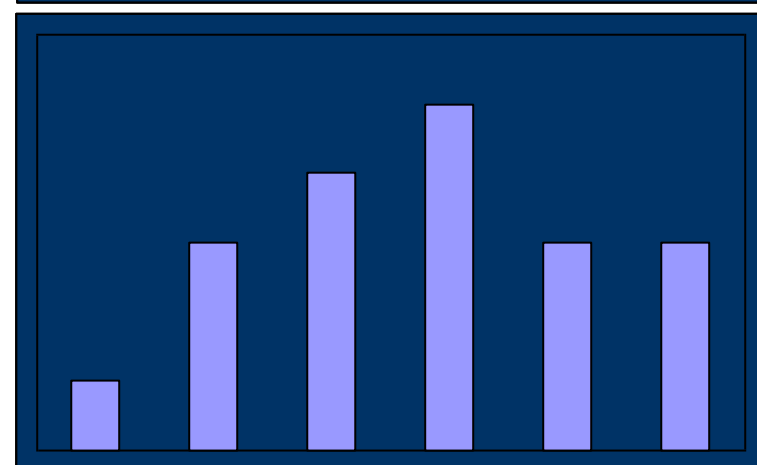
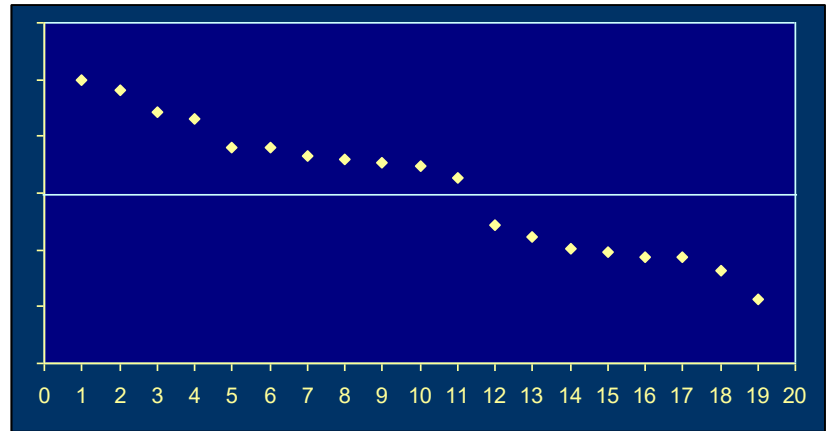
• Dr C



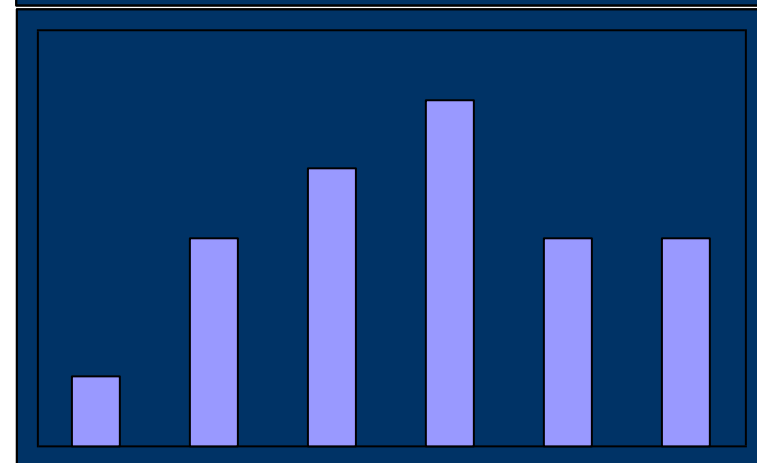
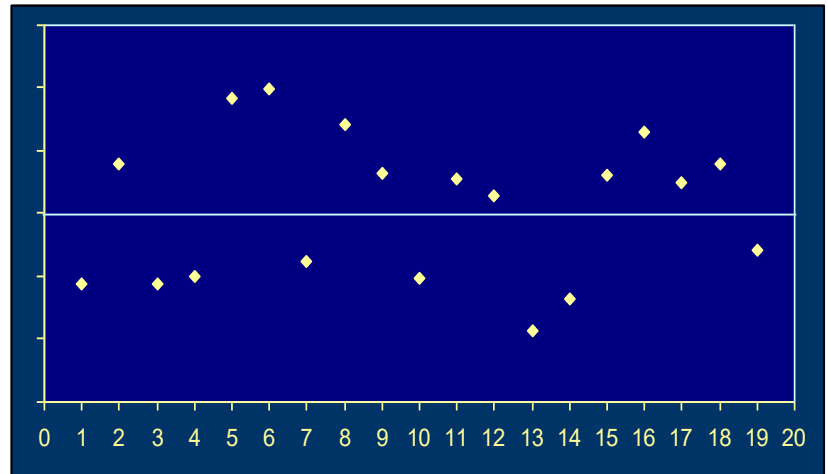
- Dr A



- Dr B



- Dr C



Order of data has vital information

# Effect of monitoring surgical outcomes using control charts to reduce major adverse events in patients: cluster randomised trial

Antoine Duclos,<sup>1,2,3</sup> François Chollet,<sup>2</sup> Léa Pascal,<sup>2</sup> Hector Ormando,<sup>4</sup> Matthew J Carty,<sup>3</sup> Stéphanie Polazzi,<sup>1,2</sup> Jean-Christophe Lifante,<sup>1,5</sup> on behalf of the SHEWHART Trial Group

## ABSTRACT OBJECTIVE

To determine the effect of introducing prospective monitoring of outcomes using control charts and regular feedback on indicators to surgical teams on major adverse events in patients.

## DESIGN

National, parallel, cluster randomised trial embedding a difference-in-differences analysis.

## SETTING

40 surgical departments of hospitals across France.

## PARTICIPANTS

155 362 adults who underwent digestive tract surgery. 20 of the surgical departments were randomised to prospective monitoring of outcomes using control charts with regular feedback on indicators (intervention group) and 20 to usual care only (control group).

## INTERVENTIONS

Prospective monitoring of outcomes using control charts, provided in sets quarterly, with regular feedback on indicators (intervention hospitals). To facilitate implementation of the programme, study champion partnerships were established at each site, comprising a surgeon and another member of the surgical team (surgeon, anaesthetist, or nurse), and were trained to conduct team meetings, display posters in operating rooms, maintain a logbook, and devise an improvement plan.

## MAIN OUTCOME MEASURES

The primary outcome was a composite of major adverse events (inpatient death, intensive care stay, reoperation, and severe complications) within 30 days after surgery. Changes in surgical outcomes

were compared before and after implementation of the programme between intervention and control hospitals, with adjustment for patient mix and clustering.

## RESULTS

75 047 patients were analysed in the intervention hospitals (37 579 before and 37 468 after programme implementation) versus 80 315 in the control hospitals (41 548 and 38 767). After introduction of the control chart, the absolute risk of a major adverse event was reduced by 0.9% (95% confidence interval 0.4% to 1.4%) in intervention compared with control hospitals, corresponding to 114 patients (70 to 280) who needed to receive the intervention to prevent one major adverse event. A significant decrease in major adverse events (adjusted ratio of odds ratios 0.89, 95% confidence interval 0.83 to 0.96), patient death (0.84, 0.71 to 0.99), and intensive care stay (0.85, 0.76 to 0.94) was found in intervention compared with control hospitals. The same trend was observed for reoperation (0.91, 0.82 to 1.00), whereas severe complications remained unchanged (0.96, 0.87 to 1.07). Among the intervention hospitals, the effect size was proportional to the degree of control chart implementation witnessed. Highly compliant hospitals experienced a more important reduction in major adverse events (0.84, 0.77 to 0.92), patient death (0.78, 0.63 to 0.97), intensive care stay (0.76, 0.67 to 0.87), and reoperation (0.84, 0.74 to 0.96).

## CONCLUSIONS

The implementation of control charts with feedback on indicators to surgical teams was associated with concomitant reductions in major adverse events in patients. Understanding variations in surgical outcomes and how to provide safe surgery is imperative for improvements

## WHAT IS ALREADY KNOWN ON THIS TOPIC

Modern surgery still has a high incidence of adverse outcomes, with important consequences for patients

Control charts to monitor outcomes have been implemented in a wide range of settings and specialties, suggesting a broad applicability to healthcare

Tangible evidence of the impact of a nationwide system for monitoring outcomes using control charts to reduce inpatient adverse events occurrence is lacking

## WHAT THIS STUDY ADDS

A statistically significant reduction in major adverse events and patient death after surgery was found after implementation of a programme using control charts with regular feedback on indicators to surgical teams

The findings support the routine use of control charts to monitor variations in surgical outcomes over time to help prevent major adverse events

This affordable tool based on commonly available hospital data can be a cornerstone in the continuous improvement of patient safety

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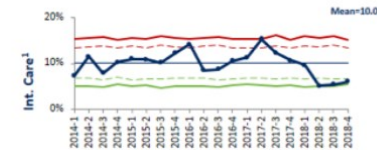
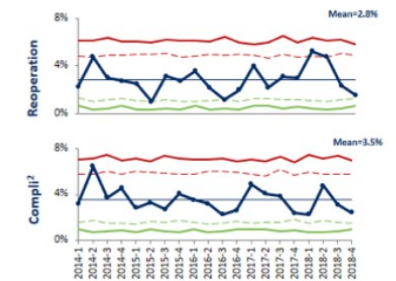
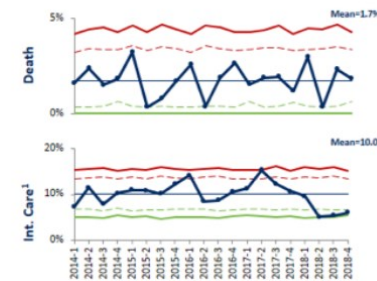
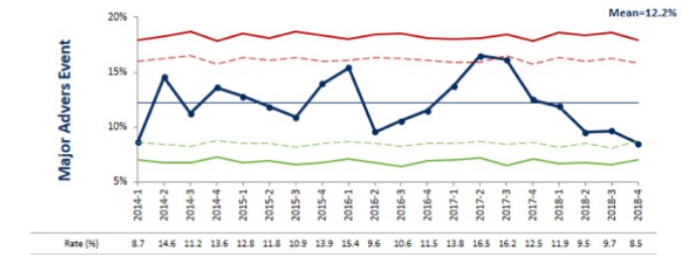
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## Surgical Outcomes Monitoring



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# National Health Service (NHS) trust boards adopt statistical process control reporting: the impact of the Making Data Count Training Programme

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<sup>2</sup>Patient and Staff Experience, Northumbria Healthcare NHS Foundation Trust, Northumberland, UK  
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 Published Online First 30 April 2021

**ABSTRACT**  
**Background** Red, amber, green (RAG) reports persist as the tool most commonly used by NHS trust boards to understand performance and gain assurance, despite statistical process control (SPC) being a more reliable way of presenting data over time. The aim of this study is to report board members' feedback on an educational intervention focusing on the use of SPC in NHS trust performance reports, review the presence of SPC charts in performance reports and explore board members' experience of behavioural changes in their board or fellow board members following the intervention.  
**Methods** A 90-minute board training session in the use of SPC—Making Data Count—was delivered to 61 NHS trust boards between November 2017 and July 2019. This paper describes the approach taken with boards to enable them to understand the limitations of RAG reports and the benefits of using

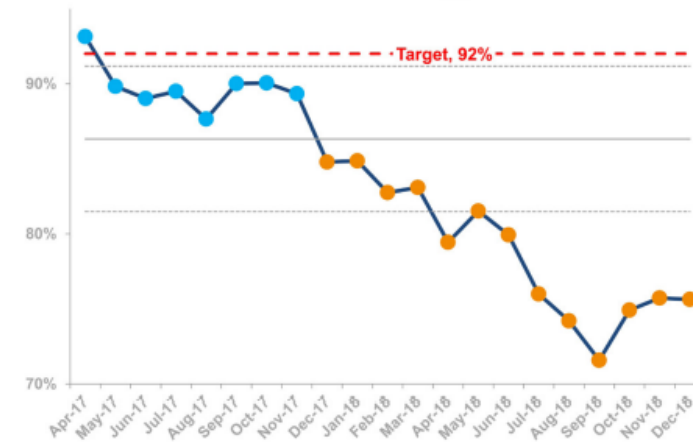
**INTRODUCTION**  
 Developing People Improving Care (DPIC),<sup>1</sup> launched in 2016 by the National Improvement and Leadership Development Board following the Smith review,<sup>2</sup> recognised the need to set out a long-term strategy to build improvement and leadership capacity and capability across the health and care system. It identified five evidence-based conditions common to high-quality health and care systems with cultures that equip and encourage people in NHS-funded roles to learn and deliver continuous improvement:  
 ▶ Condition 1: Leaders equipped to develop high-quality local health and care systems in partnership.  
 ▶ Condition 2: Compassionate, inclusive and effective leaders at all levels.  
 ▶ Condition 3: Knowledge of improvement

## Specialty RTT Performance

Specialty Performance	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Trend	Trend
Cardiology	94.7%	92.0%	92.3%	92.3%	93.0%	92.7%	94.3%	93.7%	94.4%	↑	0.7%
Dermatology	98.4%	98.1%	98.2%	95.8%	89.3%	85.7%	90.3%	90.8%	92.1%	↑	1.3%
Ear, Nose & Throat	92.0%	92.9%	92.3%	91.8%	90.0%	89.1%	88.4%	88.4%	87.0%	↓	-1.4%
Gastroenterology	86.5%	87.7%	86.3%	87.7%	87.7%	86.7%	85.8%	85.5%	86.1%	↑	0.6%
General Medicine	100.0%	100.0%	100.0%	100.0%	100.0%	92.3%	100.0%	100.0%	100.0%		0.0%
General Surgery	75.5%	78.5%	82.4%	87.5%	89.0%	87.1%	90.4%	88.8%	87.9%	↓	-0.9%
Geriatric Medicine	98.9%	98.9%	98.0%	96.3%	94.4%	96.9%	98.0%	99.1%	98.6%	↓	-0.5%
Gynaecology	87.0%	87.8%	89.3%	89.3%	88.9%	87.9%	87.9%	87.1%	85.3%	↓	-1.8%
Neurology	92.1%	92.1%	92.8%	89.2%	83.2%	84.7%	86.3%	87.6%	86.7%	↓	-0.9%
Ophthalmology	81.2%	84.5%	84.9%	86.3%	89.2%	89.3%	90.4%	90.0%	87.6%	↓	-2.4%
Oral Surgery	78.8%	81.8%	83.6%	82.6%	81.8%	83.9%	84.6%	85.7%	83.5%	↓	-2.2%
Orthopaedics	88.6%	92.0%	91.4%	89.3%	87.4%	87.1%	85.5%	83.6%	83.2%	↓	-0.4%
Other	87.9%	88.4%	90.0%	89.7%	89.8%	89.6%	91.0%	91.5%	90.4%	↓	-1.1%
Plastic Surgery	82.2%	84.7%	87.6%	89.2%	88.7%	88.2%	88.6%	87.9%	84.7%	↓	-3.2%
Respiratory Medicine	79.3%	83.4%	87.5%	89.8%	92.2%	93.2%	92.6%	92.2%	86.1%	↓	-6.1%
Rheumatology	79.4%	81.5%	79.9%	76.0%	74.1%	71.5%	74.9%	75.7%	75.6%	↓	-0.1%
Urology	85.4%	87.5%	88.7%	89.9%	91.5%	91.4%	92.0%	92.2%	90.6%	↓	-1.6%
TRUST	86.1%	87.7%	88.7%	88.7%	88.3%	87.9%	88.7%	88.7%	87.4%	↓	-1.3%

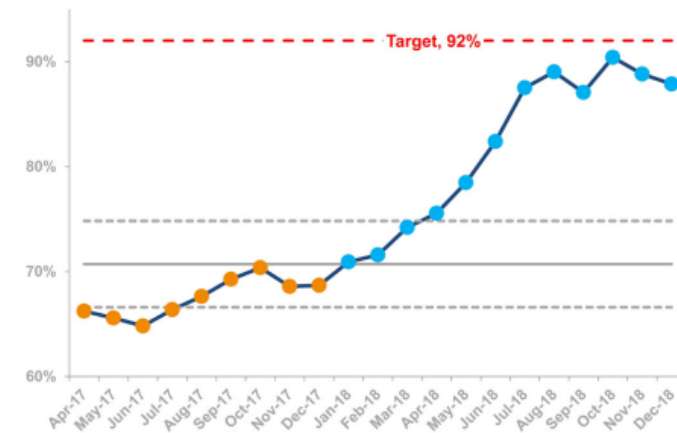
**Figure 1** Data from an acute trust showing referral to treatment (RTT) performance against nationally mandated targets. Red and green indicate whether a target is being achieved.

## Rheumatology



**Figure 3** Rheumatology data from Figure 1 presented in SPC format. This reveals a deteriorating pattern of performance which was difficult to detect in Figure 1.

## General Surgery



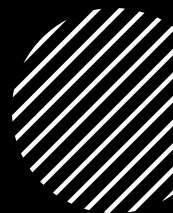
**Figure 2** General surgery data from figure 1 presented in SPC format. This reveals improvement that has been masked by the red.

# Key points : variation is the voice of the system

- Systems cause variation
  - Common cause – due to the system
  - Special cause – extrinsic to the system
- Systems capability vs targets
- Visualise variation
  - Run charts
  - Statistical Process Control Charts, Funnel plots
  - ...
- Reflections...



# Share your insights...



Any key insights...



So what...  
(any scope for application)



One wish...