

Part 2...

- Dr Nathan Proudlove
 - Teaching, facilitating & doing QI with the NHS
- Practical challenges on the frontline
 - e.g., software
- An *Excel* implementation of the new I'-chart
- Comments and reflections

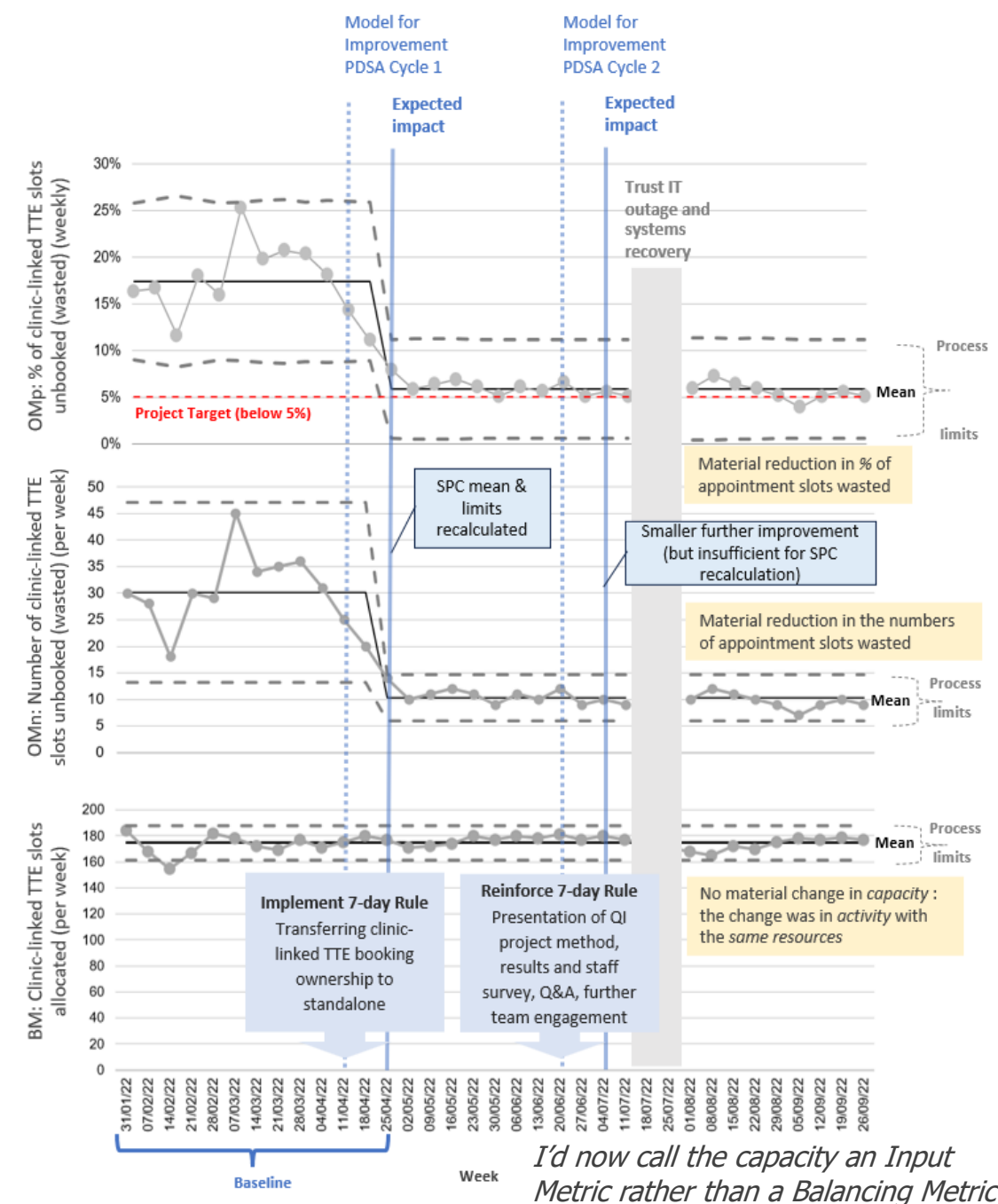
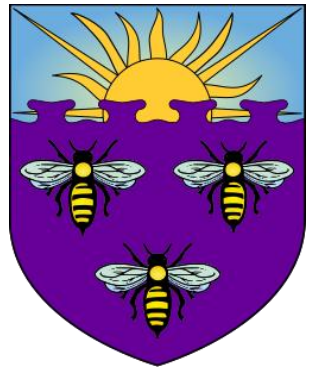


Figure 2: TEE Outpatient QI Project – SPC charts of Metrics over Time

OM = Outcome Metric; BM = Balancing Metric; PDSA = Plan-Do-Study-Act Cycle

Teaching, facilitating & doing QI with the NHS



Operational Research, Operations Management, QI

Associate Professor, Alliance Manchester Business School, University of Manchester

- Module Leader, MSc *Business Analytics*
- Programme Director and Module Leader, **NHS Higher Specialist Scientist Training (HSST) Programme (DClinSci / PgDip)**



National School of Healthcare Science

and

- Associate tutor & supervisor, MSc in *Surgical Science and Practice* and Postgraduate Certificate in *Patient Safety and Quality Improvement*, University of Oxford
- Researcher, Queen Mary University of London & Barts Health



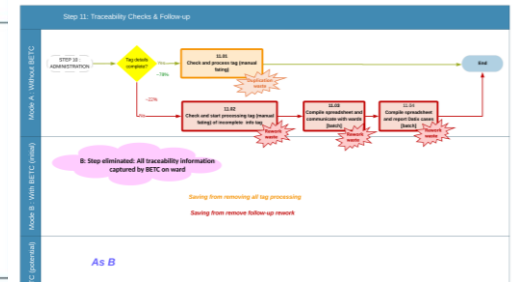
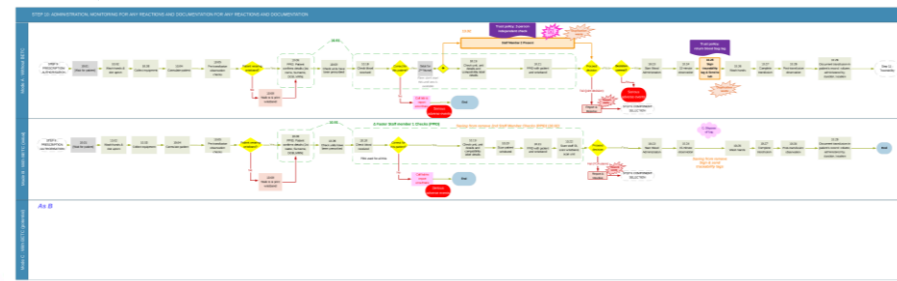
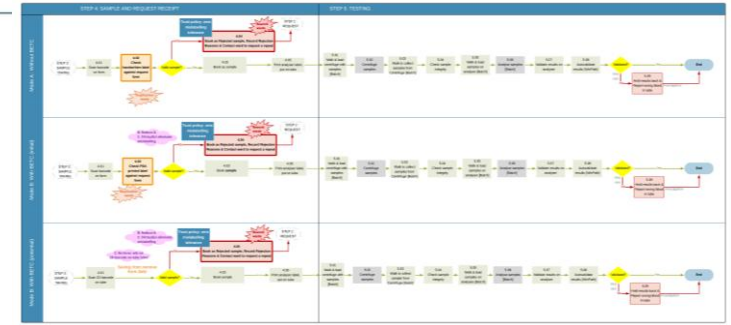
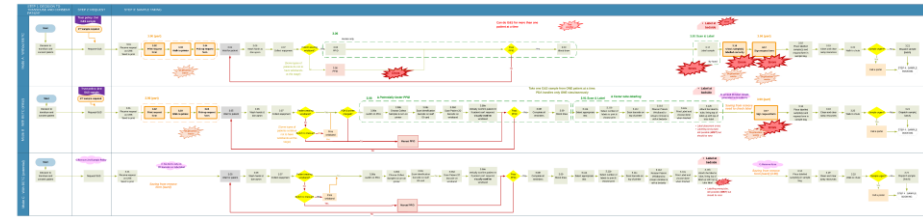
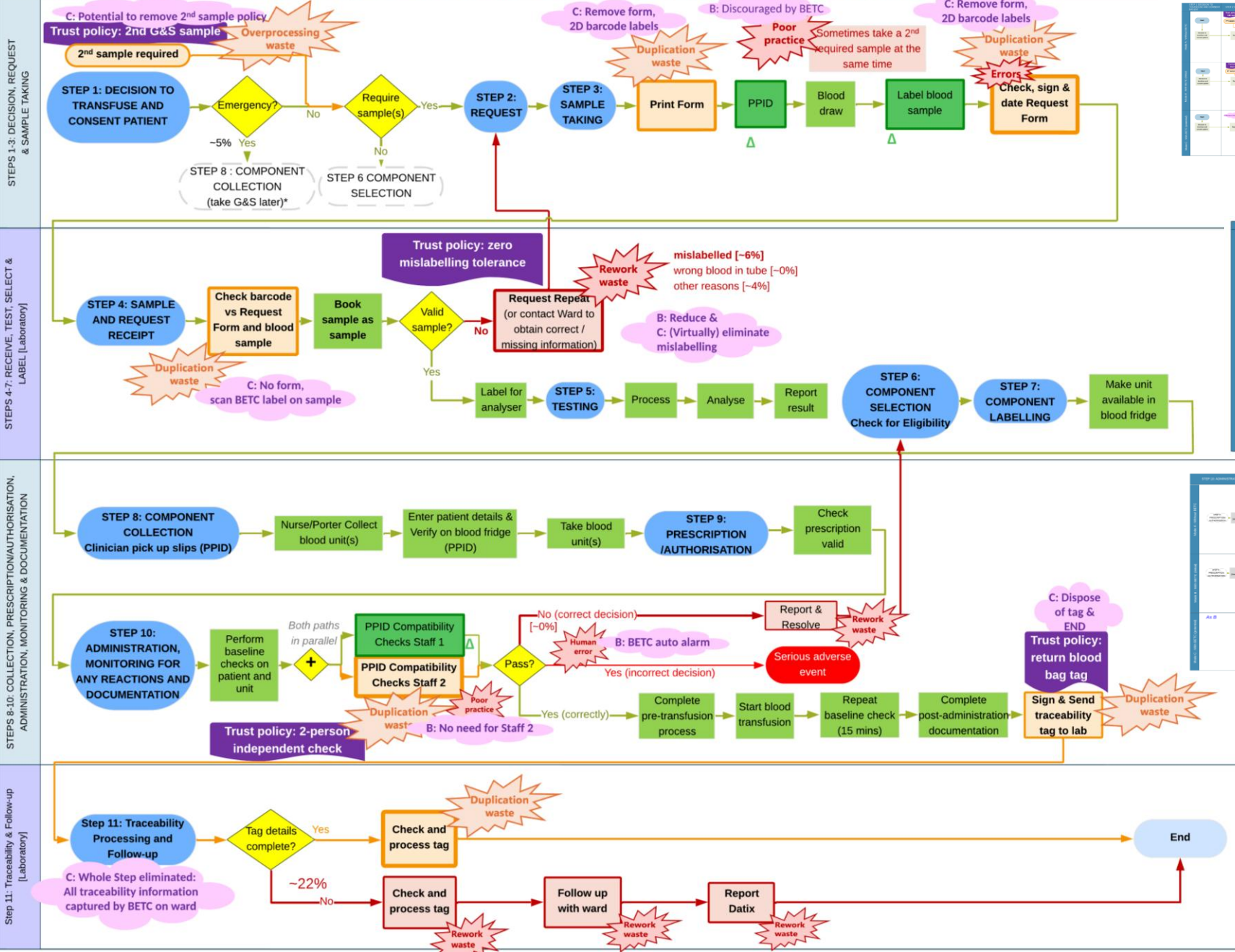
Barts Health NHS Trust



Blood Transfusion Process at Barts Health NHS Trust

Without-BETC process (Mode A) with changes in BETC wards: Mode B (BETC initial implementation) and Mode C (BETC full potential)

Doing QI with the NHS



R : qicharts2 + ggplot2

SPC P' chart

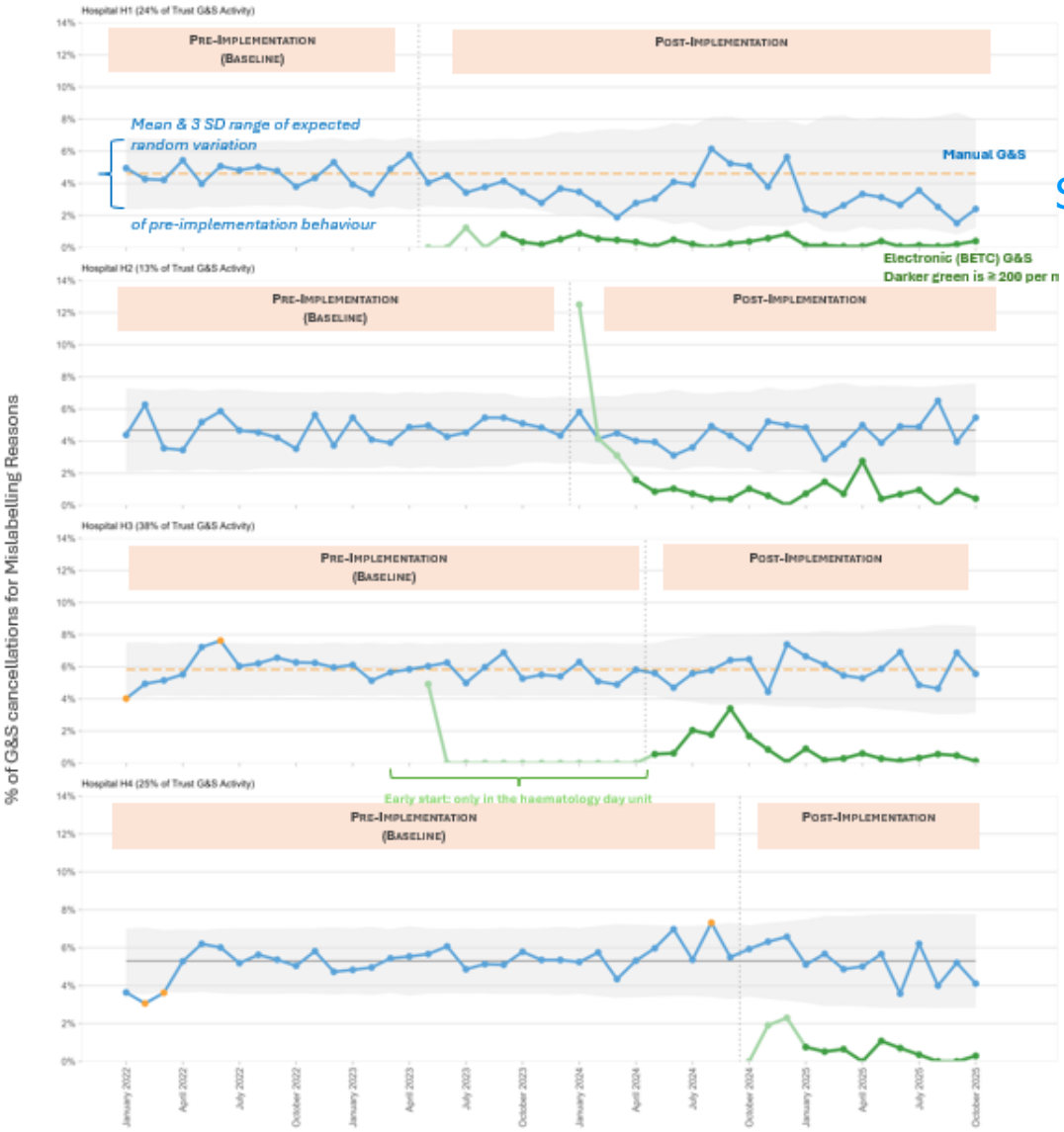


Figure 1: Group & Screen mislabelling rejection rates at the four hospital sites, comparing the rates for manually vs electronic (without vs with BETC support)

The **blue** line is the manual samples with ranges derived from statistical process control (SPC) P'-chart calculations. **Orange** points and mean lines alert us to potentially non-random behaviours using SPC's detection rules, these are minor given the amount of data. The **green** lines are rejection rates for BETC G&S samples, **light green** for early use (< 200 G&S per month); low rates and small denominators make the rates volatile.

SPC G chart

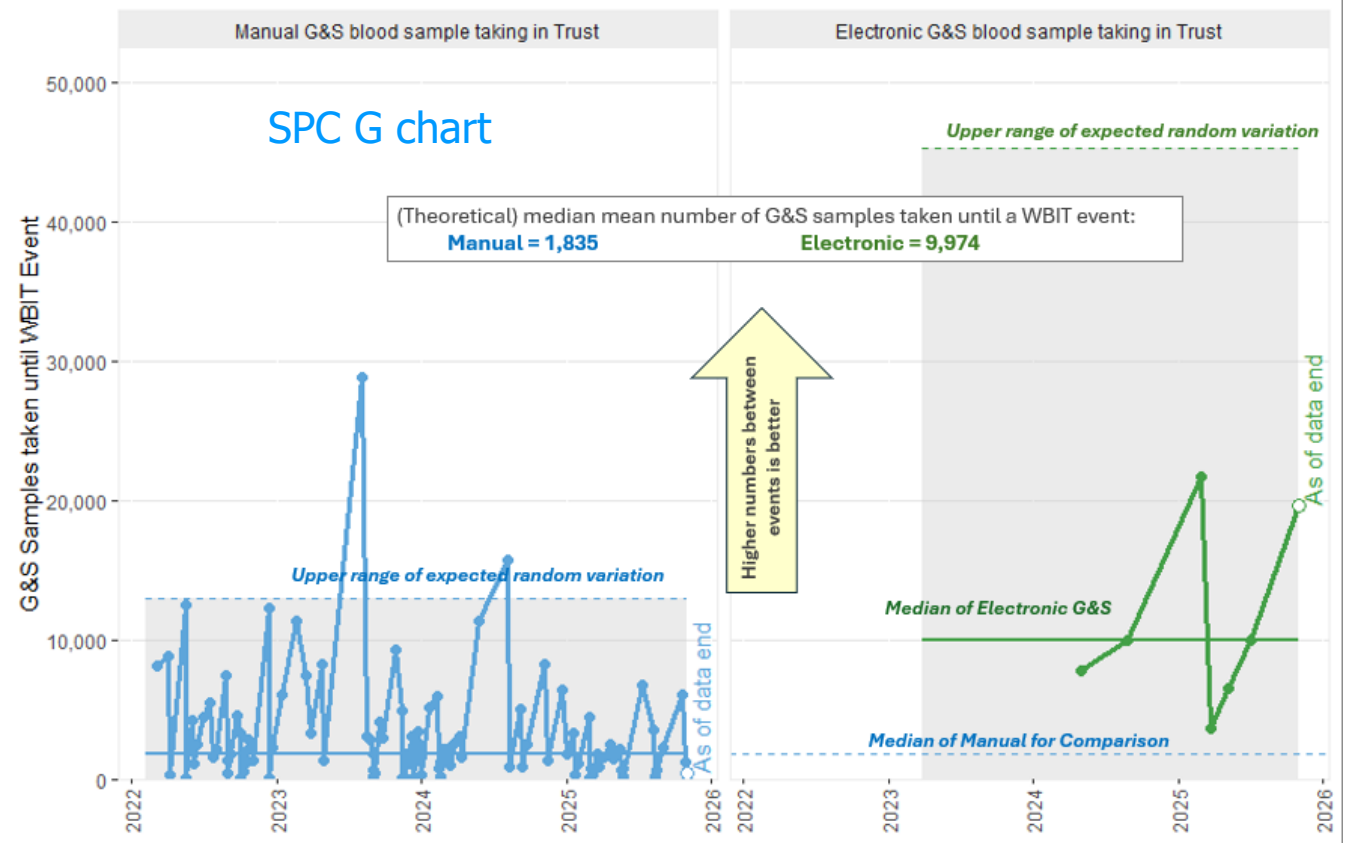
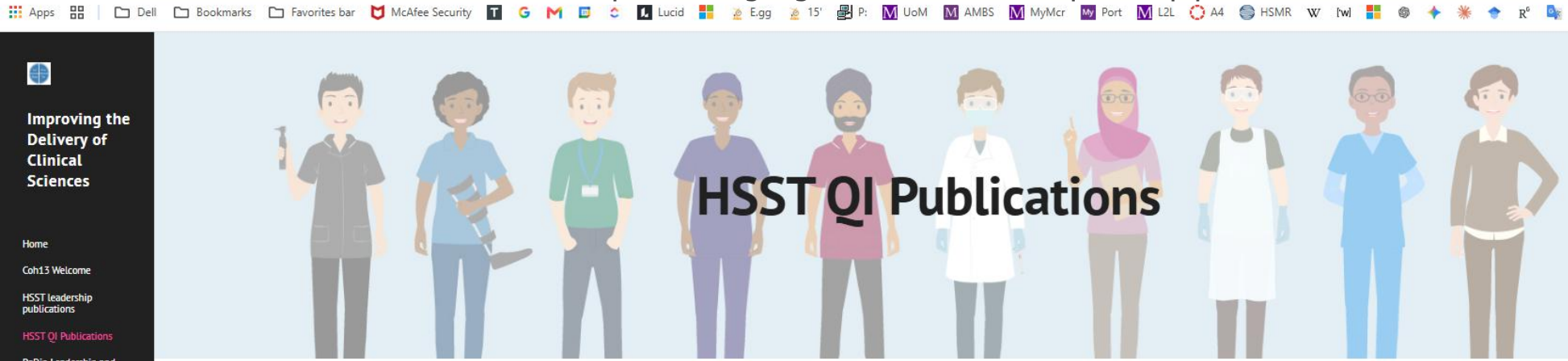


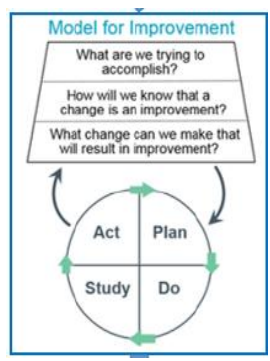
Figure 3 : Group & Screen Wrong Blood in Tube events shown in statistical process control G-chart format, comparing the manually vs electronic G&S.

The Y axis is the number of G&S samples between each WBIT event. Hollow circles are the running number of cases as of the end of the data series (right-censored data). All seven data points for the electronic system are above the median of the manual system.



Improving the Delivery of Clinical Sciences

- Home
- Coh13 Welcome
- HSST Leadership publications
- HSST QI Publications
- PgDip Leadership and Management in the Healthcare Sciences
- DClinSci Theses



Open access Quality improvement report

BMJ Open Quality Clinical-scientist-led transoesophageal echocardiography (TOE): using extended roles to improve the service

Nikki Kaye,¹ Michael Purdon,¹ Rebecca Schofield,¹ Grazia Antonacci,^{2,3} Nathan Proudlove^{1,4}

ABSTRACT
At the North West Anglia NHS Foundation Trust, we perform transoesophageal echocardiography (TOE), a semi-invasive diagnostic test using ultrasound for high-quality heart imaging. TOE allows accurate diagnosis of serious heart problems to support high-quality clinical decision-making about treatment pathways. The procedure can be lengthy and is traditionally performed by a consultant cardiologist, who typically has multiple commitments. This constrains patient access to TOE, leading to waits from referral to test, delaying treatment decisions.

WHAT IS ALREADY KNOWN ON THIS TOPIC
⇒ Consultant cardiologist capacity in the English National Health Service (NHS) is severely constrained, limiting access to diagnostic procedures such as transoesophageal echocardiography (TOE) for both inpatients and outpatients; this has not been investigated in the literature.

WHAT THIS STUDY ADDS
⇒ This study demonstrates how a TOE service can be redesigned for clinical scientist leadership and achieve results as good as (or better than) under a consultant cardiologist, improving patient access and liberating consultant cardiologist time.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

This is work done or started for the NHS Higher Specialist Scientist Training (HSST) Programme's Unit A4 *Leadership & Quality Improvement in the Clinical and Scientific Environment*, run by Alliance Business School of the University of Manchester. Unit leader Dr Nathan Proudlove nathan.proudlove@manchester.ac.uk

Clinical specialisms covered so far are: Cardiac Science, Clinical Bioinformatics (Genomics), Clinical Immunology, Genomics, Haematology and Transfusion Science, Histocompatibility & Immunogenetics, Imaging Physics, Medical Physics, Microbiology, Neurophysiological Sciences, Nuclear Medicine, Radiotherapy Physics, Reproductive Science

Most papers demonstrate using the Model for Improvement (Mfi), with tools & techniques including: a driver diagram, process mapping, root cause analysis, statistical process control (SPC) and plan-do-study-act (PDSA) cycles.

- click on the table and open in a new tab to see all contents and filter

Theme	Specialism	Year	QI/Int/Type	Journal/Conference/Univ Title	HSST Authors	URL
Informatics	Clinical Bioinformatics	2023	other	Peer-reviewed Journal <i>Ethics and Information Tech</i>	Ethics framework for predictive clinical AI model updating	Michal Pruski https://doi.org/10.1093/bioinformatics/btad001
Informatics	Clinical Bioinformatics (Genom	2022	QI	Peer-reviewed Journal <i>BMJ Open Quality</i>	A quality improvement project to reduce the turnaround times of infec	Ying Li https://doi.org/10.1136/bmjopen-2022-028268
Informatics	Clinical Bioinformatics (Genom	2022	QI	DClinSci Thesis University of Manchester	The development and implementation of a framework for managing c	Andrew Parrish https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Clinical Immunology	2020	Conference long abs	<i>Annals of the Rheumatic D</i>	Statistical process control and process mapping quantify the effects of	Stevens M https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Clinical Immunology	2024	QI	Peer-reviewed Journal <i>Journal of Clinical Patholog</i>	Successful demand management in the diagnostic immunology laborat	Kristen Lilly https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Haematology and Transfusion S	2023	Entrepre	DClinSci Thesis Manchester Metropolitan	Utilisation of LEAN Start Up methodology for the identification, develo	Matthew Hazell https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Haematology and Transfusion S	2022	QI	Peer-reviewed Journal <i>BMJ Open Quality</i>	Making every drop count: reducing wastage of a novel blood compone	Jo McCullagh https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Haematology and Transfusion S	2023	QI	Conference Poster <i>International Society of Bio</i>	Optimising WB component supply - A Monte Carlo simulation model	Jo McCullagh https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Haematology and Transfusion S	2021	QI	Peer-reviewed Journal <i>BMJ Open Quality</i>	Summarised, verified and accessible: improving clinical information m	Felicity May https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Histocompatibility & Immunog	2021	QI	Peer-reviewed Journal <i>BMJ Open Quality</i>	Improving turnaround times for HLA-B*27 and HLA-B*57:01 gene testi	Emma White https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Histocompatibility & Immunog	2025	QI	Peer-reviewed Journal <i>BMJ Open Quality</i>	A quality improvement project to reduce Beta-2-microglobulin tumaroun	Madeline Stone https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Microbiology	2025	QI	Peer-reviewed Journal <i>BMJ Open Quality</i>	Reducing laboratory delays in blood culture pathogen identification: a	Fenella Halstead https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Reproductive Science	2022	QI	Peer-reviewed Journal <i>BMJ Open Quality</i>	Doing today's work today: real-time data recording and rolling audit in	Lucy Wood https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Reproductive Science	2022	QI	Conference Poster <i>Assoc of Reprod & Clinical</i>	Doing today's work today: real-time data recording and rolling audit in	Lucy Wood https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Reproductive Science	2022	QI	DClinSci Thesis Manchester Metropolitan	Incremental gains within an assisted conception service – utilising evid	Emma Woodland https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Reproductive Science	2022	QI	Peer-reviewed Journal <i>BMJ Open Quality</i>	Improving ICSI success rates following root cause analysis and use of s	Emma Woodland https://doi.org/10.1136/bmjopen-2022-028268
Life Science	Reproductive Science	2025	QI	DClinSci Thesis Manchester Metropolitan	The IVF laboratory: from coping and workarounds to a structured and	Aida Kaffel https://doi.org/10.1136/bmjopen-2022-028268
Physical Sci	Imaging Physics	2019	QI	Conference Abstract <i>British Institute of Radiology</i>	Quality Improvement Publications in Functional Imaging: Can We Do B	Katrina Cockburn, E https://doi.org/10.1136/bmjopen-2022-028268

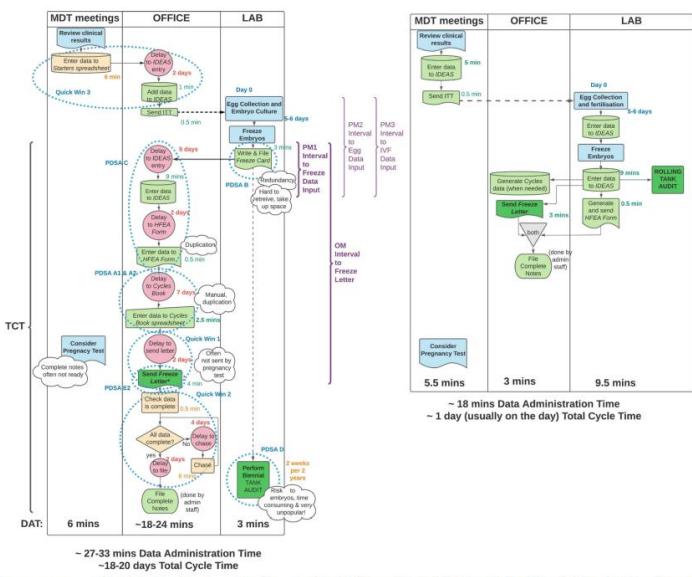
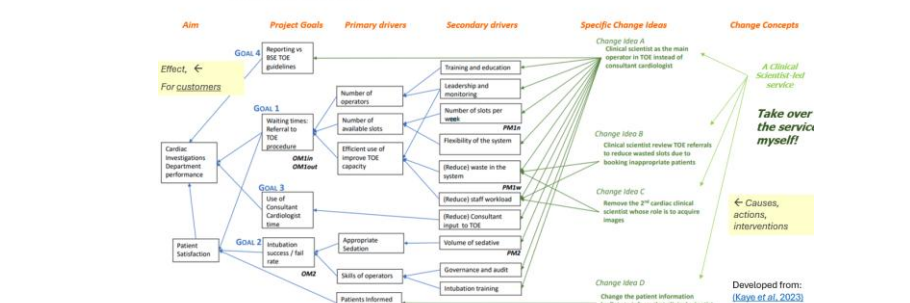
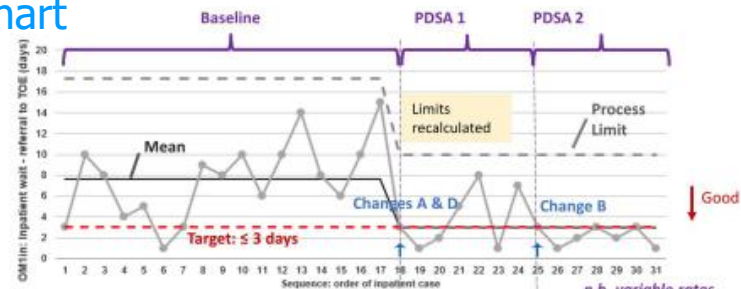
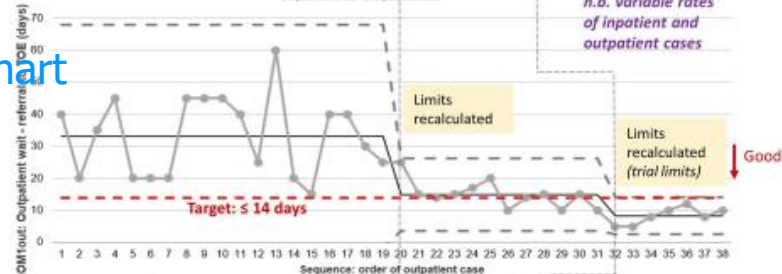


Figure 1 Process maps of administration involved in a patient IVF cycle at ACU. Left: As-Was (original) Condition Right: Improved Condition

SPC I chart



SPC I chart



Run chart



Stacks of metrics

Excel (templates)
→ PowerPoint
+ annotation

SPC I chart
(of *Xbar* data...)

[Some of these
recalculation
points may not
be the best
judgements!]

SPC P chart

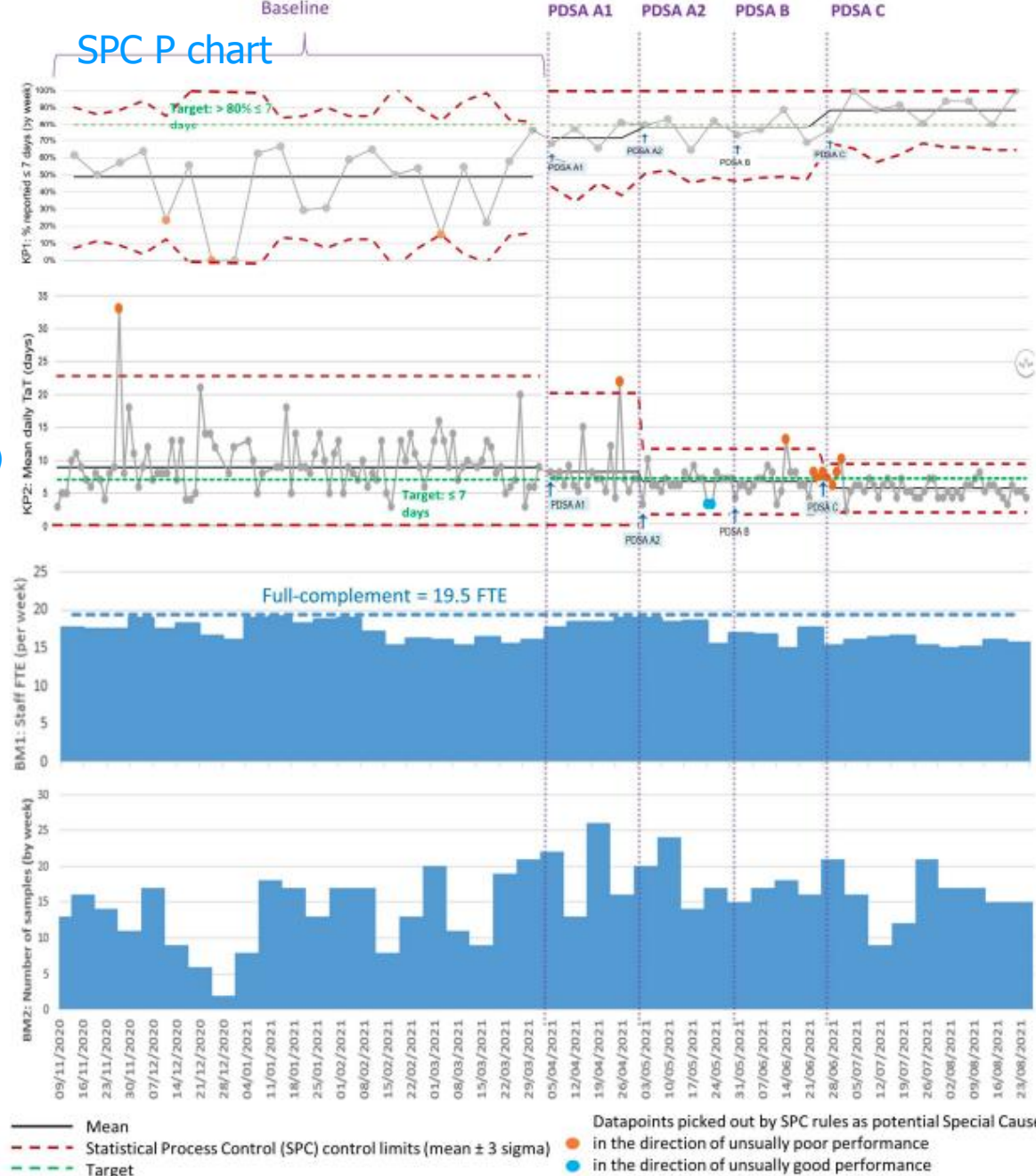
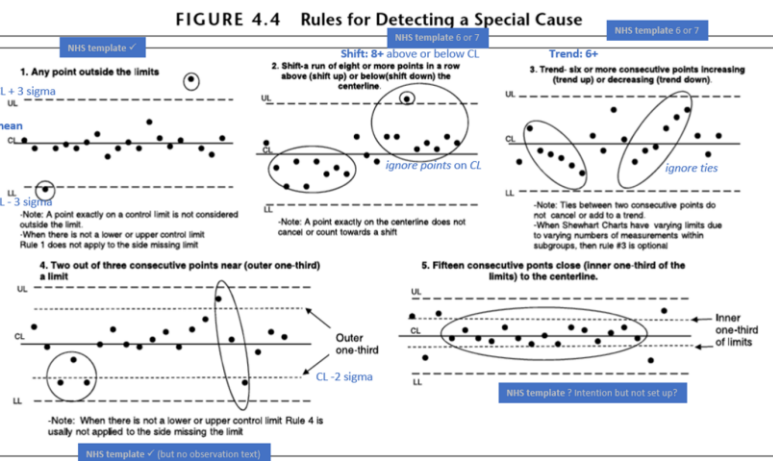
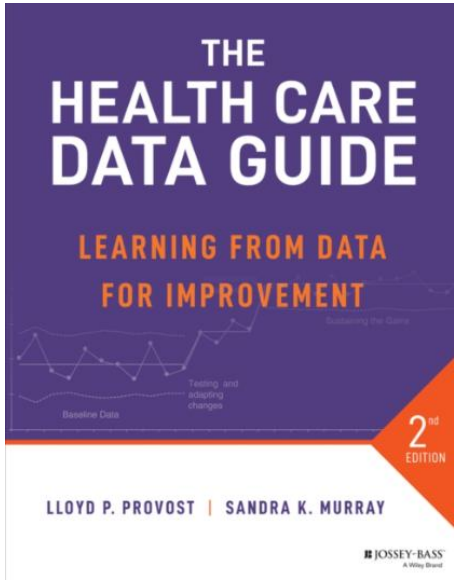


Figure 2 Main performance metrics and balancing metrics over baseline and four cycles of PDSA. Graphics often do not

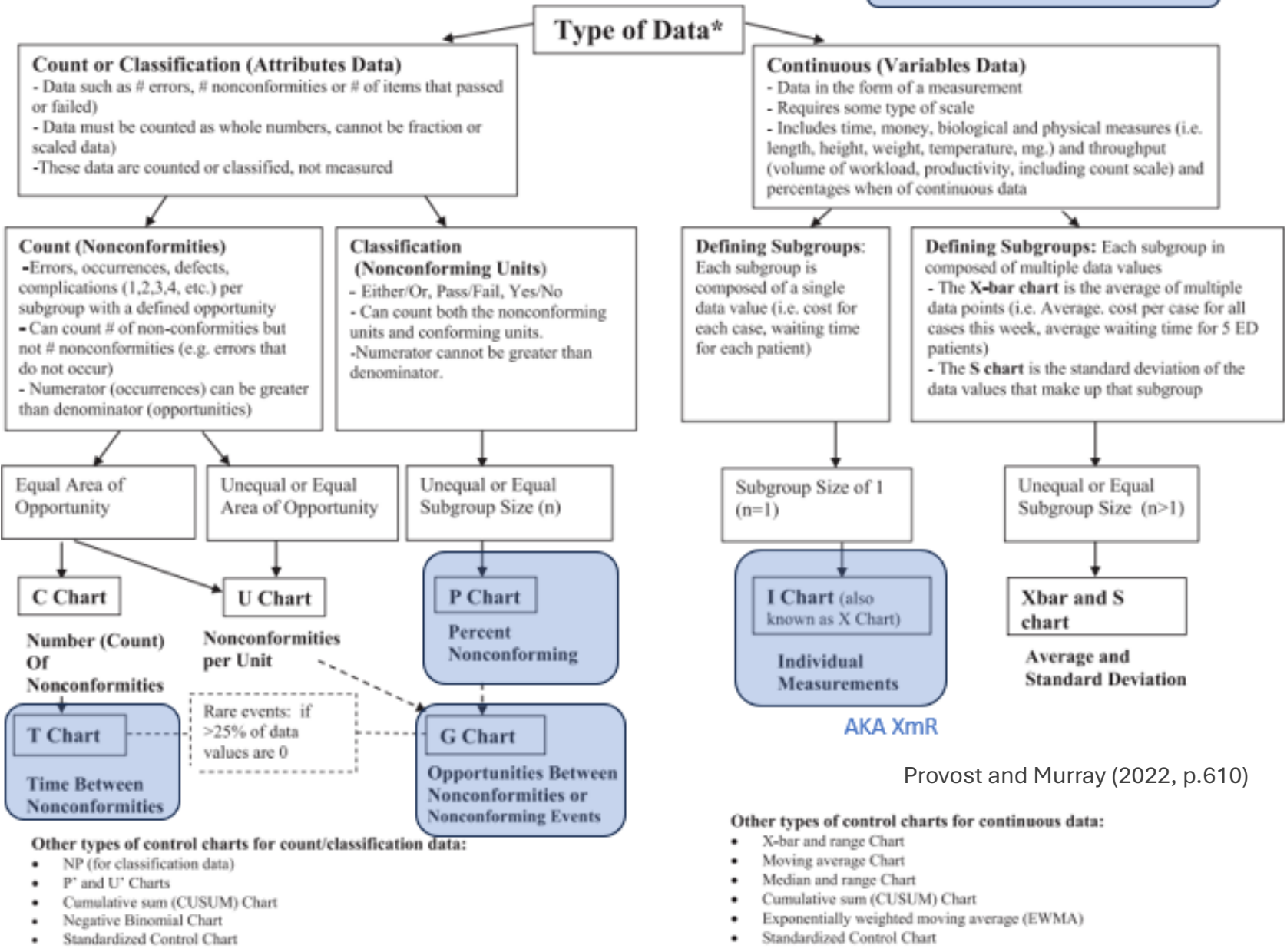
Family tree of

‘Statistical Process Control’
(SPC) charts



SPC [Shewhart] Chart Selection Guide

NHS VBA/macro templates



*A run chart may be used with any type of data. It is often the starting point for viewing data over time when little data are available.

Statistical process control tool

Document first published: 17 August 2020
Page updated: 14 April 2026
Topic: Finance
Publication type: Guidance

Statistical process control (SPC) is an analytical technique that plots data over time. It helps us understand variation and in so doing guides us to take the most appropriate action.

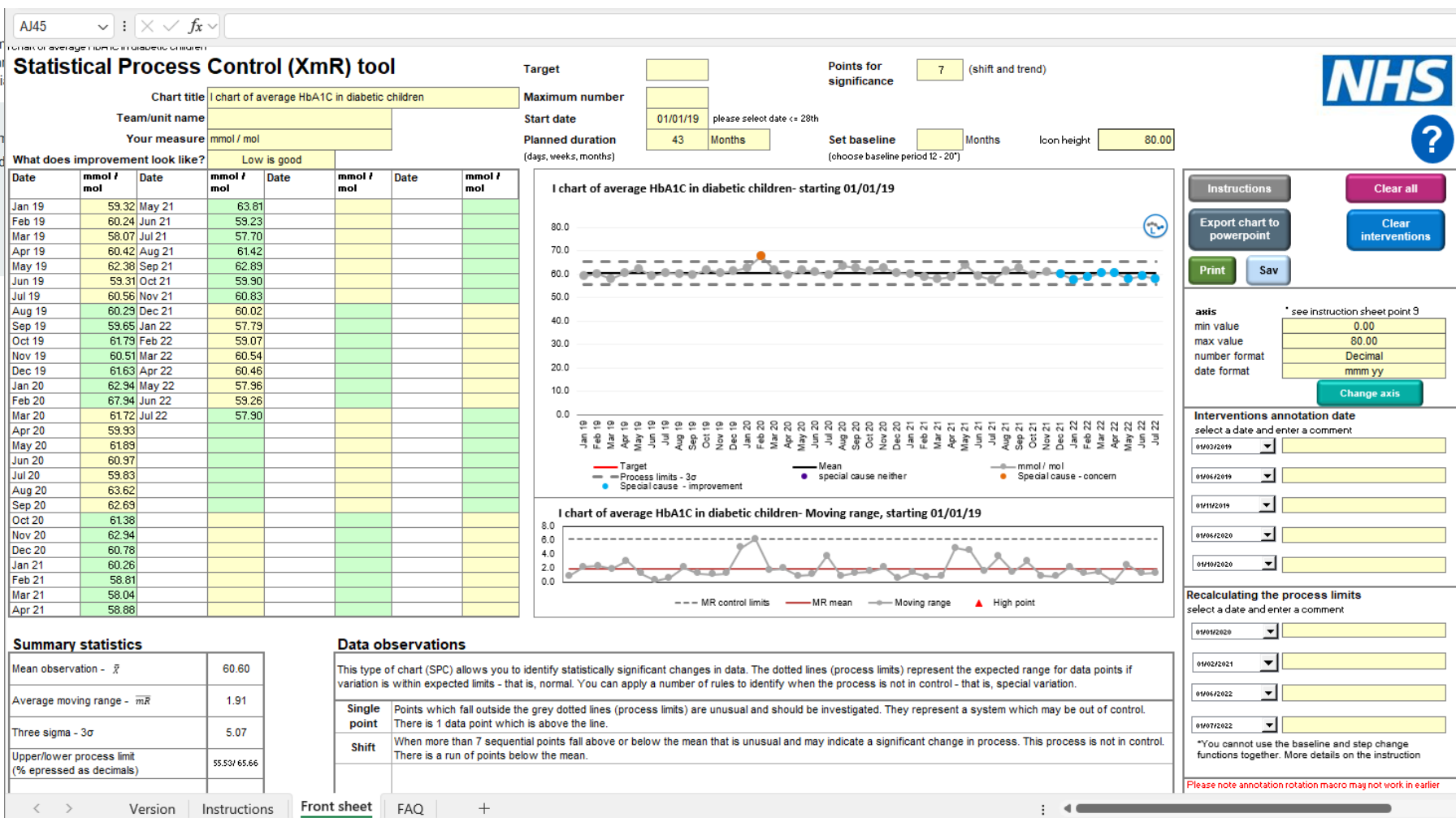
This tool will enable you to:

- record your data on a daily, weekly or monthly basis
- indicate when a process may have changed
- annotate your chart and when appropriate

Document

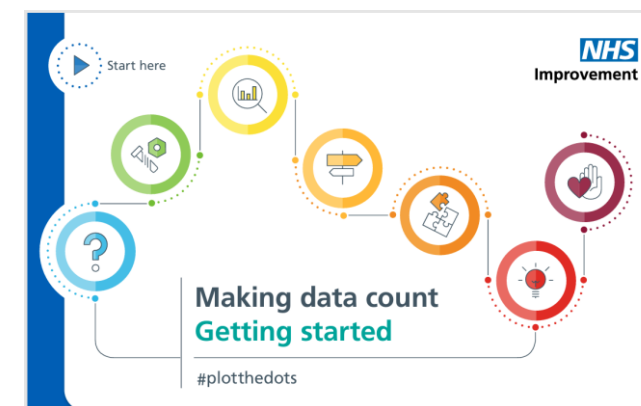


Statistical process control tool
Microsoft Excel 639 KB



ImR is the only of the MDC templates that is public

The others are on the Futures platform (archived); not as far developed



Some issues:

- Excel/ macros / VBA
- Locked cells & graphs
- Hidden calculation sheet
- mR not screened
- Special Cause rules rather 'liberal'
- Can exclude points, but not ghost
- Max dataseries length (on front sheet)
- (can 'hack': Password: SPC !)

Raw data- setup for SPC chart

Only enter data into yellow cell

Distributed e.g. through
facilitation of Collaboratives

Click here for SPC chart

Click here for template guidance



Elect

© NHS Elect 2026

DO NOT EDIT BLUE SECTIONS

Date or Occurrence	Measurement	Stage	Average	1 Sigma	Upper Control Limit	Lower Control Limit	80% of Variation	Moving Range	Average Moving Range	MR UCL
01/04/2019	59.32	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/05/2019	60.24	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055	0.918949404	1.905528555	6.225361788
01/06/2019	58.07	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055	2.175341574	1.905528555	6.225361788
01/07/2019	60.42	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/08/2019	62.38	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/09/2019	59.31	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/10/2019	60.56	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/11/2019	60.29	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/12/2019	59.65	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/01/2020	61.79	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/02/2020	60.51	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/03/2020	61.63	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/04/2020	62.94	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/05/2020	67.94	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/06/2020	61.72	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/07/2020	59.93	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/08/2020	61.89	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/09/2020	60.97	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/10/2020	59.83	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/11/2020	63.62	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/12/2020	62.69	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/01/2021	61.38	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/02/2021	62.94	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/03/2021	60.78	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/04/2021	60.26	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/05/2021	58.81	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/06/2021	58.04	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/07/2021	58.88	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/08/2021	63.81	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/09/2021	59.23	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788
01/10/2021	57.70	1	60.595273	1.689298364	65.66316809	55.52737791	63.12922055		1.905528555	6.225361788

SPC (I-MR) Chart

Click here to return to raw data

Click here for template guidance

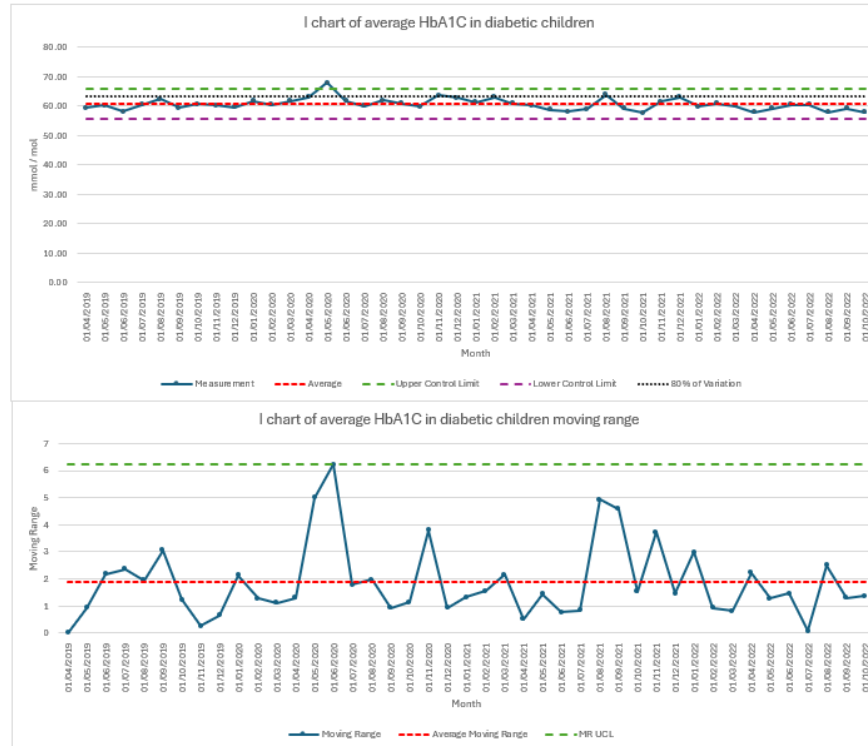


Elect

© NHS Elect 2026

Stage

1



Raw Data Setup

SPC Chart

SPC Chart Template Guidance

+

Raw Data Setup

SPC Chart

SPC Chart Template Guidance

+

Raw data - setup for I' SPC chart

Only enter data into green cells

optional

Chart Title	I chart of average HbA1C in diabetic children
Vertical (Y-Axis) Title	mmol / mol
Horizontal (X-Axis) Title	Month

Nathan Proudlove
nathan.proudlove@manchester.ac.uk
Based on © NHS Elect 2026



Elect

DO NOT EDIT BLUE SECTIONS

Include "Freeze" in the name of a Regime to freeze and project the mean and limits

Type "1" or "TRUE" in Exclude to exclude a point from the calculations and show it ghosted as an assigned special cause

If you are plotting L

You can format Col B (e.g. to be dates)

Comment is just for notes - it does not do anything

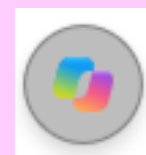
Date or Occurrence	Metric	SubGroupSize	Target	Regime	Exclude	Comment	AssignedCause	Process	CentreLine	Sigma	SigmaScreened	Upper Process Limit	Lower Process Limit	UPLScreened	LPLScreened	Mean + 1.5 Sigma
01/04/2019	59.32	1	42	1-Baseline				59.32	61.01	1.65	1.48	65.94	56.07	65.44	56.57	63.45
01/05/2019	60.24	1	42	1-Baseline				60.24	61.01	1.65	1.48	65.94	56.07	65.44	56.57	63.45
01/06/2019	58.07	1	42	1-Baseline				58.07	61.01	1.65	1.48	65.94	56.07	65.44	56.57	63.45
01/07/2019	60.42	1	42	1-Baseline				60.42	61.01	1.65	1.48	65.94	56.07	65.44	56.57	63.45
01/08/2019	62.38	1	42	1-Baseline				62.38	61.01	1.65	1.48	65.94	56.07	65.44	56.57	63.45
01/09/2019											1.48	65.94	56.07	65.44	56.57	63.45
01/10/2019											1.48	65.94	56.07	65.44	56.57	63.45
01/11/2019											1.48	65.94	56.07	65.44	56.57	63.45
01/12/2019											1.48	65.94	56.07	65.44	56.57	63.45
01/01/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/02/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/03/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/04/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/05/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/06/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/07/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/08/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/09/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/10/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/11/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/12/2020											1.48	65.94	56.07	65.44	56.57	63.45
01/01/2021											1.48	65.94	56.07	65.44	56.57	63.45
01/02/2021											1.48	65.94	56.07	65.44	56.57	63.45
01/03/2021											1.48	65.94	56.07	65.44	56.57	63.45
01/04/2021											1.48	65.94	56.07	65.44	56.57	63.45
01/05/2021	58.81	1	42	1-Baseline				58.81	61.01	1.65	1.48	65.94	56.07	65.44	56.57	63.45
01/06/2021	58.04	1	42	1-Baseline				58.04	61.01	1.65	1.48	65.94	56.07	65.44	56.57	63.45
01/07/2021	58.78	1	42	1-Baseline				58.78	61.01	1.65	1.48	65.94	56.07	65.44	56.57	63.45
01/08/2021	58.04	1	42	1-Baseline				58.04	61.01	1.65	1.48	65.94	56.07	65.44	56.57	63.45
01/09/2021	58.04	1	42	1-Baseline				58.04	61.01	1.65	1.48	65.94	56.07	65.44	56.57	63.45
01/10/2021											1.48	65.94	56.07	65.44	56.57	63.45
01/11/2021											1.48	65.94	56.07	65.44	56.57	63.45
01/12/2021											1.48	65.94	56.07	65.44	56.57	63.45
01/01/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/02/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/03/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/04/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/05/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/06/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/07/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/08/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/09/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/10/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/11/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/12/2022											1.48	65.94	56.07	65.44	56.57	63.45
01/01/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/02/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/03/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/04/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/05/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/06/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/07/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/08/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/09/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/10/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/11/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/12/2023											1.48	65.94	56.07	65.44	56.57	63.45
01/01/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/02/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/03/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/04/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/05/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/06/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/07/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/08/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/09/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/10/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/11/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/12/2024											1.48	65.94	56.07	65.44	56.57	63.45
01/01/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/02/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/03/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/04/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/05/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/06/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/07/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/08/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/09/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/10/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/11/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/12/2025											1.48	65.94	56.07	65.44	56.57	63.45
01/01/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/02/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/03/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/04/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/05/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/06/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/07/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/08/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/09/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/10/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/11/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/12/2026											1.48	65.94	56.07	65.44	56.57	63.45
01/01/2027											1.48	65.94	56.07	65.44	56.57	63.45
01/02/2027											1.48	65.94	56.07	65.44	56.57	63.45
01/03/2027											1.48	65.94	56.07	65.44	56.57	63.45
01/04/2027											1.48	65.94	56.07	65.44	56.57	63.45
01/05/2027											1.48	65.94	56.07	65.44	56.57	63.45
01/06/2027											1.48	65.94	56.07	65.44	56.57	63.45
01/07/2027											1.48	65.94	56.07	65.44	56.57	63.45
0																

My version:

- **I'**: Can enter **numerator & denominator** (subgroup size)

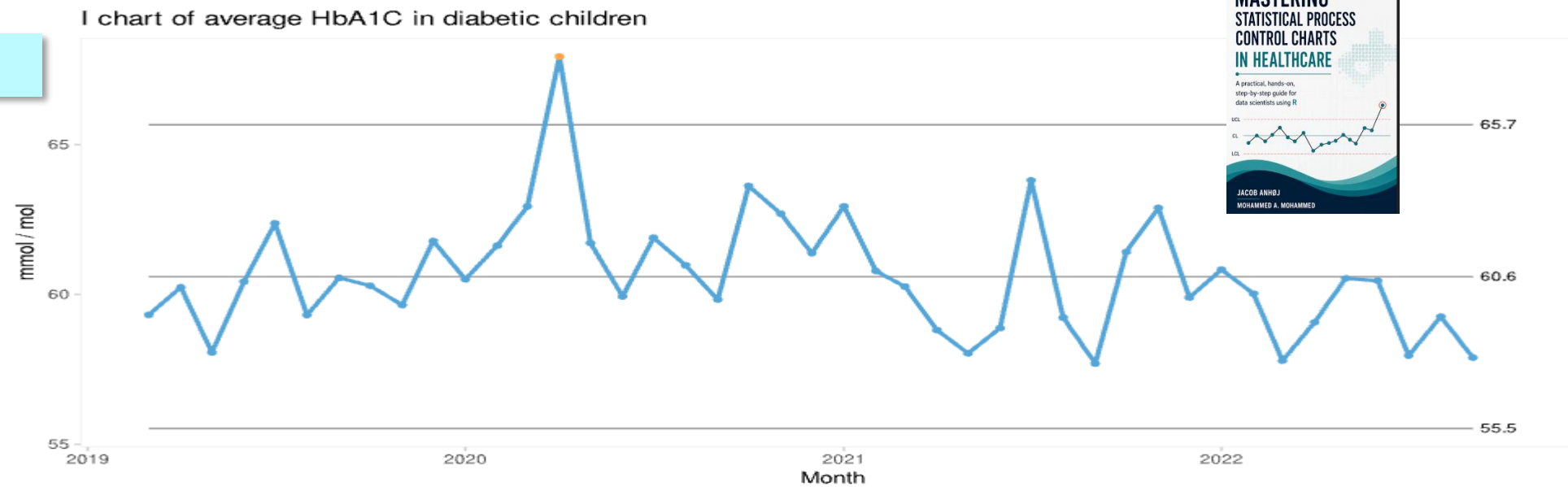
+ More Features

- screen mR / moving S
- Can Freeze centre line & process limits
- Can exclude and ghost points

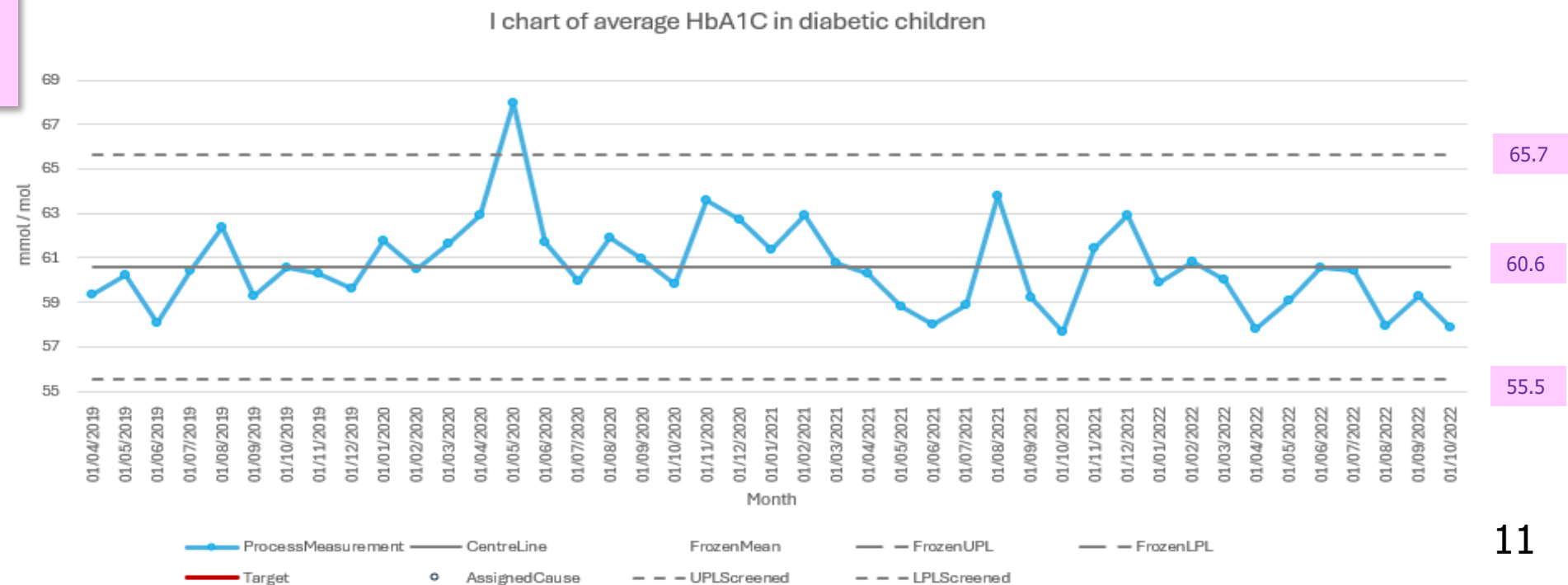


No SC rule flags added, except for mR / mS

qicharts2: qic() chart = 'i'



Using *Exce/I'* tool
Denominators = 1 $\rightarrow$ I chart



Raw data - setup for I' SPC chart

Nathan Proudlove
nathan.proudlove@manchester.ac.uk
Based on © NHS Elect 2026



Elect

Only enter data into green cells

optional

Chart Title	I chart of average HbA1C in diabetic children
Vertical (Y-Axis) Title	mmol / mol
Horizontal (X-Axis) Title	Month

DO NOT EDIT BLUE SECTIONS

Include "Freeze" in the name of a Regime to freeze and project the mean and limits

Type "1" or "TRUE" in Exclude to exclude a point from the calculations and show it ghosted as an assigned special cause

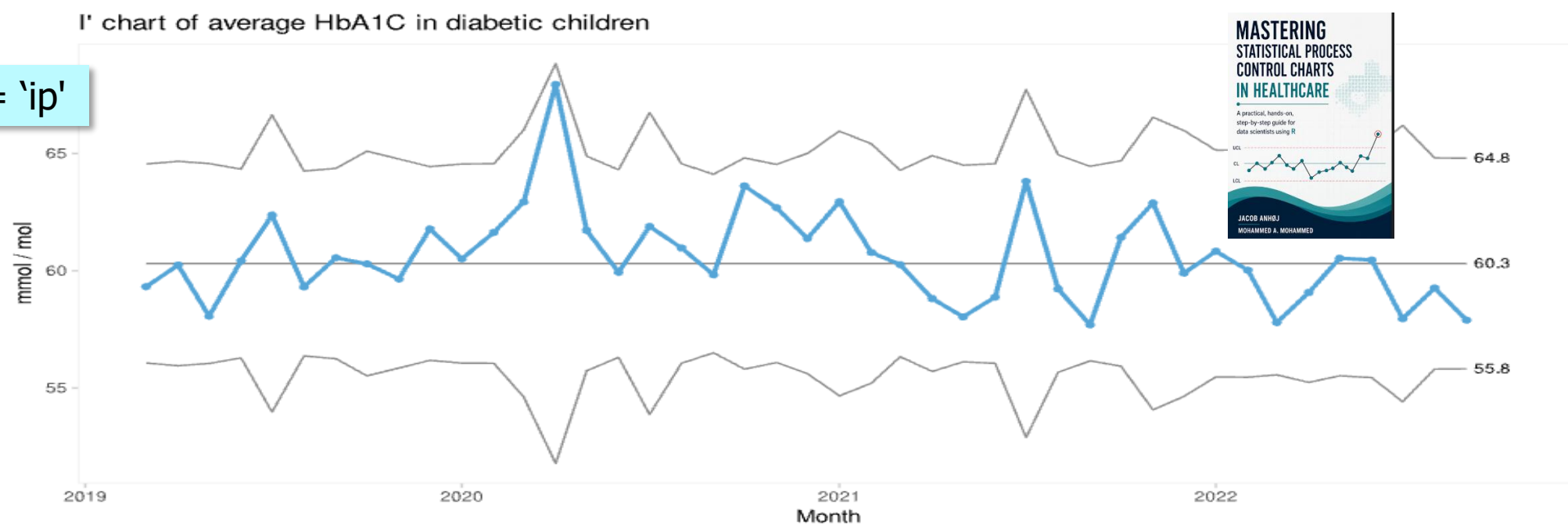
You can format Col B (e.g. to be dates)

Comment is just for notes - it does not do anything

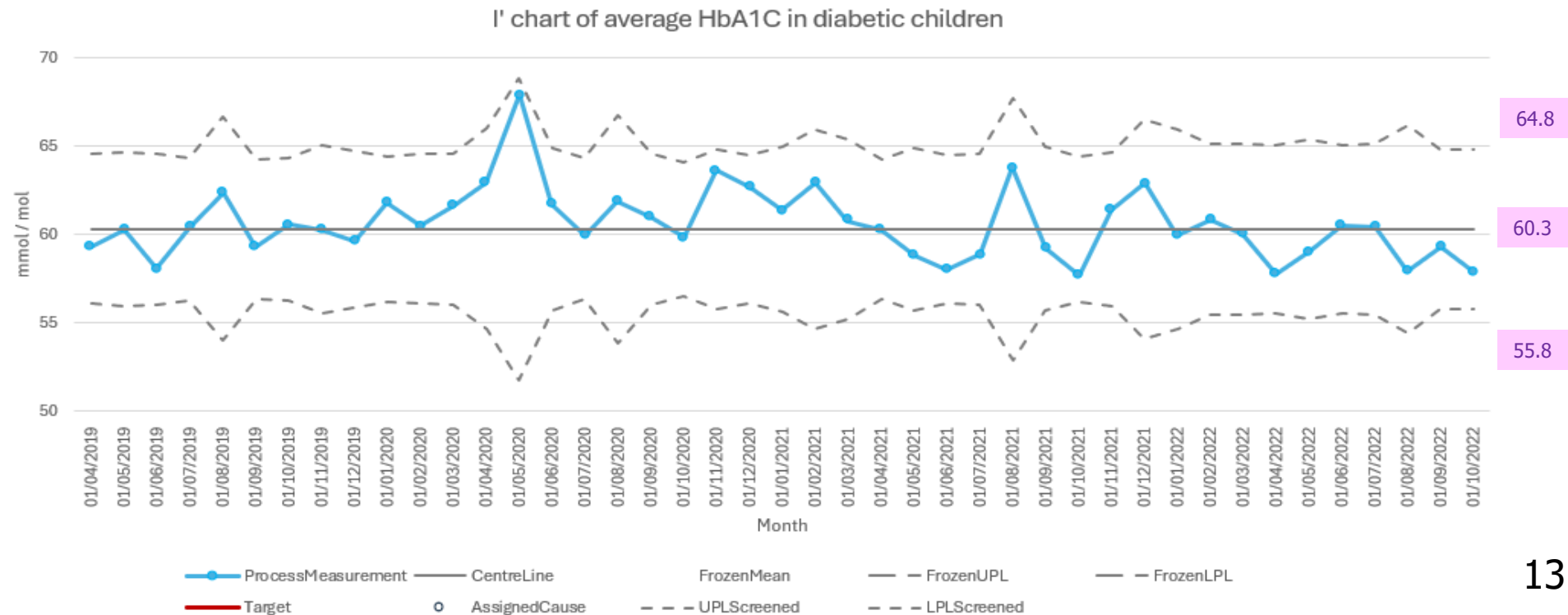
Date or Occurrence	Metric	SubGroupSize	Target	Regime	Exclude	Comment	AssignedCause	Process	CentreLine	Sigma	SigmaScreened	Upper Process Limit	Lower Process Limit	UPLScreened
01/04/2019	12695	214	42	1-Baseline				59.32	60.31	1.41	1.41	64.55	56.07	64.55
01/05/2019	12229	203	42	1-Baseline				60.24	60.31	1.45	1.45	64.67	55.95	64.67
01/06/2019	12310	212	42	1-Baseline				58.07	60.31	1.42	1.42	64.57	56.05	64.57
01/07/2019	14381	238	42	1-Baseline				60.42	60.31	1.34	1.34	64.33	56.29	64.33
01/08/2019	5988	96	42	1-Baseline				62.38	60.31	2.11	2.11	66.65	53.97	66.65
01/09/2019	14710	248	42	1-Baseline				59.31	60.31	1.31	1.31	64.25	56.37	64.25
01/10/2019								60.56	60.31	1.35	1.35	64.37	56.25	64.37
01/11/2019								60.29	60.31	1.60	1.60	65.10	55.52	65.10
01/12/2019	11572	194	42	1-Baseline				59.65	60.31	1.49	1.49	64.77	55.85	64.77
01/01/2020	13964	226	42	1-Baseline				61.79	60.31	1.38	1.38	64.44	56.18	64.44
01/02/2020	12949	214	42	1-Baseline				60.51	60.31	1.41	1.41	64.55	56.07	64.55
01/03/2020	13128	213	42	1-Baseline				61.63	60.31	1.42	1.42	64.56	56.06	64.56
01/04/2020	7490	119	42	1-Baseline				62.94	60.31	1.90	1.90	66.00	54.62	66.00
01/05/2020	3601	53	42	1-Baseline				67.94	60.31	2.84	2.84	68.84	51.78	68.84
01/06/2020	11357	184	42	1-Baseline				61.72	60.31	1.53	1.53	64.89	55.73	64.89
01/07/2020	14444	241	42	1-Baseline				59.93	60.31	1.33	1.33	64.31	56.31	64.31
01/08/2020	5756	93	42	1-Baseline				61.89	60.31	2.15	2.15	66.75	53.87	66.75
01/09/2020	12987	213	42	1-Baseline				60.97	60.31	1.42	1.42	64.56	56.06	64.56
01/10/2020	15915	266	42	1-Baseline				59.83	60.31	1.27	1.27	64.12	56.50	64.12
01/11/2020	12088	190	42	1-Baseline				63.62	60.31	1.50	1.50	64.81	55.81	64.81
01/12/2020	13542	216	42	1-Baseline				62.69	60.31	1.41	1.41	64.53	56.09	64.53
01/01/2021	10741	175	42	1-Baseline				61.38	60.31	1.56	1.56	65.00	55.62	65.00
01/02/2021	7616	121	42	1-Baseline				62.94	60.31	1.88	1.88	65.95	54.67	65.95
01/03/2021	8996	148	42	1-Baseline				60.78	60.31	1.70	1.70	65.41	55.21	65.41
01/04/2021	14704	244	42	1-Baseline				60.26	60.31	1.32	1.32	64.28	56.34	64.28
01/05/2021	10704	182	42	1-Baseline				58.81	60.31	1.53	1.53	64.91	55.71	64.91
01/06/2021	12710	219	42	1-Baseline				58.04	60.31	1.40	1.40	64.51	56.11	64.51

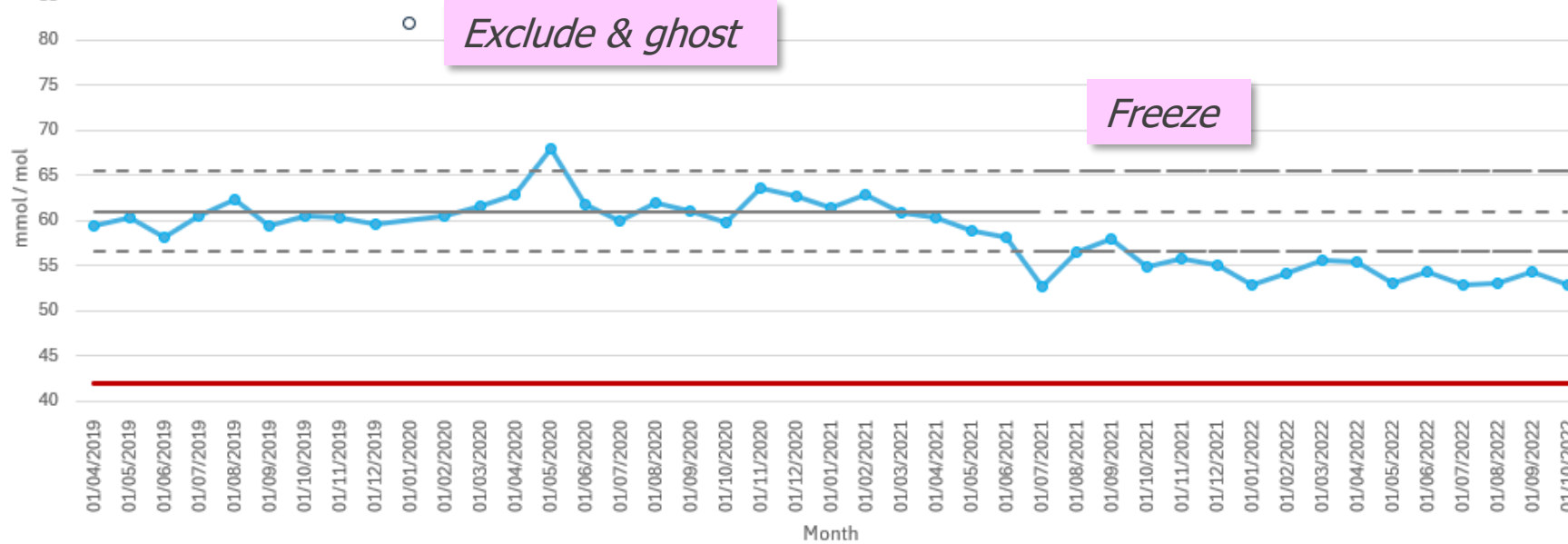
Using I' to take account of the subgroup sizes

qicharts2: qic() chart = 'ip'



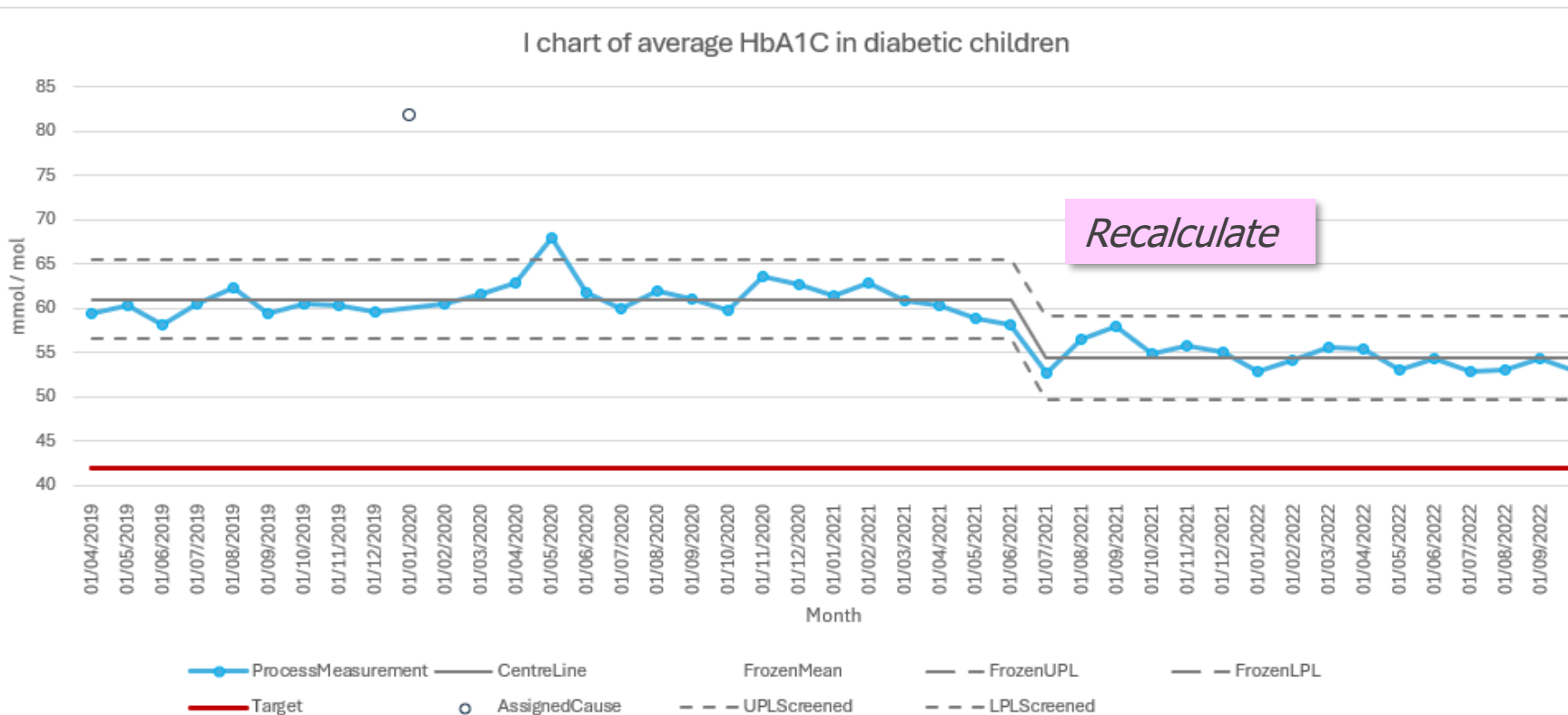
Using Excel I' tool with
Denominators
(subgroup sizes) ≥ 1





1-Freeze

If you are plotting DEMAND, then can add the mean + 1.5 s
Select chart then funnel symbol



Regime   Choose which regimes to display

1-Baseline

2-PDSA1

If you are plotting DEMAND, then can add the mean + 1.5 s
Select chart then funnel symbol

Should still add
annotation!

Reflections

A few frontline staff (and Trust/Board analysts) familiar with, or will pick up, *R* (or *Python*) – some scientists...

- Most won't go beyond *Excel* (frontline) or *PowerBI* (analysts) ?

We want to enable (free!) SPC access to support some basic training or self-learning):

- $I(mR), P/P', \bar{X}$ (mS) (and I help them use / use for them (*R*): G, CUSUM, funnel chart)

$I'(mS)$: *one chart to rule them all?*

- Accessible in *Excel* as well as *R*!

“The purpose is *not* to *have* charts. **The purpose is to use the charts...** You get no credit for *computing* the right *number* -- only for **taking the right action**. Without the follow-through of taking the right action, the computation of the right number is *meaningless*.”

Donald Wheeler

“Any good chart should motivate a series of questions for ultimately taking **ACTION!**”

“Proper application of SIMPLE tools will solve at least 85% of the situations that currently need improvement, and this is the philosophy that should be taught to the everyday practitioner ... without a lot of jargon (such as normal distribution nonsense).”



International Journal for
Quality in Health Care

Issues More Content ▾ Submit ▾ Purchase Alerts About ▾ International Journa...

Article Contents

Abstract
Supplementary data

JOURNAL ARTICLE ACCEPTED MANUSCRIPT

The I' -chart: a preliminary investigation of an improved individuals chart for quality improvement and control

Jacob Anhoj, Wayne A Taylor, Mohammed A Mohammed

International Journal for Quality in Health Care, mzag159,
<https://doi.org/10.1093/intqhc/mzag159>

Published: 26 September 2026 Article history ▾

PDF Split View Cite Permissions Share ▾

Abstract

Background

Statistical Process Control (SPC) charts are widely used in healthcare to monitor

Davis Balestracci