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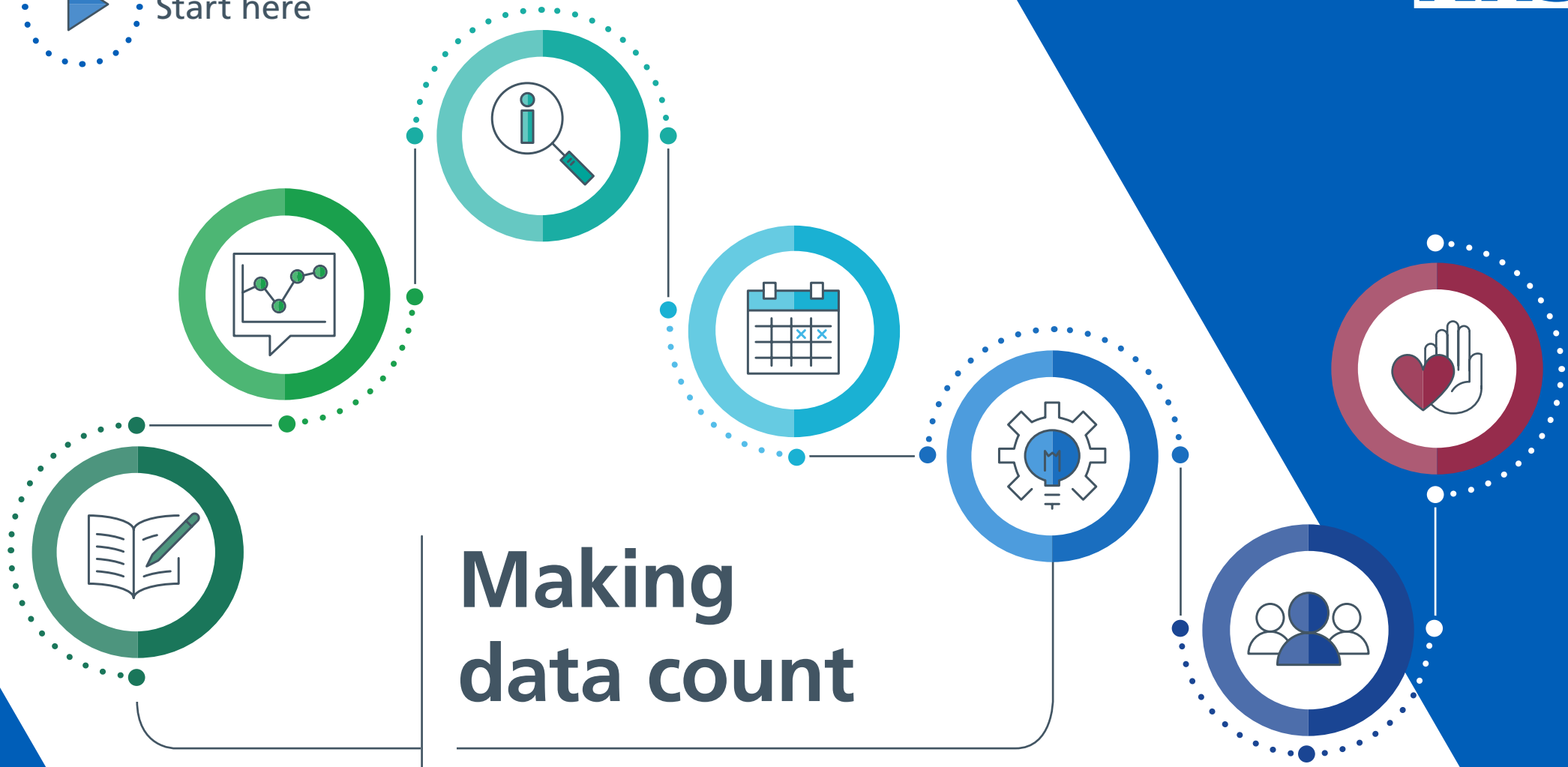


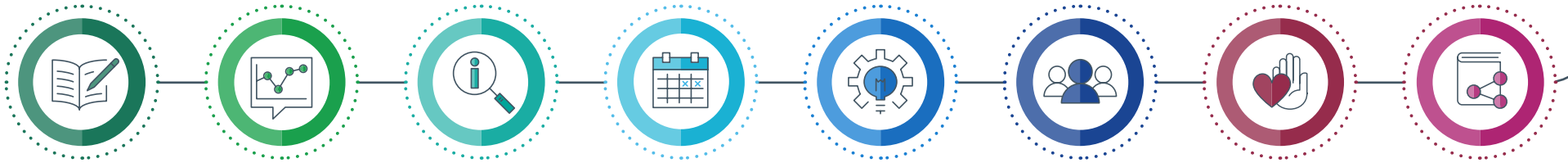
Making data count

#plotthedots

Strengthening your decisions

NHS England and NHS Improvement

Contents



Introduction

In May 2018, we published **Making data count – an interactive guide.** In this first guide we exposed the limitations of the prevalent approaches to looking at data in the NHS: two-point comparisons and traffic light or RAG reports. We introduced you to a better way to analyse data – statistical process control (SPC) – and with examples demonstrated how SPC charts can shape the conversations between people working in the NHS and the actions they take as a result.

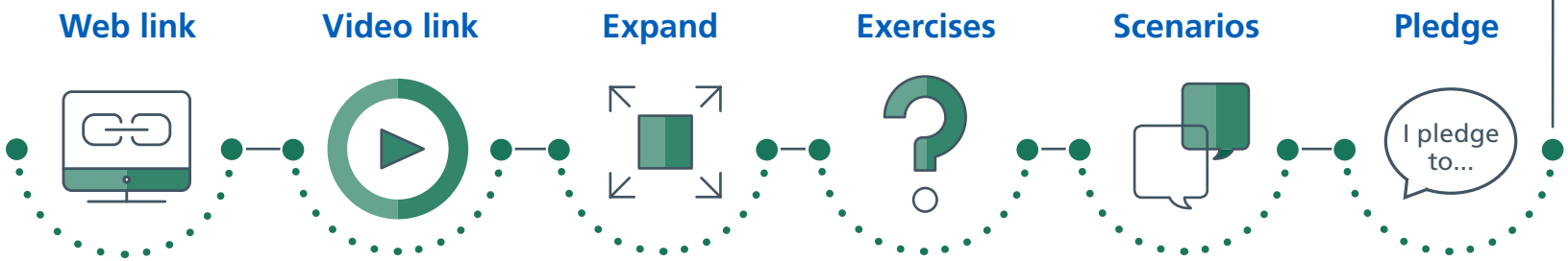
We know you are using our first Making data count guide to explore the merits of SPC analysis and to encourage your organisations to look at data in a better way. This remains the detailed guide for getting started.

In our work over the past 12 months with many NHS teams at different levels, including trust boards, we've been listening to what you need next in your SPC journey. With this second guide we'll strengthen your confidence in using SPC for analysis and effective decision-making – helping you to make the very best use of your data. We address your concerns about switching to SPC analysis and show you how to produce an easily digested summary report. We provide tips on enhancing your SPC charts to pull out the key messages and guidance on when process limits should be recalculated. Again we illustrate our advice with recent examples from across the NHS and scenarios and exercises for you to work through.

Samantha Riley
Head of Improvement Analytics, NHS Improvement

Navigating this document

We recommend that you work through this guide in the order that it was written. These icons will help you to navigate your way through the document.

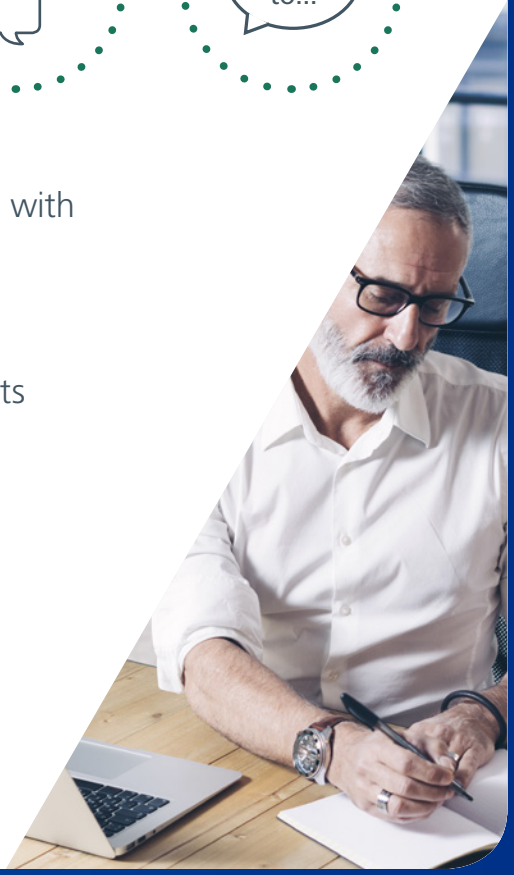


We hope you enjoy this guide and that the new knowledge that we provide, along with real life examples of how Trusts are using data most effectively across the country, inspire you to make changes locally.

Share your experiences of making the best use of data to support better judgements and decisions for action via Twitter using **#plotthedots**

This project is supported by the Health Foundation's Q Exchange programme, committed to bringing about better health and health care for people in the UK.

The Health Foundation



Getting the most from SPC

In this section we'll show you the simple things that can enhance decision-making using SPC.

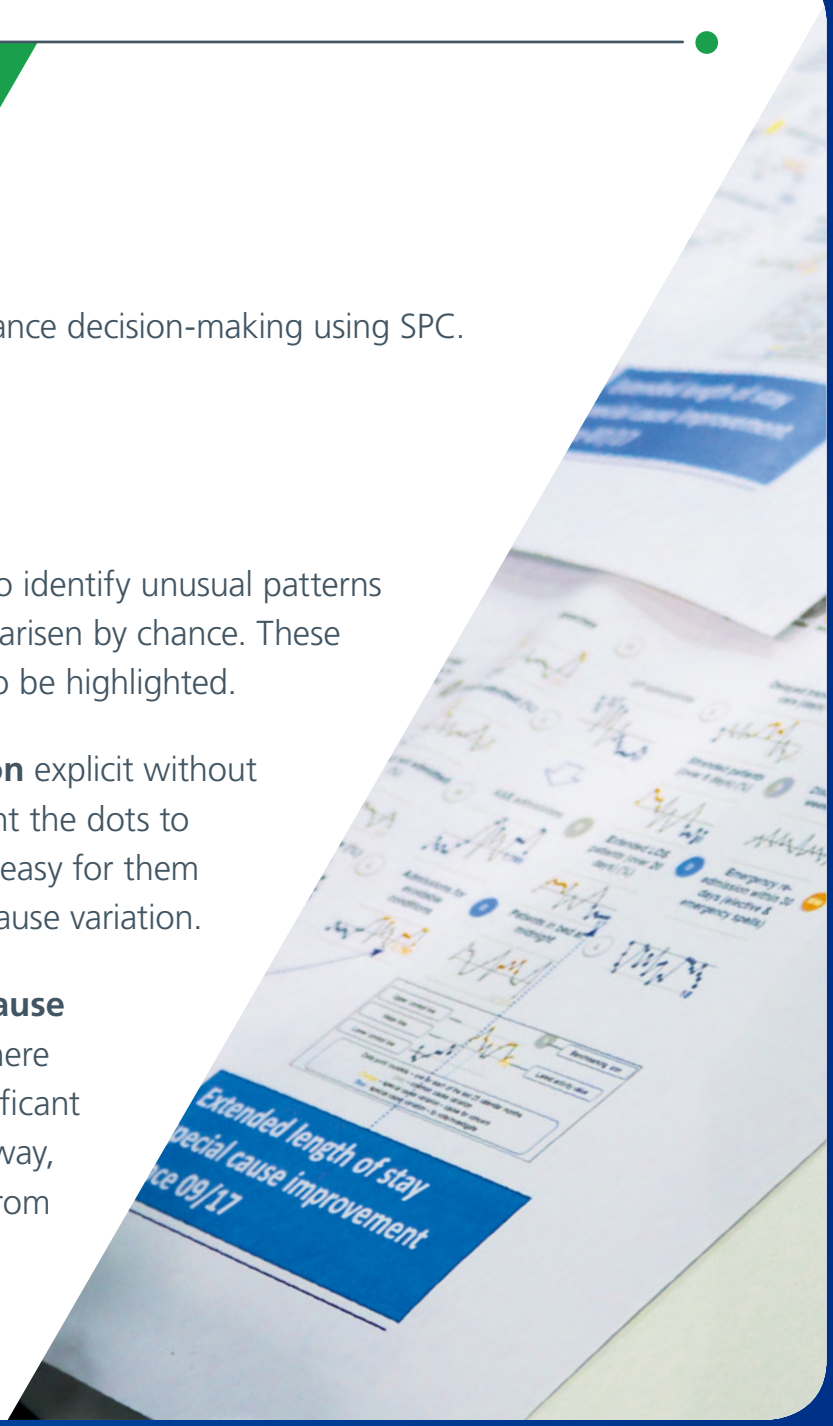
Enhancing SPC charts: top tips

Tip 1: Highlight any special cause variation

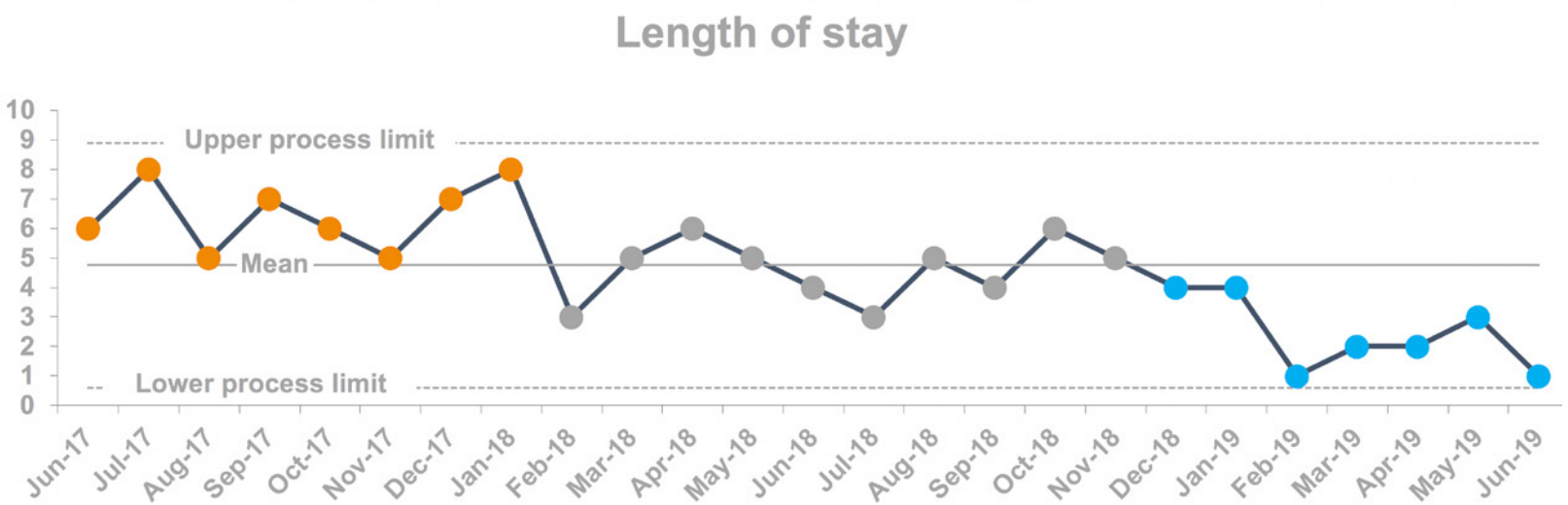
In Making data count, you learnt about using the SPC rules to identify unusual patterns in a dataset (special cause variation) that are unlikely to have arisen by chance. These pinpoint where action may be needed and as such deserve to be highlighted.

How can you make the nature of the **special cause variation** explicit without someone needing to check against all the SPC rules and count the dots to confirm whether a rule has been triggered? You can make it easy for them by setting up your system to automatically highlight special cause variation.

We use a colour code to do this: **orange** indicates **special cause variation** of particular concern and needing action; **blue** where improvement appears to lie; and **grey** data indicates no significant change (**common cause variation**). By using colour in this way, the patterns in your data deserving attention will stand out from the normal variation; your eye is immediately drawn to them.



Here's an SPC showing significant improvement in length of stay highlighted by blue dots.



Here's an example showing how effective this simple technique is. Why don't you test how long it takes your colleagues to confidently identify all the special cause variation for patients waiting over 40 weeks in figure 1 compared to figure 2.

FIGURE 1: A SPC chart without highlighted special cause variation

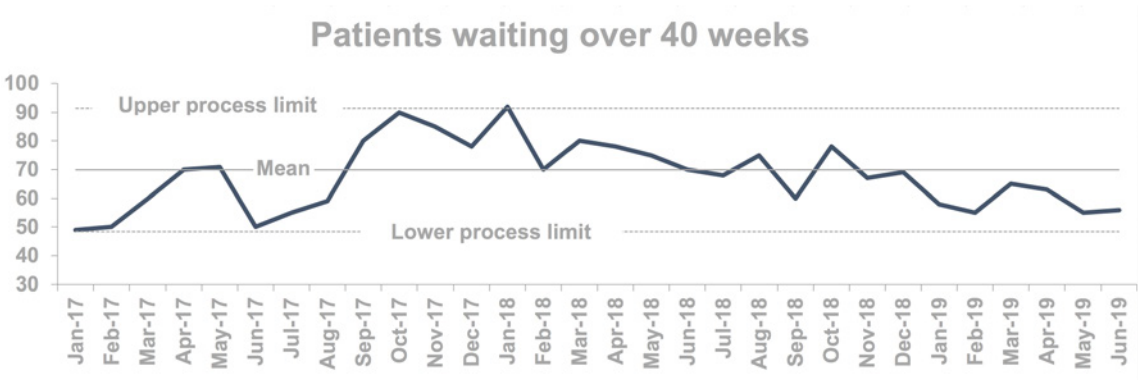
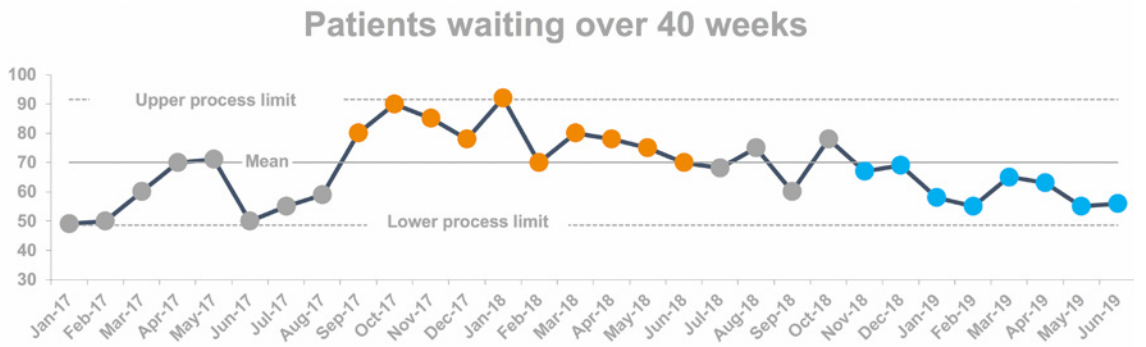


FIGURE 2: The same SPC chart with special cause variation highlighted



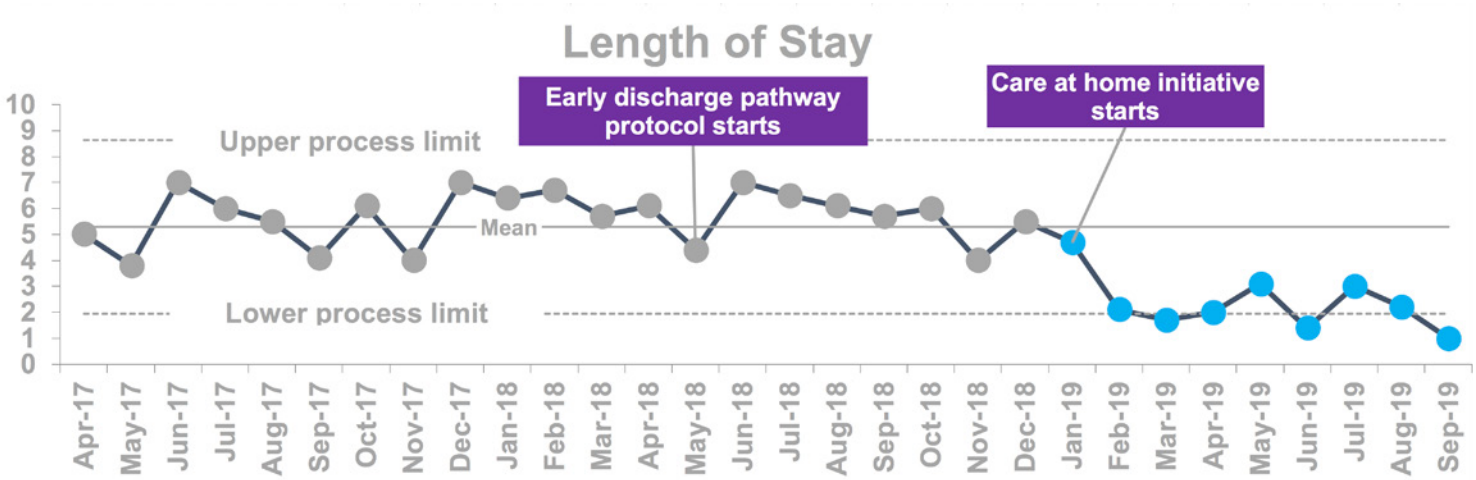
All systems used for SPC analysis can be automated to highlight special cause variation. If you can't find a local expert to help you do this, e-mail us at **nhsi.improvementanalyticsteam@nhs.net** for details of webinars covering automation.

Jayshree Pindoriya, Assistant Director of Information & Performance, Barnet, Enfield and Haringey Mental Health NHS Trust, describes changing performance reporting to utilise Statistical Process Control (SPC)

Tip 2: Identify the point a change was introduced

Another useful thing to do is to annotate your SPC charts with a visual cue indicating when a change was introduced. You then won't waste time discussing what might have caused a new pattern in a dataset. Everyone will be able to see immediately if a change has had the desired effect or if something else needs to be tried. Doing this also retains a 'memory of changes' made over time so that interventions that were ineffective are not repeated.

This chart shows that the first intervention had no impact, however the second intervention improved length of stay

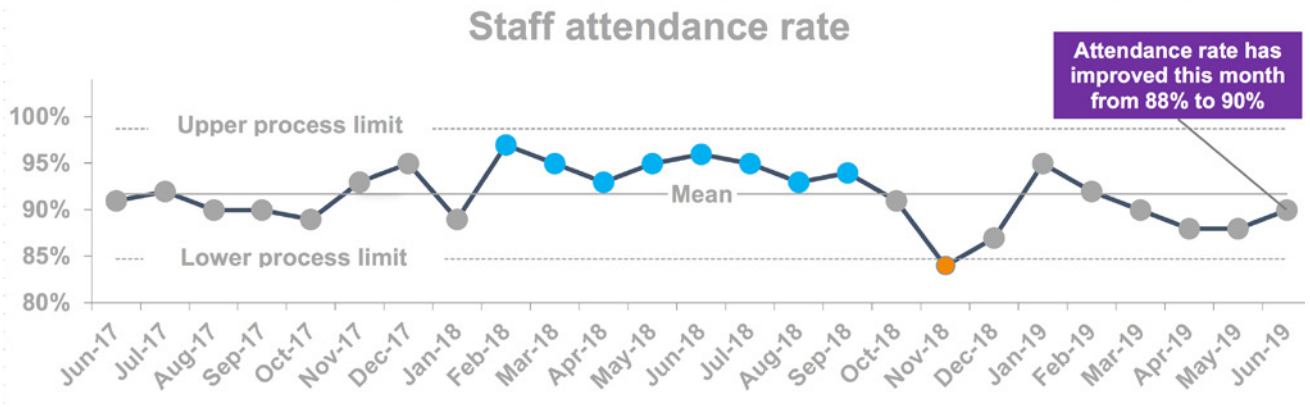


The good news is that again, whatever system you use for SPC analysis, you can annotate your SPC charts in this way. If you can't find a local expert to help with this, e-mail us at **nhsi.improvementanalyticsteam@nhs.net**

Tip 3: Add a supporting comment – but make sure it's appropriate

An easy trap to fall into is to continue with 'two-point comparison' thinking when describing SPC charts. We often see narrative that describes insignificant changes from one data point to the next.

Let's have a look at an example.



Have a think about how you would describe what the data in this chart is telling you and ask your colleagues if they agree with what you propose.

There are different ways in which supporting narrative can be written for SPC charts. Be cautious about using technical terms and think about your audience. The grid below will help you.

What the SPC chart tells us (using technical language)	What we could tell a decision-maker (using non technical language)	Why?
"We have had 7 months above the mean line"	"We have seen a significant improvement/decline since month x due to reason y"	Try not just to describe the graph - we can count the 7 points - we want context. Is it an improvement or decline and what is the cause?
"Performance increased by 2% to 79% but the indicator is showing common cause variation"	"There has been no significant change with performance at 79%"	If a change is statistically insignificant then its distracting to highlight it in a summary.
"With the target in-between the process limits random variation could cause this indicator to pass or fail"	"Variation shows us this indictor will not reliably hit the target"	Narrative describing specific SPC technical terms such as process limits could restrict the audience to those that understand SPC. Simply describe what the consequence of the analysis is for the reader.

Plotting data on a SPC chart is a starting point rather than an end in itself. To gain the real value of SPC – better decisions – you will need to change mindsets. You can prompt a more meaningful and useful conversation with colleagues – that is, one not preoccupied with change between two consecutive points – if you pull out the key messages from the chart as a whole.

Increasing your familiarity with process limits

Many of you have questions about process limits. In this section we talk you through how to treat them – hopefully increasing your confidence in knowing when they need to be recalculated, what to do if your limits are wide and how to correctly calculate them.

Recalculating limits

If you are not to miss important messages from your data, process limits may need to be recalculated – but you need to be able to judge when it's the right time to do this.

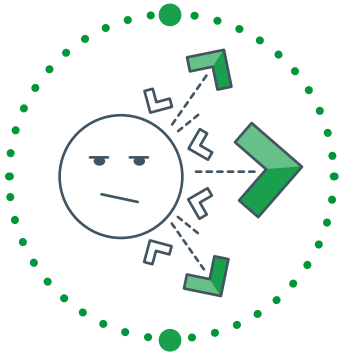
When it comes to different approaches to recalculating limits most people will fall into one of three character types. Read the character trait descriptions and decide which best matches your behaviour now and in the past. Those of you who have been analysing SPC charts for longer may recognise all three.

Reluctant

This is how people often behave when new to SPC. This character is happy plotting the dots but may not be aware that process limits can be recalculated. Or maybe they are aware but because they don't know what to do, they do nothing. Is this you?

Shifty

This character is aware that process limits can be recalculated. Shifty wants to do so at every hint that something has changed. They race ahead recalculating limits without consulting the team implementing change and thinking through the significance of what they are doing. Is this you?



Measured

This is the character we should all aspire to be. They carefully consider the data and the context and talk to colleagues involved in implementing change before recalculating the limits. Is this you? If not, by the end of this section we hope you'll know how to be Measured. And you'll better appreciate why we recommend a measured approach if you understand the risks Reluctant and Shifty are running.

We have created a scenario to test out the behaviours of our three characters – Reluctant, Shifty and Measured.

We've created a random data set by rolling dice.

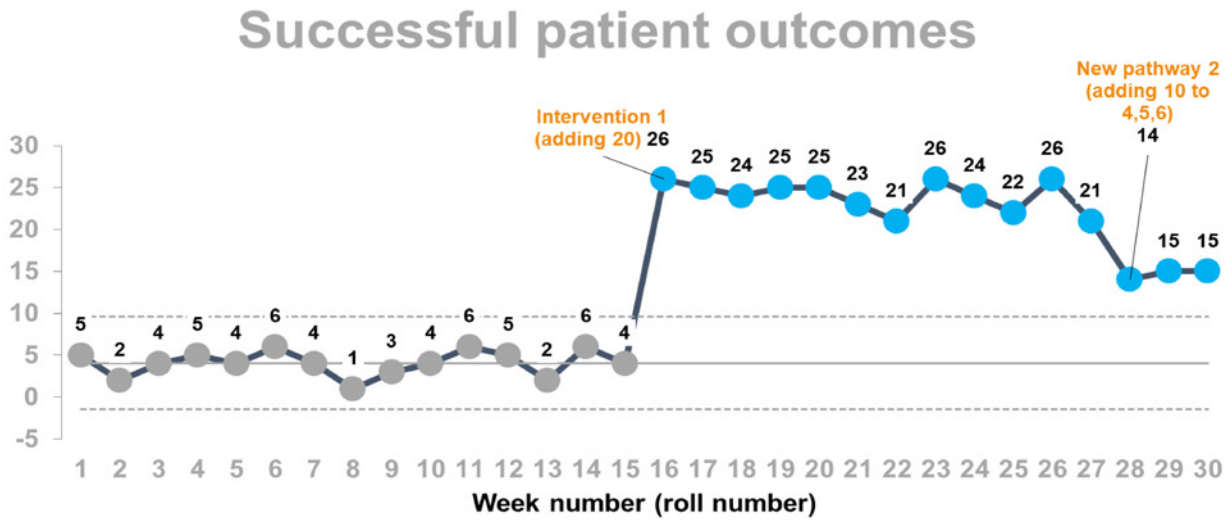
A) To start with we rolled a six sided dice 15 times and plotted the data.

B) We then rolled the dice 12 more times and added 20 to each of our scores before plotting this data on our graph.

C) At this point, we annotated the chart to indicate the implementation of a new treatment pathway.

D) Finally, we rolled a special three sided dice (with faces displaying 4, 5 and 6) three times and added 10 to each of our scores before adding this data to our graph.

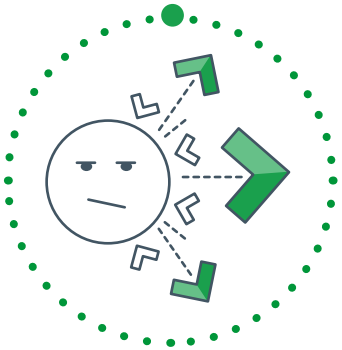
In our scenario, this data represents successful patient outcomes, so high numbers are desirable. Here is the chart we ended up with. Let's have a look at how each character responds to the data.



The problem with Reluctant

Reluctant recognised the special cause variation – in this case improvement – in the successful patient outcomes. Reluctant knows that a team are working hard to embed the new treatment pathway which appears to be having a positive impact. Reluctant can see 15 weeks of **special cause variation** but decides not to recalculate the process limits as they are not confident to do so.

By not redrawing the limits the SPC chart will lose sensitivity and any further improvement or deterioration is likely to be hidden.

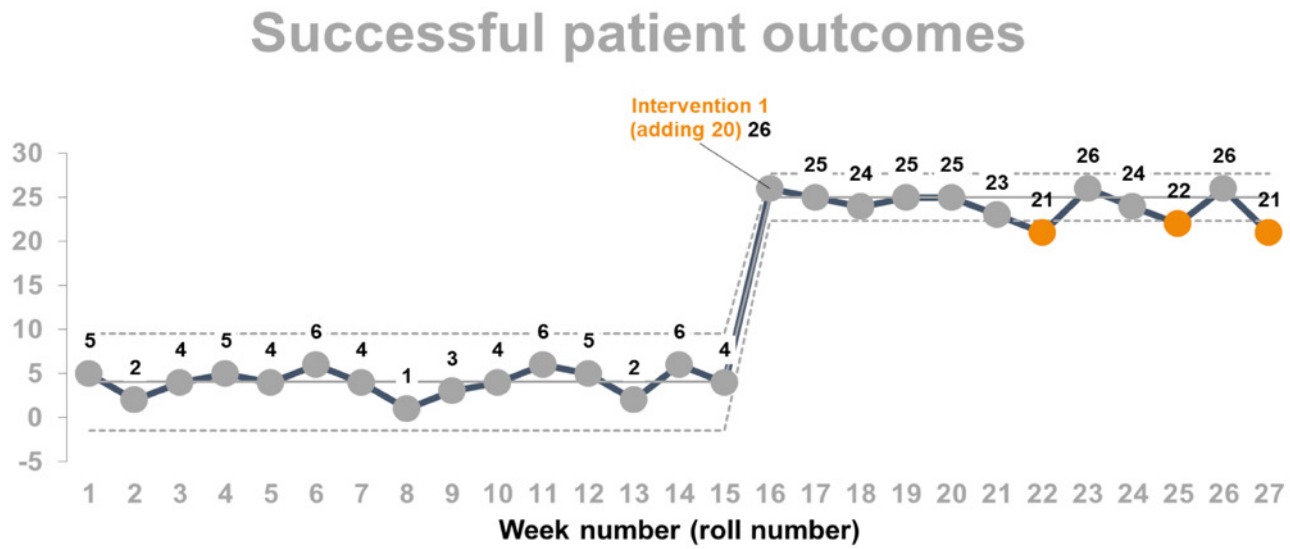


The problem with Shifty

Shifty is impatient by nature! Shifty's impatience means that they don't discuss the nature of any special cause with colleagues. This is an important step missed. Sometimes Shifty also recalculates limits using small amounts of data. Using small amounts of data can create process limits, that through lack of data, don't appreciate the true variance.

In this instance, Shifty, without consulting, recalculated the process limits after only 4 points of special cause variation (basing the new limits on those 4 points alone).

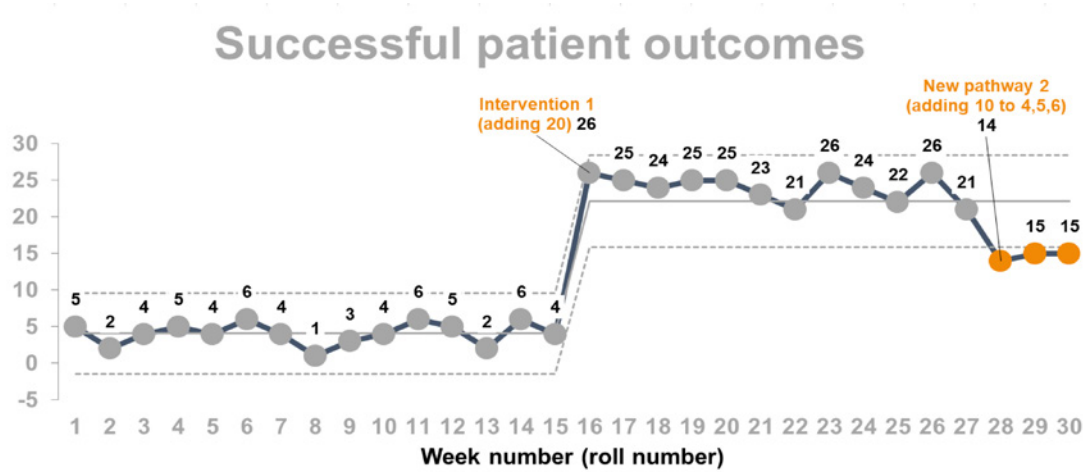
Here's the chart that Shifty creates up to week 27. Notice the special cause at weeks 22, 25 and 27. Remember during these weeks (15-27) our number generation was unchanged and therefore the SPC chart should not be highlighting any special cause. Shifty does not have enough data to create robust process limits and by creating special cause variation there is a risk of tampering by attaching significance to natural variation – and tampering is a bad thing.



The Measured approach

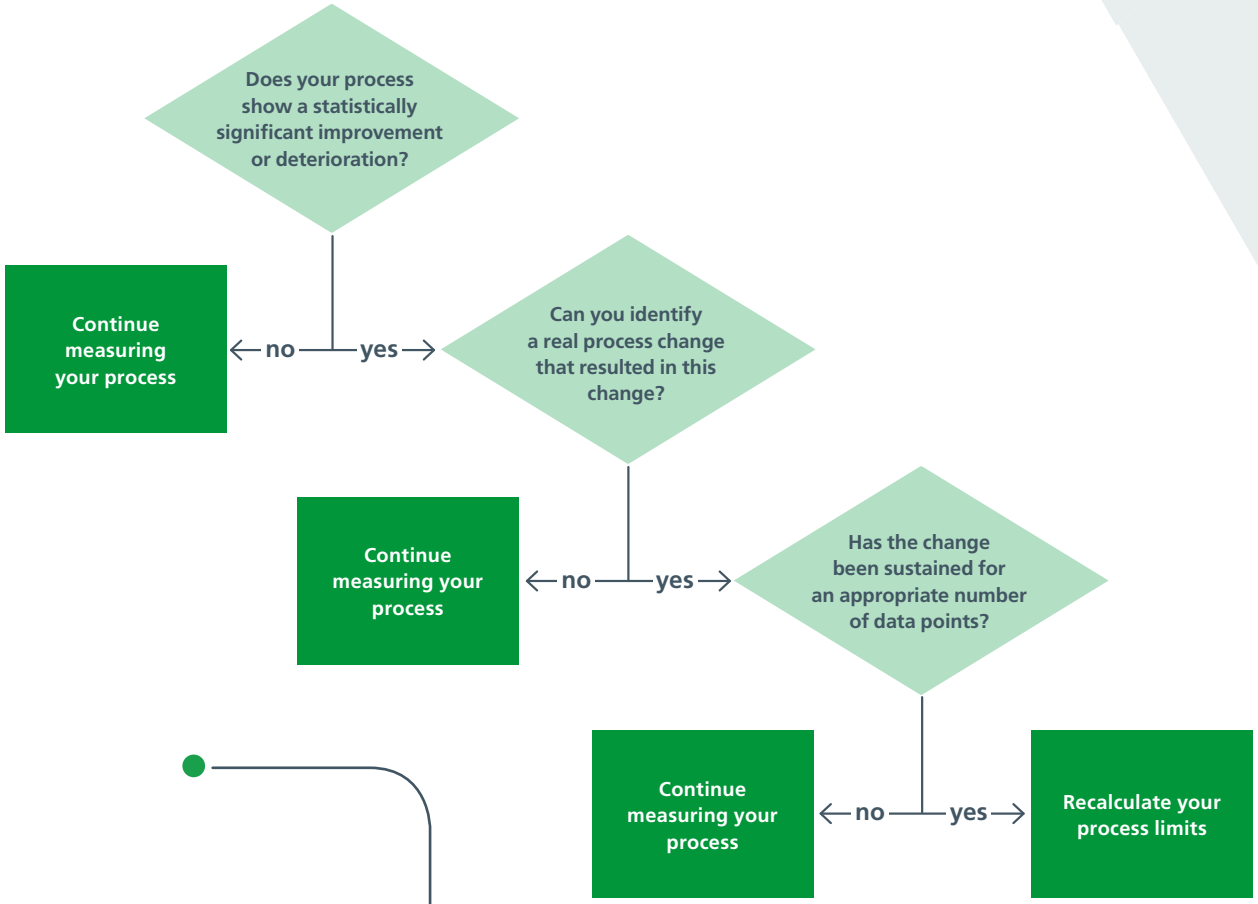
Measured has had regular meetings with the improvement team implementing the change. At the last meeting, Measured explained that the SPC chart identified 15 months of special cause variation. The team reflected on the progress made to increase successful treatment outcomes and were satisfied that the new improved process was now embedded. Measured therefore recalculates the process limits from the point of the implementation of the new pathway. This reveals some new and concerning special cause variation.

At the next project team meeting this concerning special cause is discussed and the reasons for it. Perhaps a new factor is reducing the effectiveness of the new pathway or perhaps the improvement is not embedded after all. An action plan is agreed to address this concern and get the project back on track.



How to be measured

Here's a handy flow chart to help you take a measured approach to the recalculation of process limits.



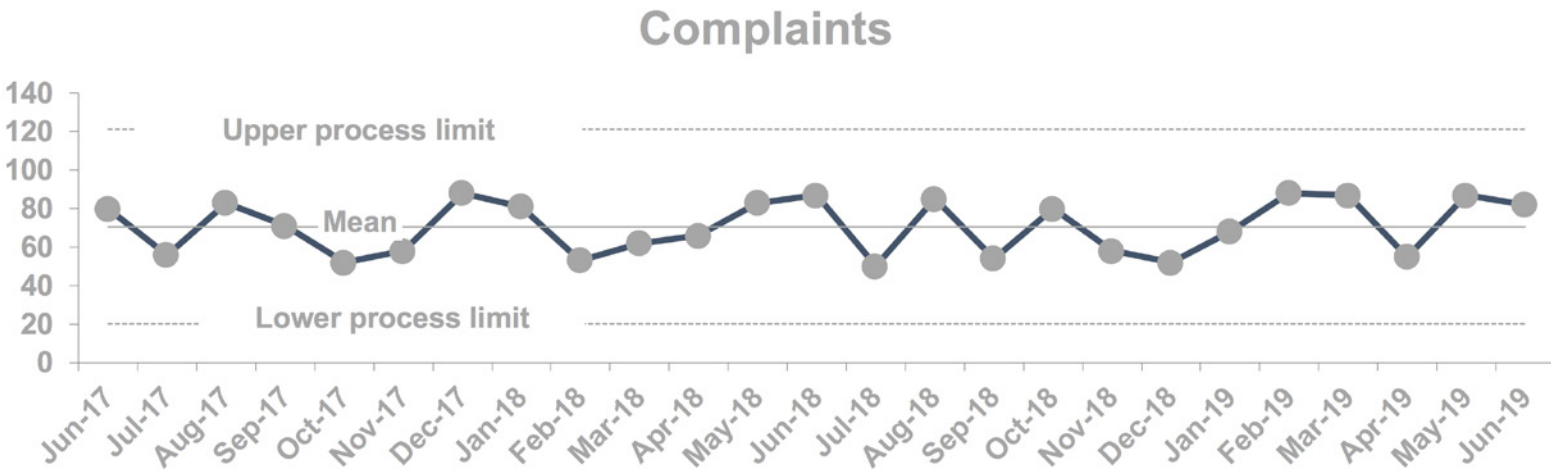
If you work closely with the raw data, understand the process related to it and talk to the people implementing change – alongside the risks we've already highlighted - you'll be on safe ground.

How to deal with wide process limits

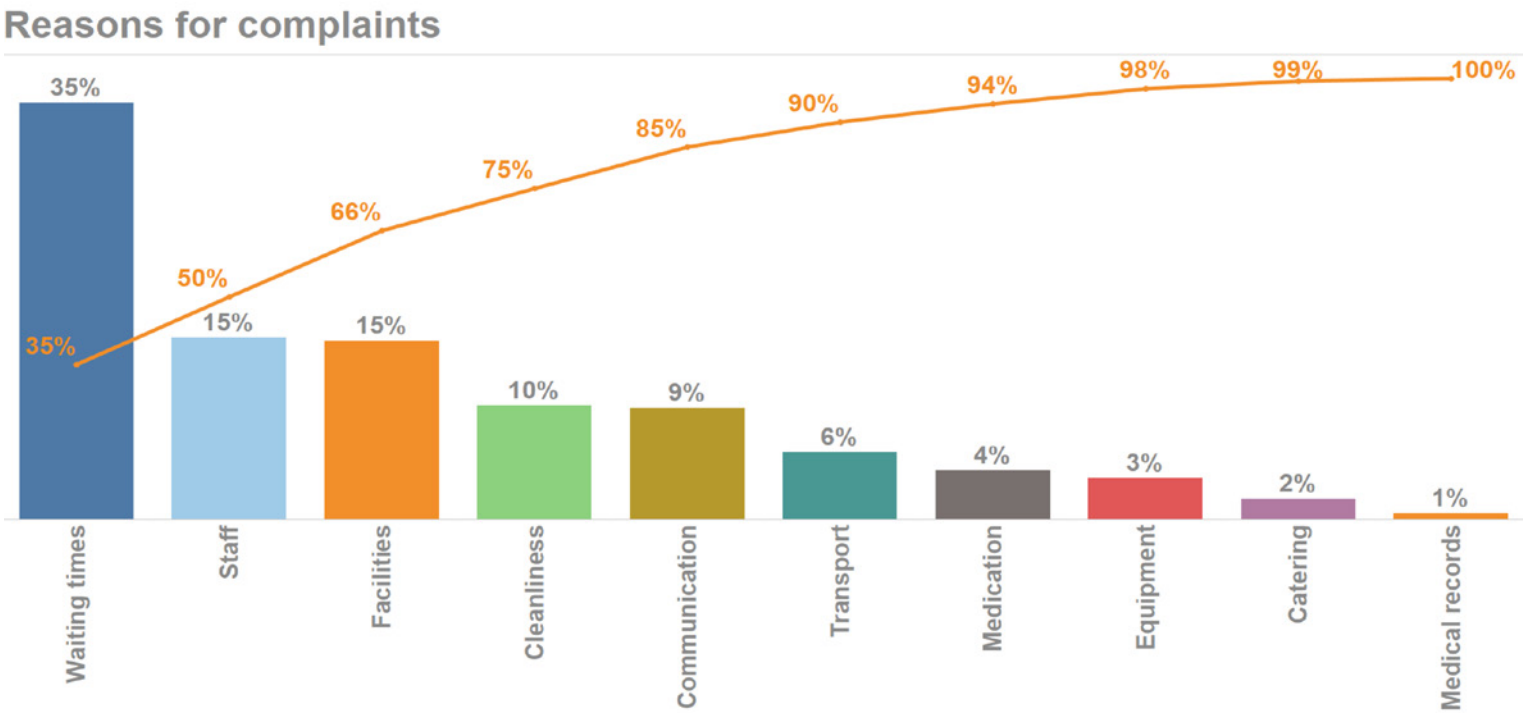
Another common concern is how to deal with process limits that are far apart. What do you do if your SPC chart displays only common cause variation – that is, you can't see any unusual patterns in the data but the limits are very wide?

Wide process limits indicate a process or system that is volatile and unreliable. You need to understand what's causing the instability and look to reduce or eliminate this. If performance is predictable you'll find it easier to plan and manage services, and provide your patients with more certainty.

Have a look at this graph and discuss with your colleagues what it tells you and what action you would take.



Hopefully you noted that the upper process limit was 120 (indicating that up to 120 complaints per month could be expected) and discussed whether this high number presents a problem. You may have decided to plan a process mapping session and to collect some data on the reasons for complaints and which departments they relate to. You could then use a pareto chart to understand your priority areas and decide what changes to make and what to measure.



By focussing on reducing the type of complaints that contribute the highest number (in this case waiting list complaints), this should also reduce the width of the process limits.

Here are some useful resources to help you redesign your process to reduce variation.

Thanks to NHS Elect for this great guide which links measurement to the Model for Improvement

Here's the link to our easy-to-use pareto chart tool

Here's the link to our easy-to-use SPC chart tool

Here's a 10-minute video in which **Mike Davidge**, Director at NHS Elect, talks about how to measure improvement.

Does it matter how you calculate process limits?

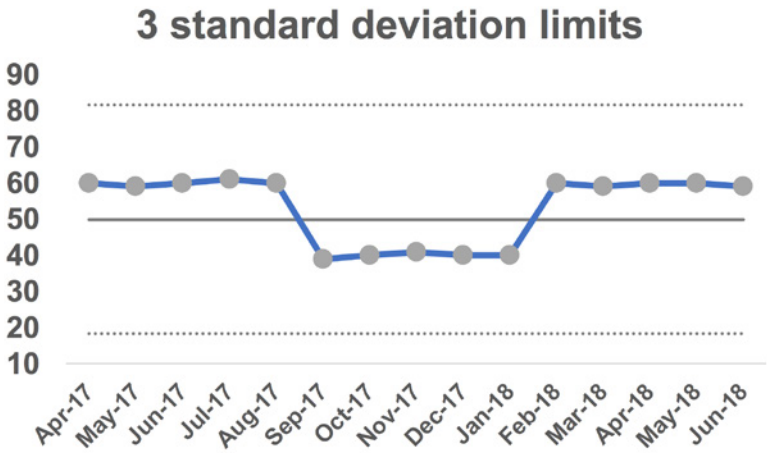
Understanding how to calculate process limits correctly is important. Don't worry – we're not going to get too technical.

Standard deviation or sigma? They are not the same thing. **You should use three sigma to calculate limits rather than three standard deviations.**

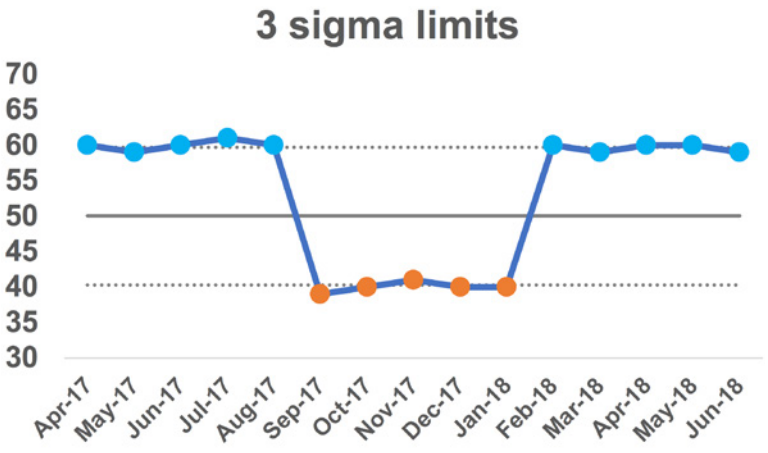
Standard deviation measures the average distance from each and every data point to the mean. The chronological order in which you plot the data is irrelevant. You could reorder the data and the calculation would stay the same. This means special cause variation can be missed. Sigma considers the average change from one point to the next in chronological order. Think about why the chronological order of data is key to understanding trends and significance.

Improvement Analysts **Alex and Thomas,** discuss the importance of calculating control limits correctly.

Look at the following chart with 3 standard deviation limits. Notice how wide the limits are and the lack of special cause variation despite two dramatic changes.



Now look at the following chart with the same data against 3 sigma limits. Notice how the limits are much narrower and special cause variation has picked up the two dramatic periods of change.



Why not use two sigma to create limits? Because this will result in an excessive number of false alerts and, if acted on, tampering – wasting time and effort.

Setting incorrect limits will mislead decision-making so you do need to get this right.

Here's a useful article describing this topic in more detail

If you need advice on this, e-mail us at **nhsi.improvementanalyticsteam@nhs.net**

Using SPC for comparison

In this section we'll look at an approach that complements SPC – benchmarking. We will introduce a benchmarking approach – funnel plot – which is based on similar calculations to SPC.

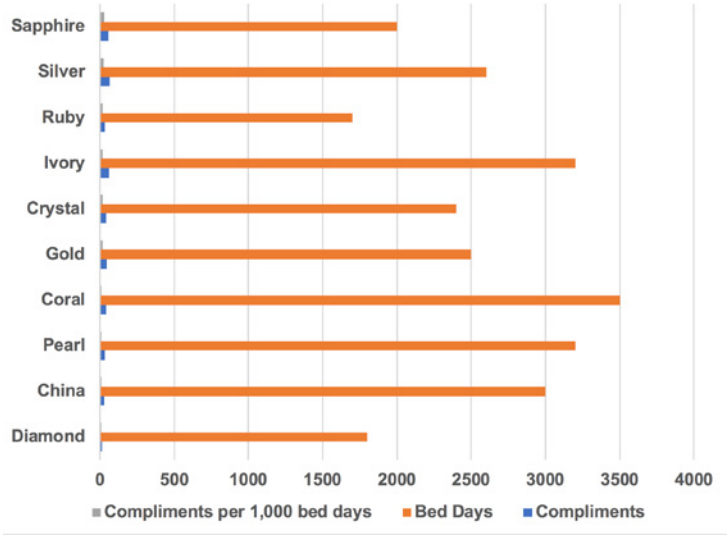
Benchmarking: good and bad ways to do it

As well as looking at change over time, decisions can be informed by comparing your performance to others – whether other departments, clinicians or organisations.

There are good and bad ways to present benchmarking data.

Discuss the following chart with your colleagues

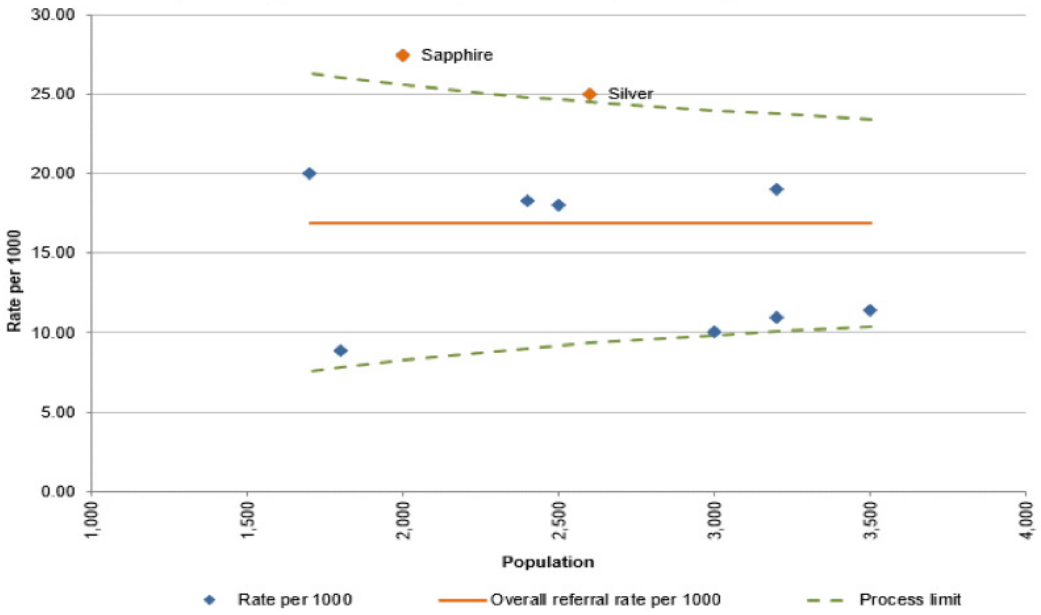
FIGURE 3: Compliments per 1,000 bed days



- Is this a useful presentation of data?
- Was it easy to identify the significantly good practice and which wards were significantly behind and needed more support (or did you just identify the ward at the top and bottom of the list?)

A useful tool for benchmarking is a funnel plot which uses process limits based on three sigma to understand when the things being compared are significantly different from the rest of the crowd. We know that it is unlikely that the items we are comparing will have identical performance, but how do we know when they are different? Is the 'top of the league' performer standing out from the crowd and a true exemplar to be learnt from? Or part of a group of equally significantly good performers? Is the 'bottom of the league' performer in need of a supportive intervention? Or are they not significantly different but just bottom because someone has to be? If you don't know the answer, funnel plots will help you avoid this.

FIGURE 4: Compliments per 1,000 bed days



Compare figure 4 against figure 3. Do you think that the funnel plot would lead to more meaningful conversations and less tampering? Relying on figure 3, might we have missed the good practice at Silver just because they were not top of the league?

Here's a link to our easy to use funnel plot tool

Making information digestible: using icons

You've told us that one concern with switching to SPC analysis is the generation of much longer reports. An appeal of RAG summary reports is their conciseness, providing an at a glance view of performance across a range of indicators. Is there an equivalent summary report for SPC analysis?

Our solution has been to develop icons that summarise the messages from SPC charts. **Variation icons** describe the type of variation being exhibited and **assurance icons** whether the system is capable of achieving a standard or target.

Peter Howie, Trust Secretary at Lincolnshire Partnership NHS Foundation Trust, describes how the use of SPC icons has benefited board conversations.

Variation			Assurance		
					
Common cause – no significant change	Special cause of concerning nature or higher pressure due to (H)igher or (L)ower values	Special cause of improving nature or lower pressure due to (H)igher or (L)ower values	Variation indicates inconsistently hitting passing and falling short of the target	Variation indicates consistently (P)assing the target	Variation indicates consistently (F)alling short of the target

Variation icons: **orange** indicates concerning **special cause variation** requiring action; **blue** indicates where improvement appears to lie, and **grey** indicates no significant change (**common cause variation**).

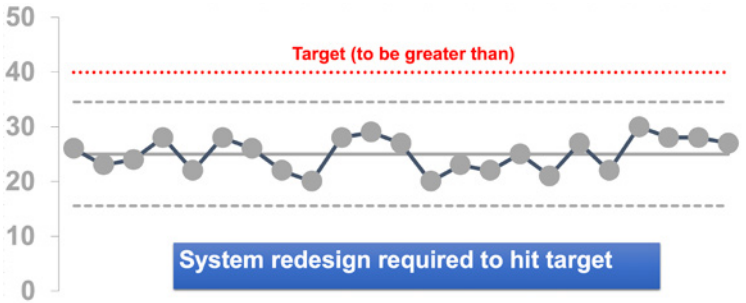
Assurance icons: **Blue** indicates that you would consistently expect to achieve a target. **Orange** indicates that you would consistently expect to miss the target. A **grey** icon tells you that sometimes the target will be met and sometimes missed due to random variation – in a RAG report this indicator would flip between red and green.

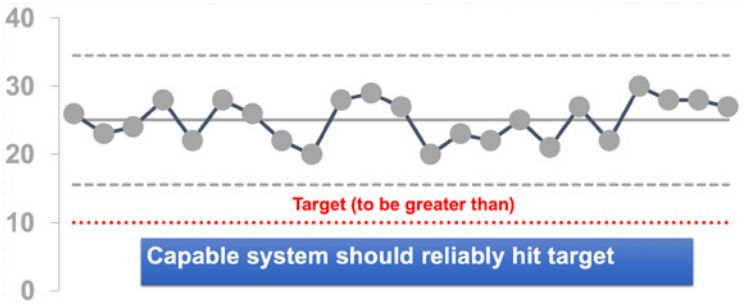
Where icons indicate an area needs attention, you could give more detail by attaching the full SPC chart and narrative describing the context, issues and actions in an appendix.

The position of a target line in relation to the process limits will inform you if your indicator can hit a target or threshold consistently, by random chance, or not at all.

If your target line is in between the process limits be cautious about reacting to success (green) and failure (red) when natural variation may be causing the target to be passed or failed. Remember that approximately 99% of data points should fall within the process limits. These graphs will help guide your action:

Improvement Analysts **Alex and Thomas,** discuss the presence of target lines in statistical process control (SPC) charts for assurance.





Statistical process control is increasingly being used to have more meaningful conversations across different parts of the health service, between providers, commissioners and regulatory bodies. Provider trusts have reported back to us that the use of SPC has prompted more productive conversations focused on actions to improve services. Less time has been wasted over reacting to data which indicates no significance.

Nigel Acheson, Deputy Chief Inspector of Hospitals, The Care Quality Commission, describes the role of statistical process control in regulation.

So here is our alternative to a traditional RAG report – summary icons guide your attention and action.

SPC Summary Dashboard

Key Performance Indicator	Target & Assurance	August 2018 & Variance	Average Performance
Sickness Rate (%)	4.6	4.8	5
Staff Turnover (%)	8.0	12.0	15
Appraisal (%)	95.0	96.0	90
Supervision (%)	85.0	96.0	92
Mandatory Training (%)	90.0	96.0	95
Staff FFT positive feedback (%)	90.0	84.0	86
Staff FFT response rate (%)	15.0	12.0	16
Records Management (%)	75.0	85.0	90

Whatever system you use for analysis, you can create an icon summary report like this – some trusts have already done it! If you can't find a local expert to help you with this, e-mail us at **nhsi.improvementanalyticsteam@nhs.net** for details of relevant webinars.

Accounting for difference

In the NHS there's a strong sense that performance is heavily affected by the seasons, particularly winter. How many times have you heard the term 'winter pressures'? Our experience is that often the effect of seasonality is overstated.

Seasonality is often assumed to affect performance in particular calendar months. While Christmas is always on 25 December, other events such as Easter and Ramadan are not on fixed dates or even months. Similarly, the occurrence of flu or extreme winter conditions is unpredictable. Defining performance by calendar month can be misleading when the months in question share few characteristics apart from their name.

Let's look at two common approaches to addressing seasonality.

- What's the best way to visualise data to account for seasonality?
- And how can you minimise the risk of misinterpretation?

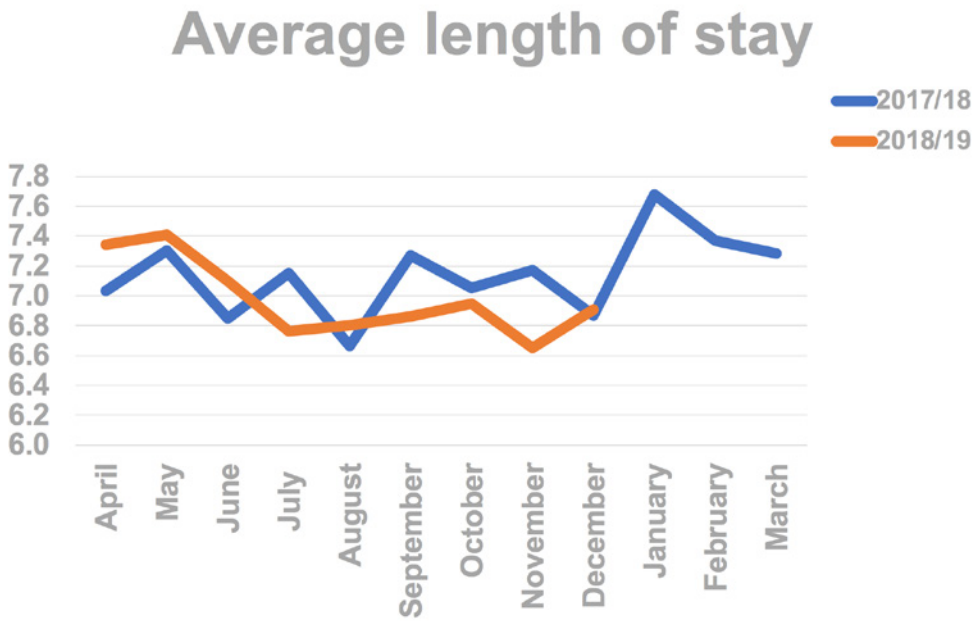
Graphs that prompt two-point comparison thinking

How often do you see graphs like this? A graph with two different coloured lines – each showing the data across a different year.

We'd suggest the graph below for average length of stay encourages two-point comparison thinking. It leads you to compare performance in a selected month this year with that last year.

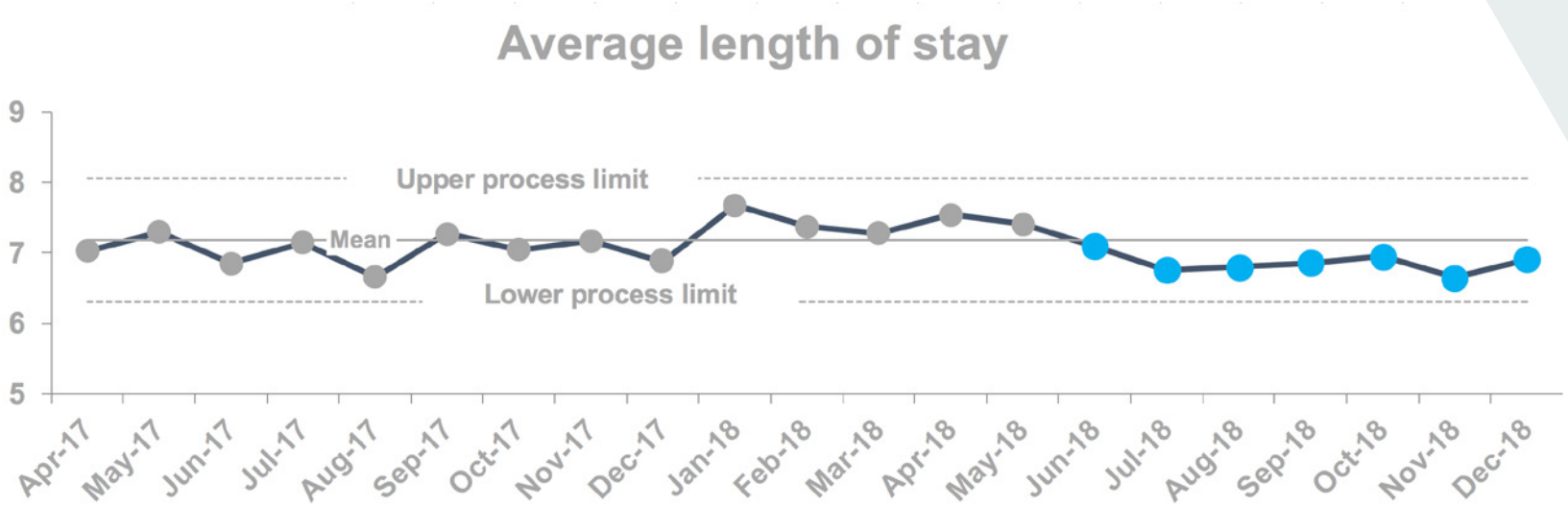
The narrative supporting this graph was:

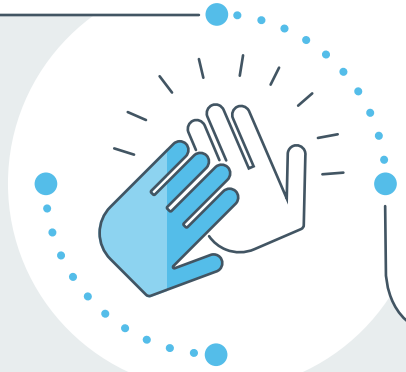
"Performance this December was similar to December last year. Performance remains unchanged despite winter pressures. This is good news – we won't need to take any corrective action here……."



But what was happening to length of stay in all the other months?

By plotting the same data as a SPC chart you can see much more clearly that December 2018 is the seventh month in a continuous run of improvement. Fantastic news!



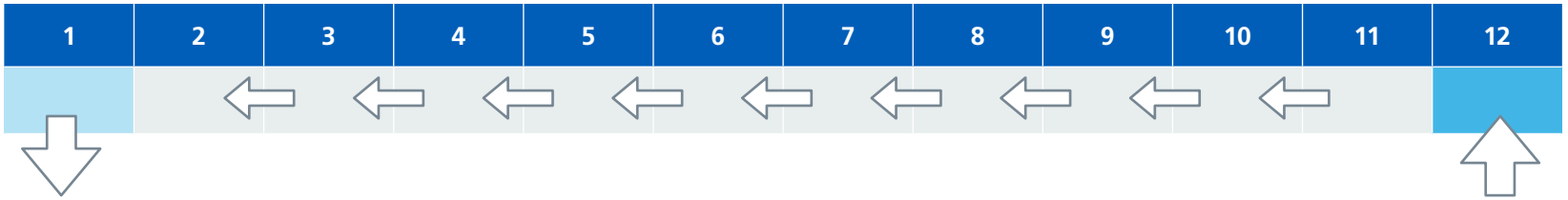


Let's celebrate and congratulate the team for the successful implementation of their improvement programme. Or, if we don't know what caused this improvement, let's go and investigate.

By running the two lines in sequence – rather than breaking by year – and creating a SPC chart you have learnt much more from the data.

12-month rolling averages

Rolling averages smooth out variation and are often used to mitigate the effect of seasonality. Workforce datasets, such as sickness and turnover rates, are often presented as rolling averages. The problem is that it's hard to spot change in a 12-month rolling average. From one month to the next, 10 out of 12 data points from which the average is calculated are the same – that's 83%.



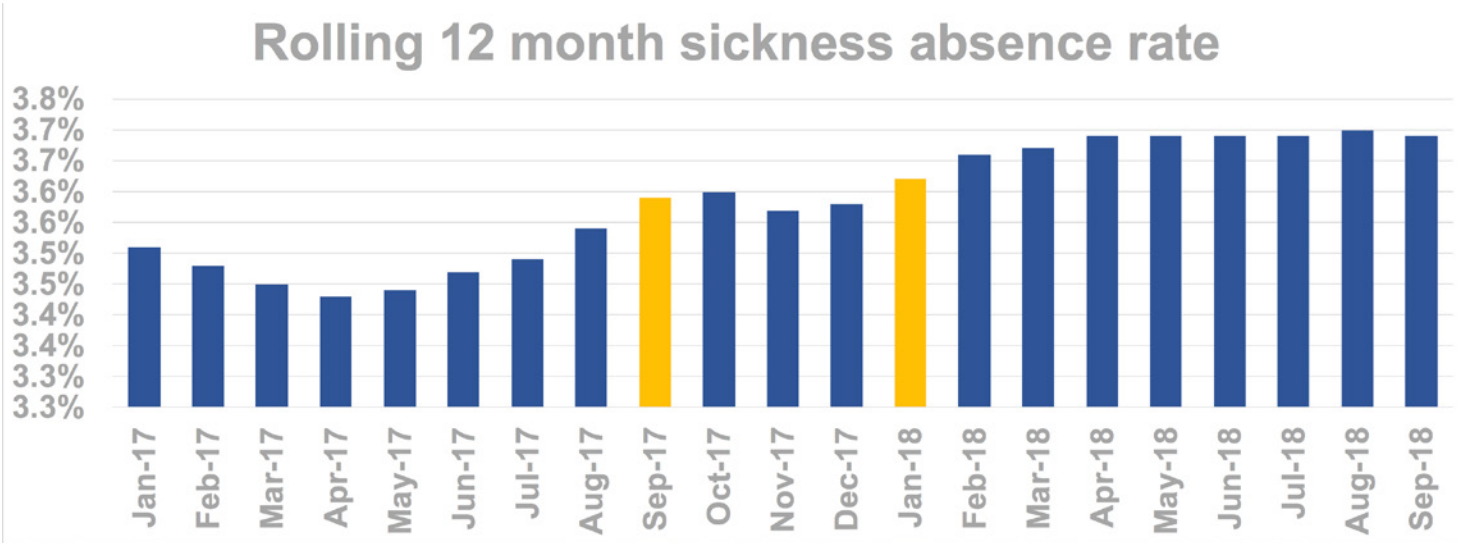
One 'old' data point leaves calculation

Ten existing data points remain inside the calculation

One new data point data enters calculation

You know how important it is to understand variation when making decisions. So how useful is a rolling average which by its nature masks variation? The data point 'leaving' the calculation may be as significant as the one 'entering' it. It's certainly possible that a notable change identified this month was caused by the data point from 12 months ago dropping out of the average calculation.

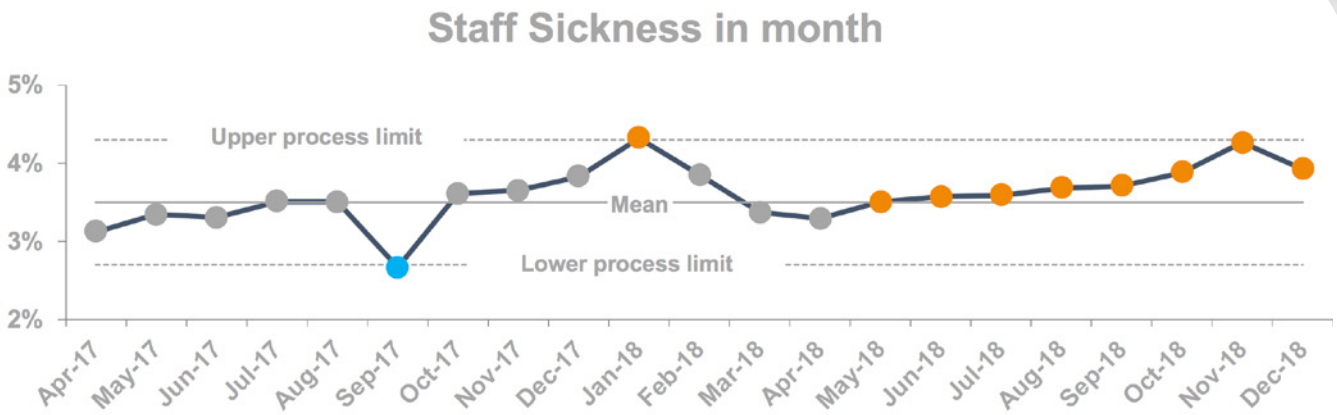
Let's look at this example showing rolling averages for sickness absence over 12 months.



Look in particular at the rolling averages for September 2017 and January 2018.

- What's your impression?
- Are they similar?

Here's a SPC chart showing in-month sickness.



Now you can see significant improvement in September 2017. This was obscured in the rolling average chart where September 2017 appeared to be the sixth continuous month of deterioration.

And what about January 2018? In the rolling average chart, performance in September 2017 and January 2018 looked similar, but – as revealed by the SPC chart – they couldn't be more different. September 2017 represents significant improvement and January 2018 cause for significant concern.

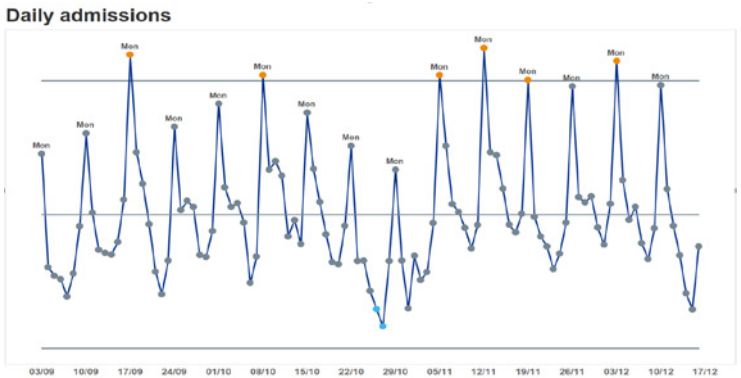
Why mask variation with a rolling average when the variation is the very thing that you need to understand and react appropriately to?

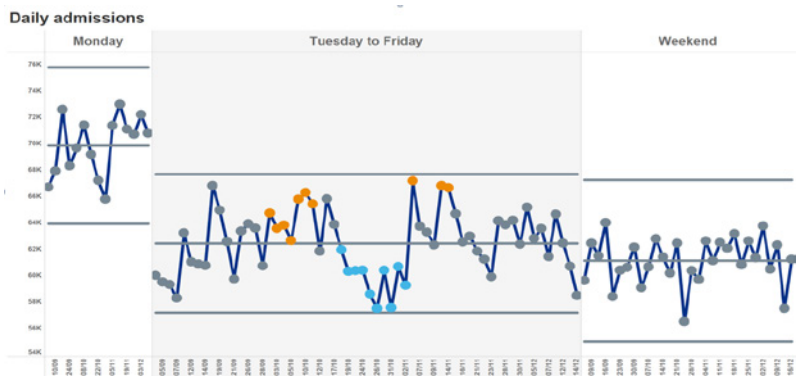
Dealing with data relating to more than one process

What do you do if you think that your dataset relates to more than one process? You may be convinced that seasonality is having a strong effect or there might be something else affecting your data. This could be a weekend/week day effect or the effect of school holidays. How do you stop this being highlighted as special cause variation in your SPC chart?

If you are concerned that different processes may be operating, the easiest way to establish this is to plot two or more SPC charts, one for each process.

Let's look at an example – daily admissions to an acute hospital. Monday admissions are often so significantly different to other days of the week that it is sensible to separate them out. By doing this it is easier to identify and act upon changes that are significant. Similarly you might also consider separating out weekend admissions.





You may be tempted to create winter and summer SPC charts, but which months do you class as winter and which summer? Especially if you live in the UK! We would caution against this. It's dangerous to consider winter as spanning from December to February, you need to isolate the factors that define winter. If it's the winter weather creating more slips and falls then a winter SPC chart should be related to the weather not the month name.

Other examples could include in hours or out of activity or your travel time to work depending on your method of transport (maybe by bike, on foot or by bus).

Learning from others

We often get asked which Trusts have developed the most helpful board reports. More and more trusts are redesigning their integrated performance reports – and this is often an iterative process. Here we highlight a selection of trusts that have introduced a variety of useful approaches to their reporting.

Click a location to see more

What people are saying?

Lots of people working in the NHS – with many different types of roles – are experiencing the benefits of adopting SPC. Here's a selection of quotes that we have heard.

Sally Morgan, Principal Clinical Psychologist, describes the importance of using statistical process control for clinicians.

"Now with SPC the board have a better sense of where to focus, it helps us to ask strategic rather than operational questions."

Trust Board Secretary

"The Icons quickly identify special cause variation. They help us to focus our time on what needs greater scrutiny."

Associate Director of Contracting and Performance

"The board understands that there will always be variation, but it is the special cause variation that requires further exploration – this has changed the conversations about performance at board level."

Director of Finance & Information

"SPC has given me another string to my bow to be able to support business cases. An example is that I was able to evidence minimal variance in achieving full establishment in the last 3 years which enabled a business case to be supported to invest in admin to support development of QI for the trust."

Assistant Director, Business Development & Service Improvement

"SPC has opened my eyes and helped me understand what to focus my energy on. It has aided my thinking about making best use of my resource to target areas which are not achieving. An example of this is RTT compliance. Looking at the data as SPC made me realise they we had been wasting time and energy on small dips in performance (due to the RAG rating). SPC made us realise that we were far exceeding the target, and had been for a long time. This made me think about reallocating resource to help another struggling team help them meet their targets".

Clinician working in Children's Services

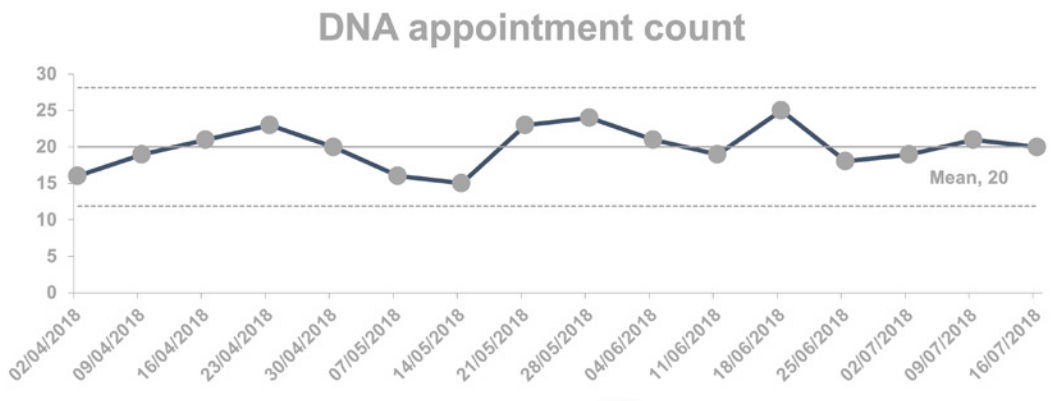
Learning together

Scenario 1: Understanding when to recalculate limits

Your trust has implemented an improvement programme to reduce did not attend (DNA) appointments in its outpatient clinics; that is, patients who fail to show up for their appointment. A text-based messaging system now reminds patients about their appointment. If they need to cancel, this will prompt patients to do so and free up the slot for another patient.

As the measurement lead it's your job to update the project group on progress. You know you can only identify change if you're clear what the performance was before the improvement programme was introduced. You ask an analyst to plot the data for the 16 weeks leading up to the launch.

Here's the SPC chart you take to the meeting.



Project lead

Thank you for the data. I'm not a data expert. How will I tell if the project is succeeding? I don't want to commit to a long-term contract if we don't see change.

Measurement lead (you)
Select A or B

A

If special cause variation is triggered below the mean line you can be sure something significant has happened. You could then sign the contract.

B

If special cause variation is triggered below the mean line you can be sure something significant has happened. You then need to be sure that the messaging system is responsible for the improvement. Once you are, you could then sign the contract.

Project lead

Thank you for the data. I'm not a data expert. How will I tell if the project is succeeding? I don't want to commit to a long-term contract if we don't see change.

Thank you. I'll take note of that mean line of 20 DNAs per month – we need to show improvement against this target.

Measurement lead (you)
Select A or B

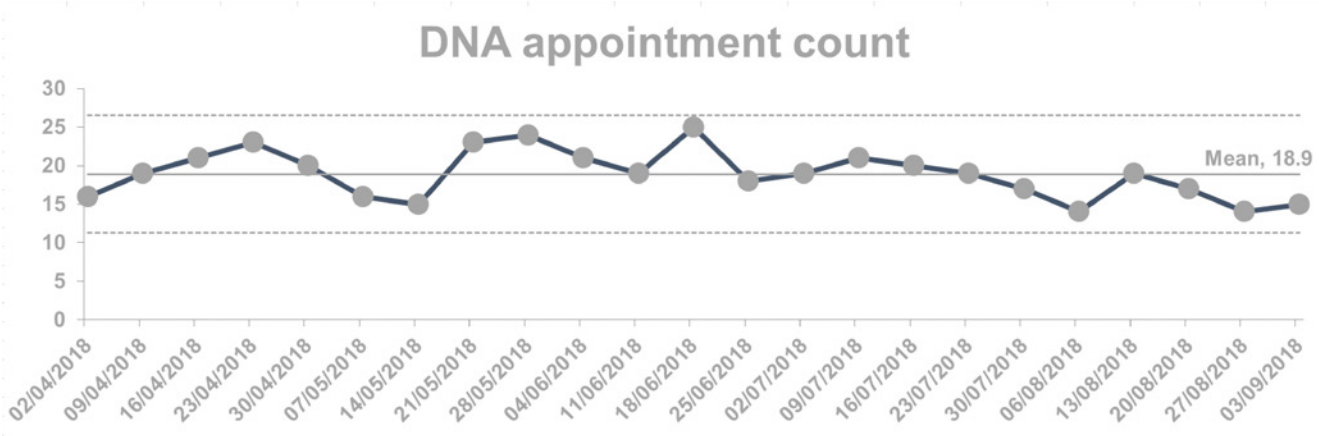
A

If special cause variation is triggered below the mean line you can be sure something significant has happened. You could then sign the contract.

B

If special cause variation is triggered below the mean line you can be sure something significant has happened. You then need to be sure that the messaging system is responsible for the improvement. Once you are, you could then sign the contract.

Here's the SPC chart you take to the next performance meeting. Your analyst has added the latest seven data points.



Project lead

Thank you for the chart, but I don't understand. I thought we were doing so well. Every week staff tell me they are recording fewer than 20 DNAs. We were so confident of success. We had a celebration last week, but your chart shows common cause variation, no change.

Measurement lead (you)
Select A or B

A

More data has been added to the chart, reducing the mean. You now need to be achieving fewer than 18.9 DNAs.

B

Oh dear, I see an error. Look the mean and process limits have been changed since our last meeting. We've moved the goal posts and are no longer comparing performance before and after the start of the improvement programme!

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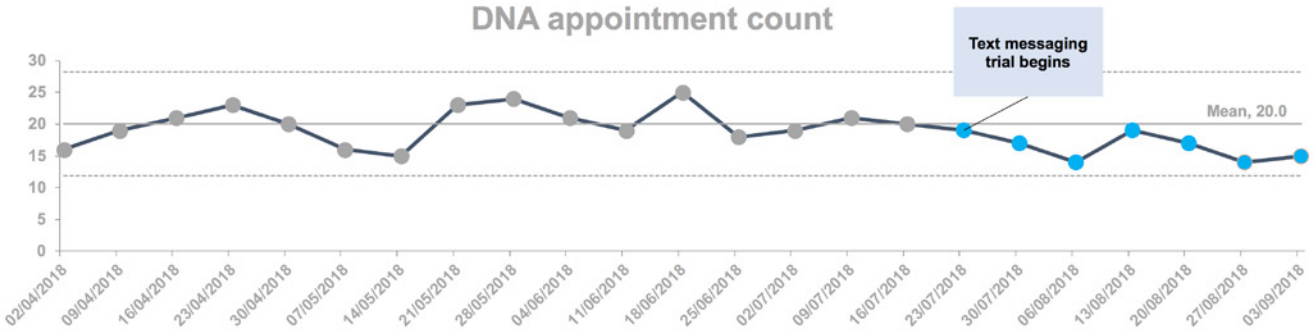
Oh dear, I see an error. Look the mean and process limits have been changed since our last meeting. We've moved the goal posts and are no longer comparing performance before and after the start of the improvement programme!

You ask the analyst to redraw the graph with the mean and process limits locked after the first 16 weeks.



Project lead

That's great. Can you recalculate the mean and process limits, so we can see the new mean line to demonstrate improvement?

Measurement lead (you)
Select A or B

A

We can do, but I advise caution. We have seen a significant improvement, but have you investigated to be sure that the improvement is due to the project and not an external factor?

B

Yes, of course, the statistical significance criteria have been met. The sooner we recalculate the sooner we can see improvement.

Project lead

That's great. Can you recalculate the mean and process limits, so we can see the new mean line to demonstrate improvement?

We were so happy to see an improvement and assumed it was due to our text messages. I think we need to investigate.

Measurement lead (you)
Select A or B

A

We can do, but I advise caution. We have seen a significant improvement, but have you investigated to be sure that the improvement is due to the project and not an external factor?

B

Yes, of course, the statistical significance criteria have been met. The sooner we recalculate the sooner we can see improvement.

Another factor was found to be at play over the same seven weeks. A decision was made to rebook some low risk appointments (which have a higher DNA rate) in favour of bringing in more high risk patients (who are likely to DNA less frequently). Despite this the executive team decided to sign a three-month contract with the messaging company to take advantage of favourable terms. The improvement team moves on to other areas and your involvement ends.

Three months later you are again asked to present data to decide if the contract should be renewed.

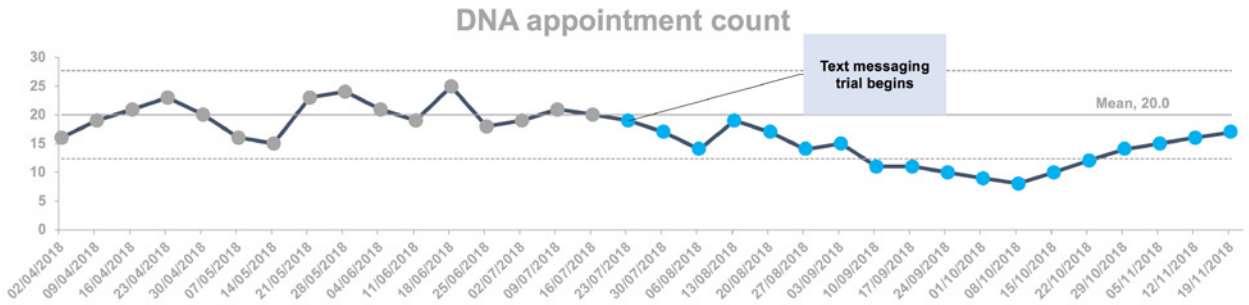
Project lead

Such a long improvement; this is evidence of sustained success, isn't it?

Measurement lead (you)
Select A or B

A — Yes – this is clear improvement

B — It appears so on this chart, but we have been operating in a different environment since the trial started. Let me ask for the data to be plotted again with the process limits recalculated from the trial start. We might learn something more from our data. We certainly have enough data to create robust process limits.



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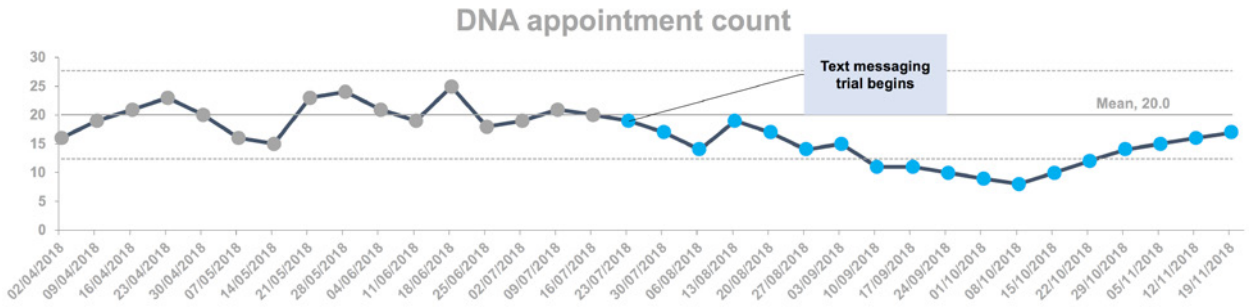
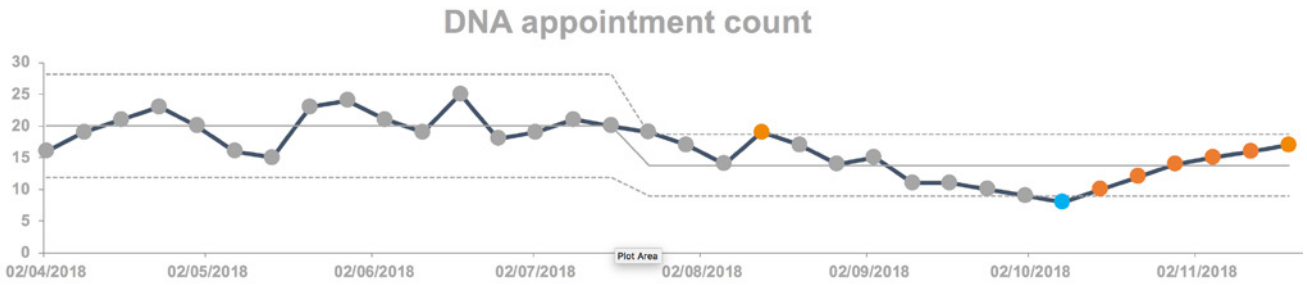


You contact your analyst and ask them to produce a chart with the process limits recalculated from the trial start. This is the chart they provide you with.



Project lead

This looks different! I see orange dots which alerts me to a concerning pattern in the data.

Measurement lead (you)
Select A or B

A

Yes, don't sign the contract, performance is deteriorating.

B

There's clearly been an improvement. Look at the mean line – it drops from 20 to 11. We need to find out what is causing the recent deterioration so that we can maintain the improvement.

Project lead

This looks different! I see orange dots which alerts me to a concerning pattern in the data.

We found a connectivity issue with some of the software and the text messages from two clinics were not reaching their recipients. It's clear the text messaging system is successful but recalculating the limits has given us a new perspective and more information. I'll ask the messaging company to fix this bug before we renew the contract.

Measurement lead (you)
Select A or B

A

Yes, don't sign the contract, performance is deteriorating.

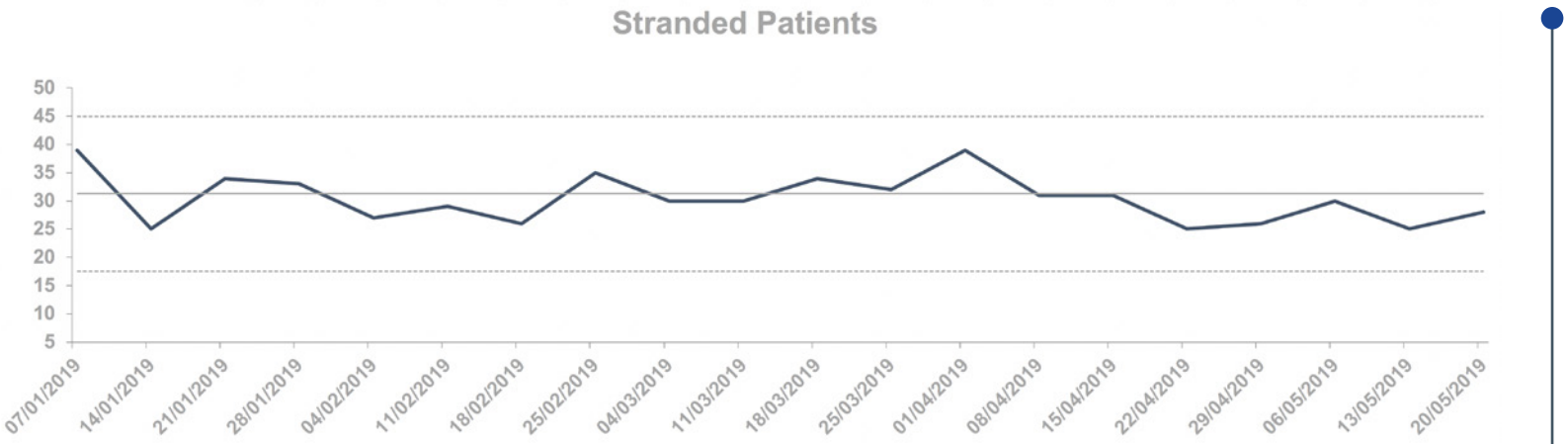
B

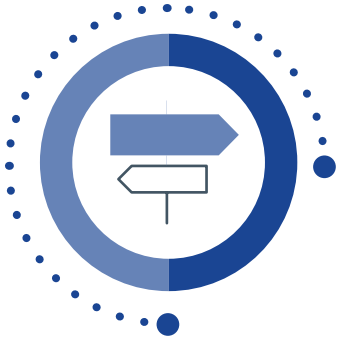
There's clearly been an improvement. Look at the mean line – it drops from 20 to 11. We need to find out what is causing the recent deterioration so that we can maintain the improvement.

Scenario 2: Making messages from SPC charts clear for decision makers

Your trust has implemented a new improvement programme to help reduce the number of stranded and super-stranded patients.

As a senior analyst, one of your jobs is to provide analytical support to this programme. Seven weeks into the intervention, you produce a SPC chart showing the number of stranded patients over the past 20 weeks.





Medical Director

Thank you for producing this chart, but I'm not sure what it tells me. The staff I've spoken to say that they're seeing fewer stranded patients on the wards, but I can't tell if this data is saying the same thing or not.

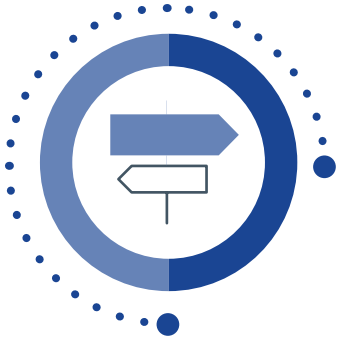
Senior Analyst (you)
Select A or B

A

You need to count the number of points above or below the mean, to understand whether anything significant has happened. Then you need to closely look at the data to see whether any of the other SPC rules have been triggered.

B

You make a good point. It's hard to tell from the chart whether anything significant has happened. I'll find a way to automatically highlight special cause. I don't want to use red and green as they are colours of judgement. So I will use blue for improvement and orange for concern.



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Senior Analyst (you)
Select A or B

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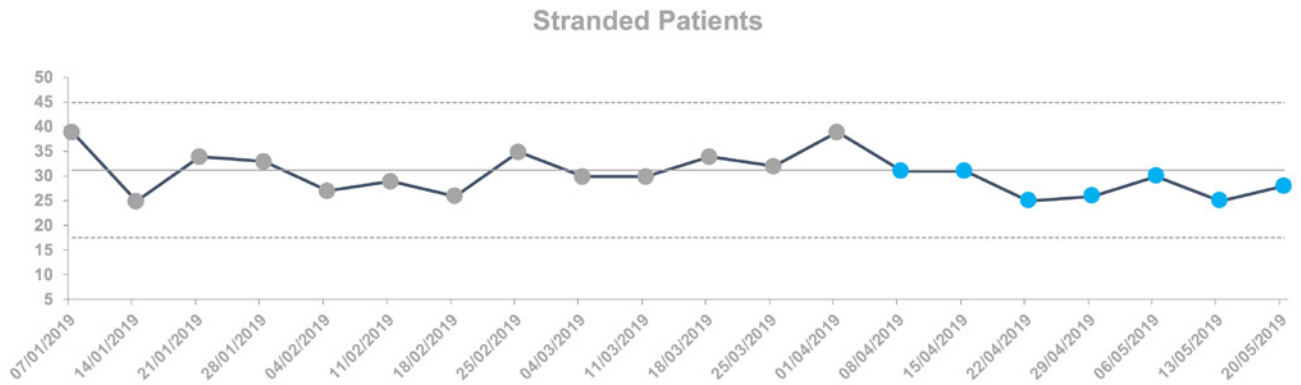
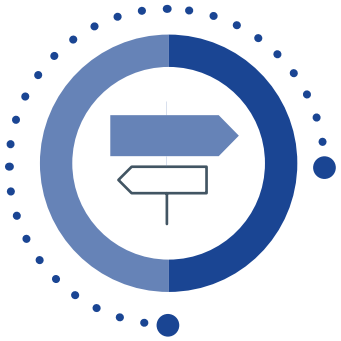


The next board meeting is a few weeks later. The board are aware of the improvement programme, and want to know if it's worked. You put the new SPC chart, with highlighted special cause variation, into the integrated performance report. Under the chart, you include the following commentary: "There has been a significant reduction in the number of stranded patients since the improvement programme commenced seven weeks ago. However, since last week, the number of stranded patients has increased by 3".

After the meeting, the Medical Director comes to speak to you.



Medical Director

I'm a little confused. I thought you said that the points highlighted in blue represent an improvement? But the commentary you provided said that there's been an increase since last month. Board members read that and became concerned that the programme hasn't been as effective as we suggested.

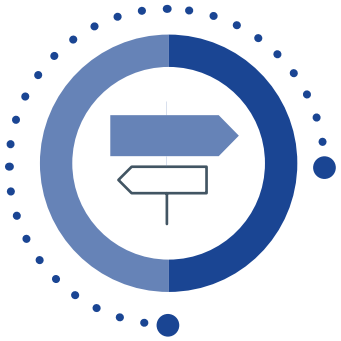
Senior Analyst (you)
Select A or B

A

You're right, I shouldn't have written that. We have seen seven months of improvement. I'm new to SPC and I fell into the trap of writing commentary in the traditional way….. describing the change this month compared to last. It would have been better for me to say that since the intervention seven weeks ago, we've seen and continue to see significant improvement.

B

Well yes, we're in a period of improvement overall, but it's still important to know if the number of stranded patients has increased since last week. You want to know if it looks like you're moving out of the period of improvement, right?



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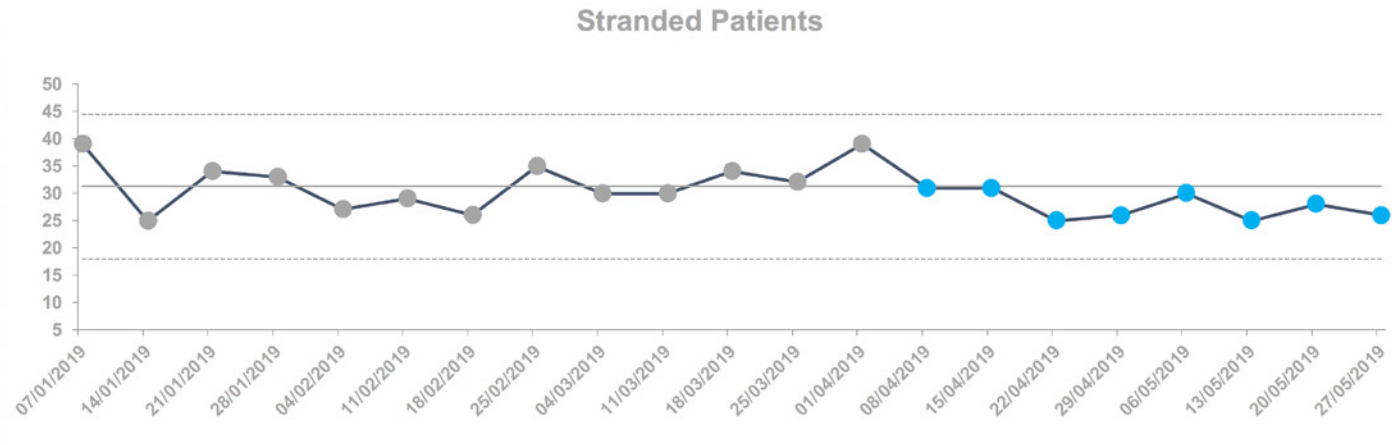
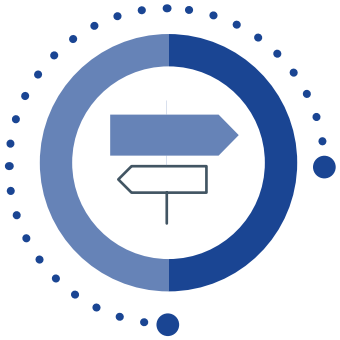
Well yes, we're in a period of improvement overall, but it's still important to know if the number of stranded patients has increased since last week. You want to know if it looks like you're moving out of the period of improvement, right?

The following week, you're asked to share your stranded patient data with the CCG in advance of a meeting. After the meeting, you get a call from the Director of Commissioning.





Director of Commissioning

Thank you very much for sharing your data – it was really easy to see the improvement in the SPC chart. However, we spent a lot of time discussing what might have happened eight months ago. Do you know why there's been such a sustained improvement in the number of stranded patients? We need to know if it was an intentional change that is going to continue, or just an accident.

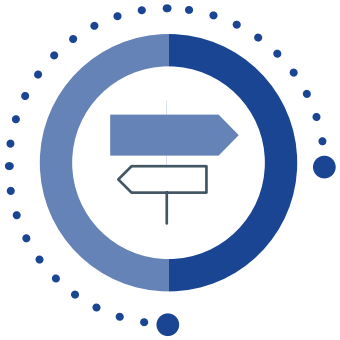
Senior Analyst (you)
Select A or B

A

The improvement is a result of an improvement programme to reduce the number of stranded patients in the trust. It's clearly been successful so far, and I expect it to continue.

B

The improvement is a result of an improvement programme to reduce the number of stranded patients in the trust. Because I'm so used to preparing these charts for people who are familiar with what's happening internally, I didn't think about the importance of providing contextual information. From now on, I'll ensure that I annotate all my charts with relevant information so that you don't waste your time wondering what has happened in future.



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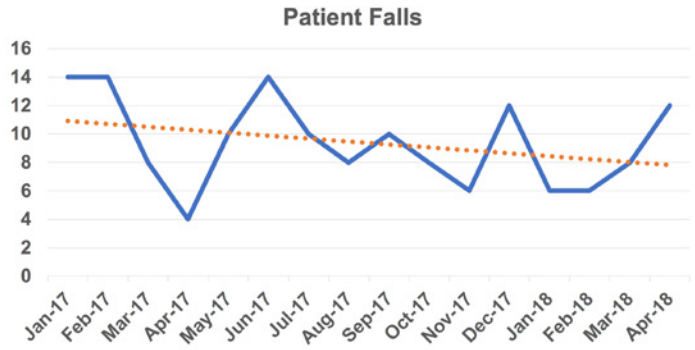
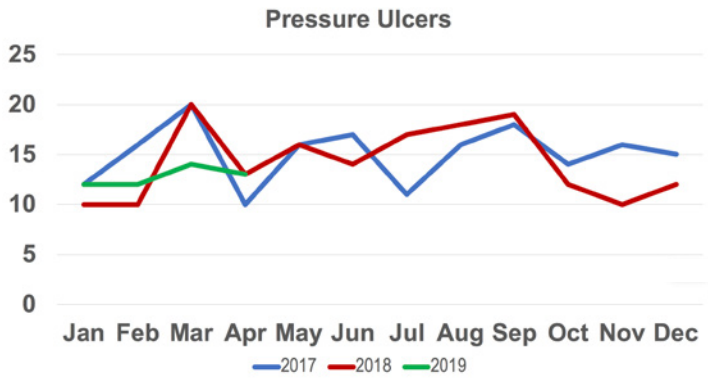
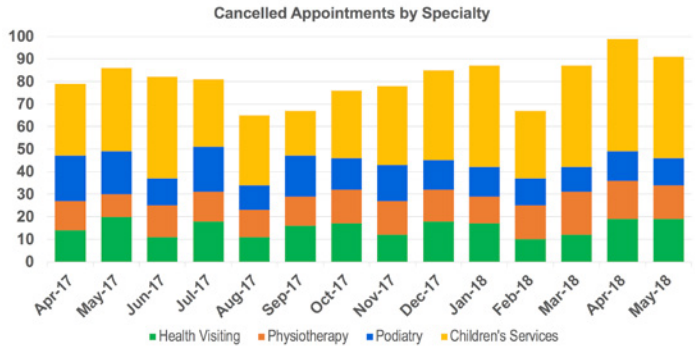
Exercise 1: Enhancing your data to aid rapid decision-making

RAG reports and two-point comparisons are not the only analytical approaches that can benefit from SPC. Select one report that you regularly receive/produce and together with colleagues look to see whether it includes any of these presentations of data.







Did you find any? Most of the reports we see contain some if not all of them.

Have a discussion about how easy it is to interpret data presented in each of these ways. How quickly did you understand the messages from the data?

Now it's time to roll your sleeves up and re-create as SPC charts any data in your report presented as spaghetti, stacked bar charts or with linear trend lines. You can use pen and paper or the SPC template that we have developed.

https://improvement.nhs.uk/resources/statistical-process-control-tool/

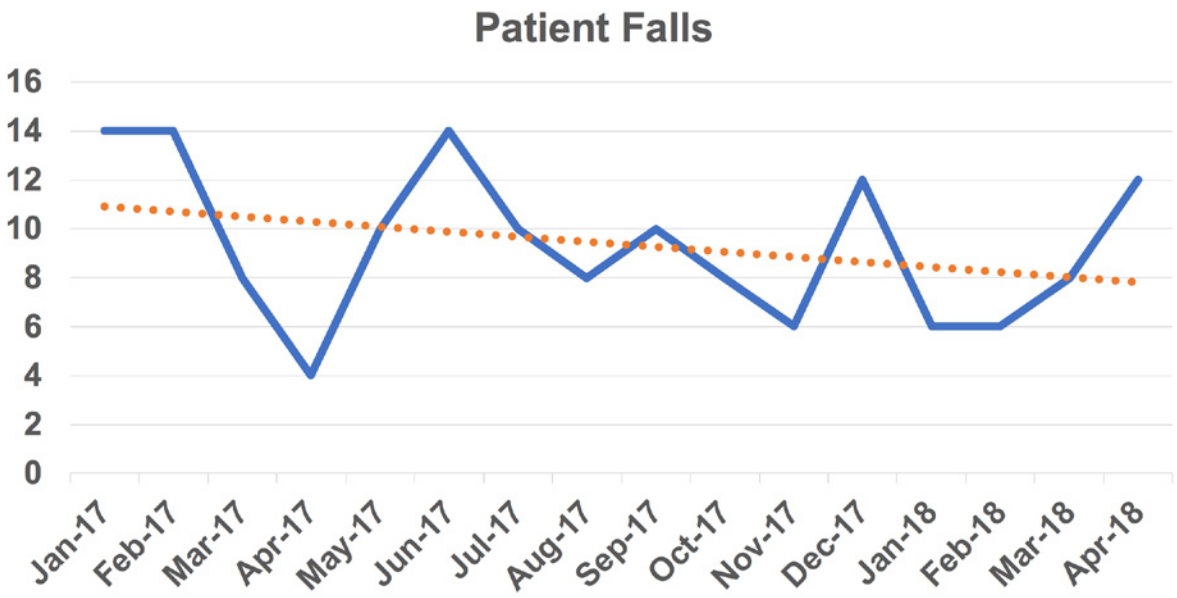
Once you have created some SPC charts, discuss what the data now tells you. How much more quickly and easily do you know the questions to ask and patterns of data to investigate?

Here are some examples in case you didn't find any of your own.

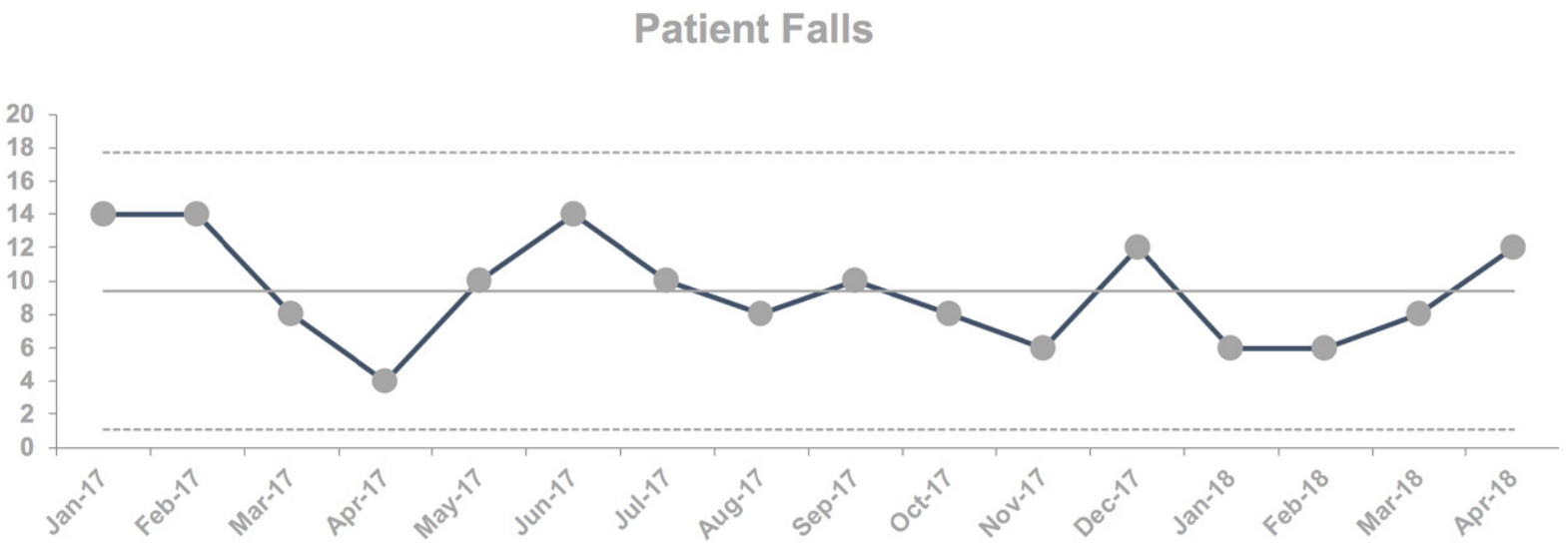
Linear trend lines

You can add a linear trend line through a data time series with one click in Excel. No wonder it's a popular addition. But does such a line aid your decision-making?

Linear trend lines can lead you to believe that something is changing when there are no significant patterns in the data.



Let's plot this data as a SPC chart.

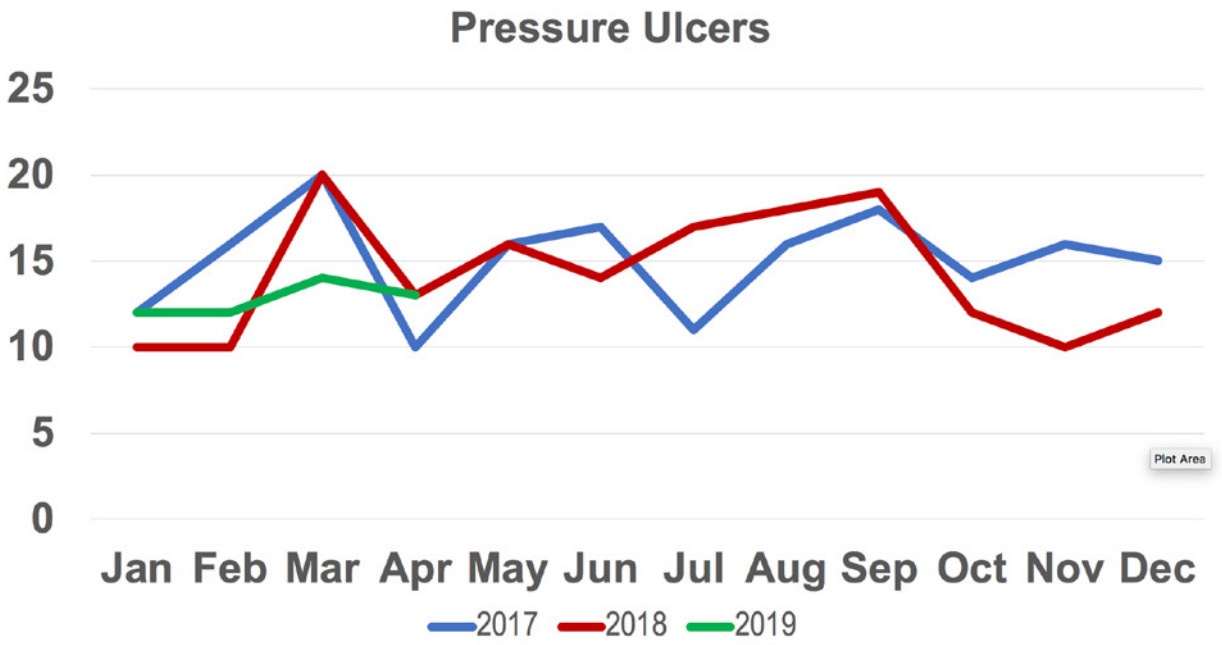


Do you get the same impression from the SPC chart as the linear trend line? Would you react differently to each of these visual presentations of data?

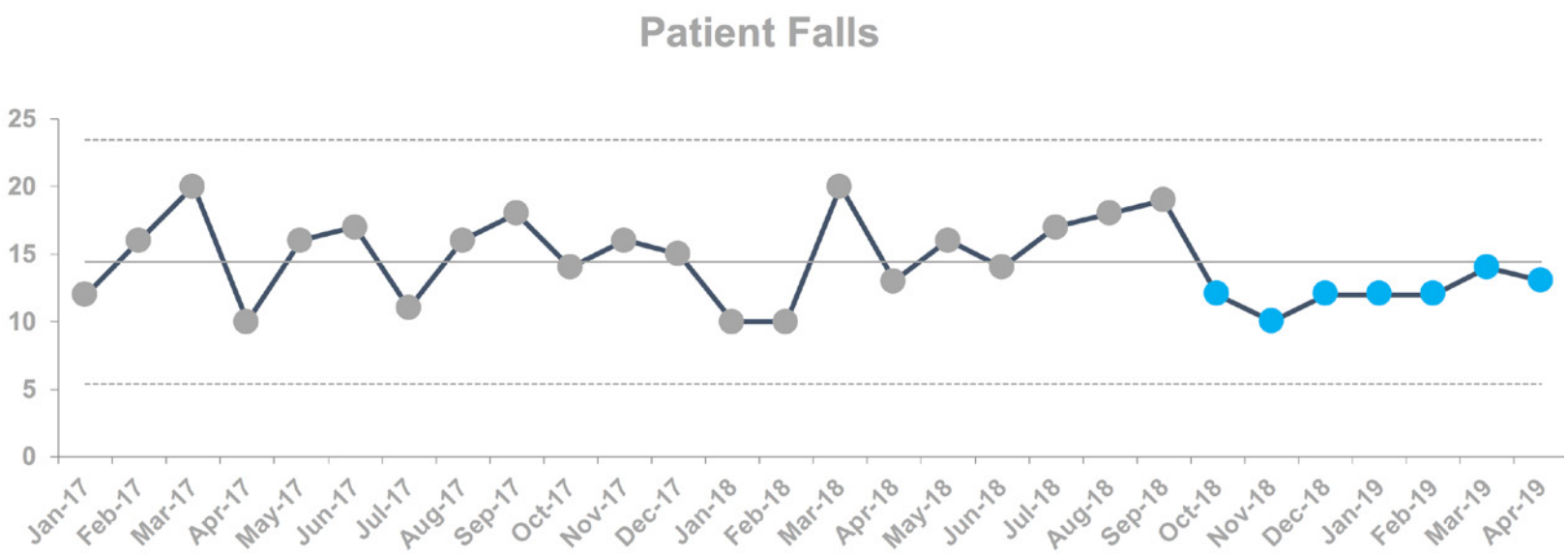
Spaghetti

We refer to charts like this as 'spaghetti' and we come across them very frequently.

How likely is it that you will mentally lay these lines in sequence to understand the patterns in the data? From our experience of working with teams across the country the answer is unlikely.



Let's re-plot this data as a SPC chart. You should now find it much easier to grasp the important messages from the data. In this case the improvement indicated by the blue dots should be investigated and learnt from.

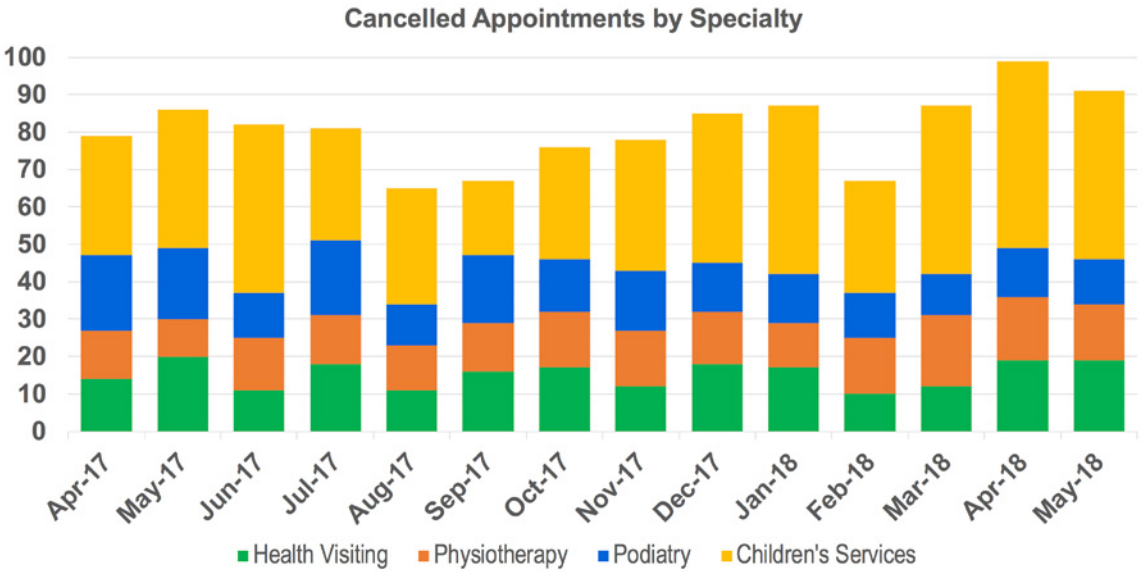


Stacked bar chart

Here's another popular way to present data – and again this is easy to produce in Excel.

Is it easy to work out what the data is telling you? Do the colours in the bars suggest any significant patterns? Most importantly, do you know what action you should take from looking at this graph?

Time for a little test – which colour shows special cause variation (if any)? Could it be green?

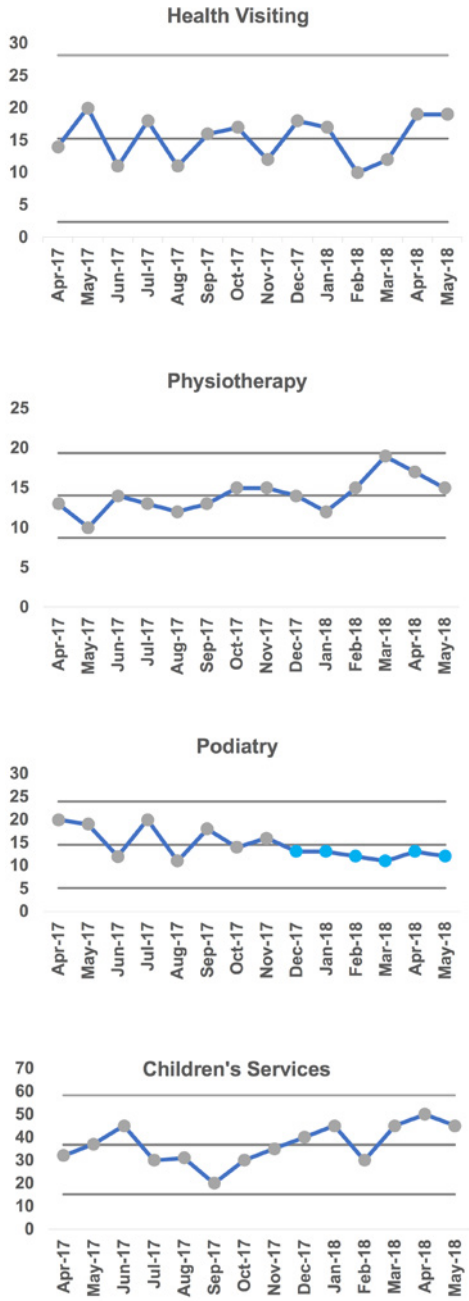


By presenting the data for each colour of the bar chart on separate SPC charts you can understand the messages from the data much more easily.

If you said green you were wrong. Any of you opting for blue – well done!

Again, visualising this data as SPC charts brings out the important messages.

So, from now on if you see poorly presented data, think about whether SPC would make the messages from the data clearer and start plotting the dots!



Exercise 2: Informing your decision making using summary icons

This exercise will help you understand how to react to summary icons.

Variation			Assurance		
					
Common cause – no significant change	Special cause of concerning nature or higher pressure due to (H)igher or (L)ower values	Special cause of improving nature or lower pressure due to (H)igher or (L)ower values	Variation indicates inconsistently hitting passing and falling short of the target	Variation indicates consistently (P)assing the target	Variation indicates consistently (F)alling short of the target

	Target		Trust	East team	West team	Central team
Risk Assessment (%)	95	*Upper Process Limit*	92	89	94	94
		Mean	90	87	93	90
		Lower Process Limit	86	81	92	86
		Latest	91	88	92	90
Care review within last 12 months (%)	95	*Upper Process Limit*	100	100	99	100
		Mean	97	98	96	97
		Lower Process Limit	95	96	93	94
		Latest	97	99	95	96
7 day follow up (%)	95	*Upper Process Limit*	97	96	97	99
		Mean	92	90	95	90
		Lower Process Limit	86	84	93	81
		Latest	96	96	96	95

Consider this extract from a SPC icon summary dashboard alongside the icon key.

Here you see information relating to three indicators – risk assessment, care review within the last 12 months and 7 day follow up.

In this extract, you are provided with information relating to 3 localities along with the trust's overall position. Imagine you are part of the performance team monitoring these three indicators. What discussions would you have based on this output? Gather together some colleagues and consider the following questions.

- What is your summary of risk assessment performance at a trust level?
- The trust is required to achieve the risk assessment target. Which teams should you focus on to achieve this?
- What is your summary of performance for 7 day follow up at a trust level?
- Where should you focus if the trust needs to achieve the 7 day follow up target consistently in future?

Here are some suggested answers. Were your answers similar?

Have a read and then discuss as a team.

- **What is your summary of risk assessment performance at a trust level?**

  The trust as a whole will consistently fall short of the risk assessment target. In addition, the trust is showing no signs of progress in moving closer to achieving the target.

- **The trust is required to achieve the risk assessment target. Which teams should you focus on to achieve this?**

  Looking at the latest score you might be tempted to celebrate the West team's efforts as they are closest to the target. You may consider rolling out their practice to other teams.

But you can also see that the West team are currently experiencing significant decline. So you may be wary about promoting their practice at this point.

You may decide to deploy the improvement team to work with the West team to help them understand and address their concern.

You may be tempted to ask the East team to make fundamental changes as they have the lowest score. However, you can also see that they are showing signs of significant improvement. Maybe the message is not to change in the East but to continue with current practice.

Finally, the central team are failing the target (as are East and West) and showing no improvement. What should you do? Could this team learn from the improvement in the East to help improve their performance?

- **What is your summary of performance for 7 day follow up at a trust level?**

  Despite the latest score being above the target, the trust will not reliably hit the target. There is also no significant improvement or deterioration in performance currently.

- **Where should you focus if the trust needs to achieve the 7 day follow up target consistently in future?**

  All three teams are exhibiting common cause variation. There are no examples of improvement to spread or concern to address. But look at the process limits - the process limits for the West team are closer together than the other two teams. This means that they have a less volatile system. You could investigate what makes the West team's system more reliable and look to remove some of the volatility in the other teams. A less volatile system will then be easier to manage and implement improvement ideas in the future.

We haven't provided you with a model answer for the third indicator – care review within the last 12 months. You can sign up to our virtual network and contribute to the discussion thread on this topic. Register at **https://www.source4networks.org.uk/** and search for 'Making data count' to join the group.

Make your pledge

Hopefully you're as passionate as we are about changing the way we use the wealth of data available to support better judgement and decisions for action.

Momentum is growing across the country with hundreds of people pledging to take action to make better use of data the norm across the NHS.

What will your pledge be?

I pledge to...

Go to template

Write down your pledge for action, take a picture of it and tweet it using **#plotthedots**

And why not sign up to our **#plotthedots** virtual network?

Register at **https://www.source4networks.org.uk/** and search for 'Making data count' to join the group.

Resources

Making data count

This detailed practical, interactive guide will show you how to make better use of your data. This guide is where you should start.

SPC (XmR) tool

This tool enables you to create your own annotated SPC chart. A XmR chart is the simplest and most versatile SPC chart.

P chart tool

A P chart is a type of SPC chart. It is used to monitor proportions and provides greater sensitivity than a XmR chart.

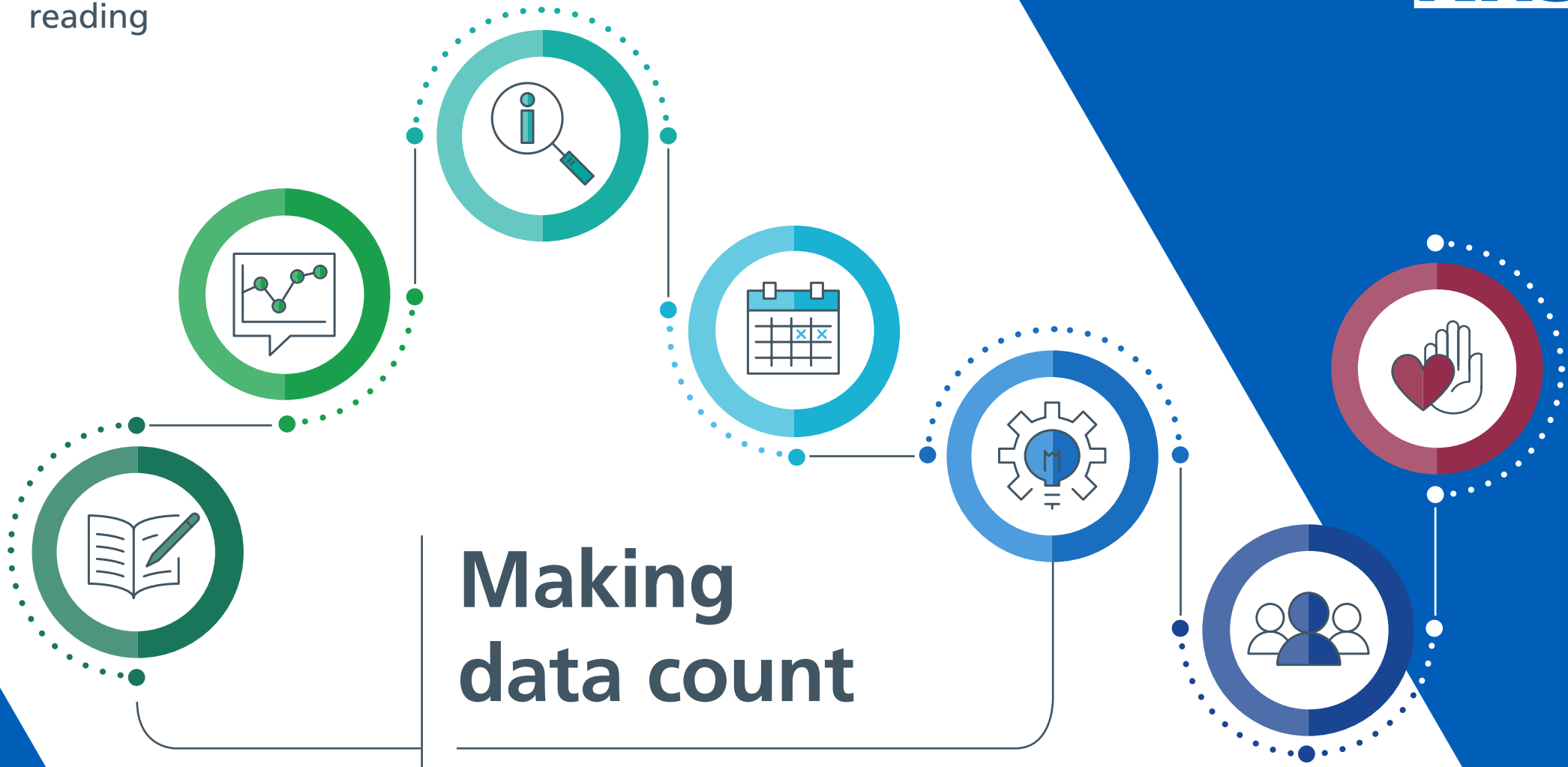
Pareto chart tool

This tool enables you to create your own pareto chart. This type of chart can be used to identify and then focus improvement work on the most significant categories.

Funnel plot tool

This tool enables you to create your own funnel plot tool. A funnel plot enables you to identify populations for whom the rate is unusually high or low.

Thank you for reading



Making data count

#plotthedots

Strengthening your decisions

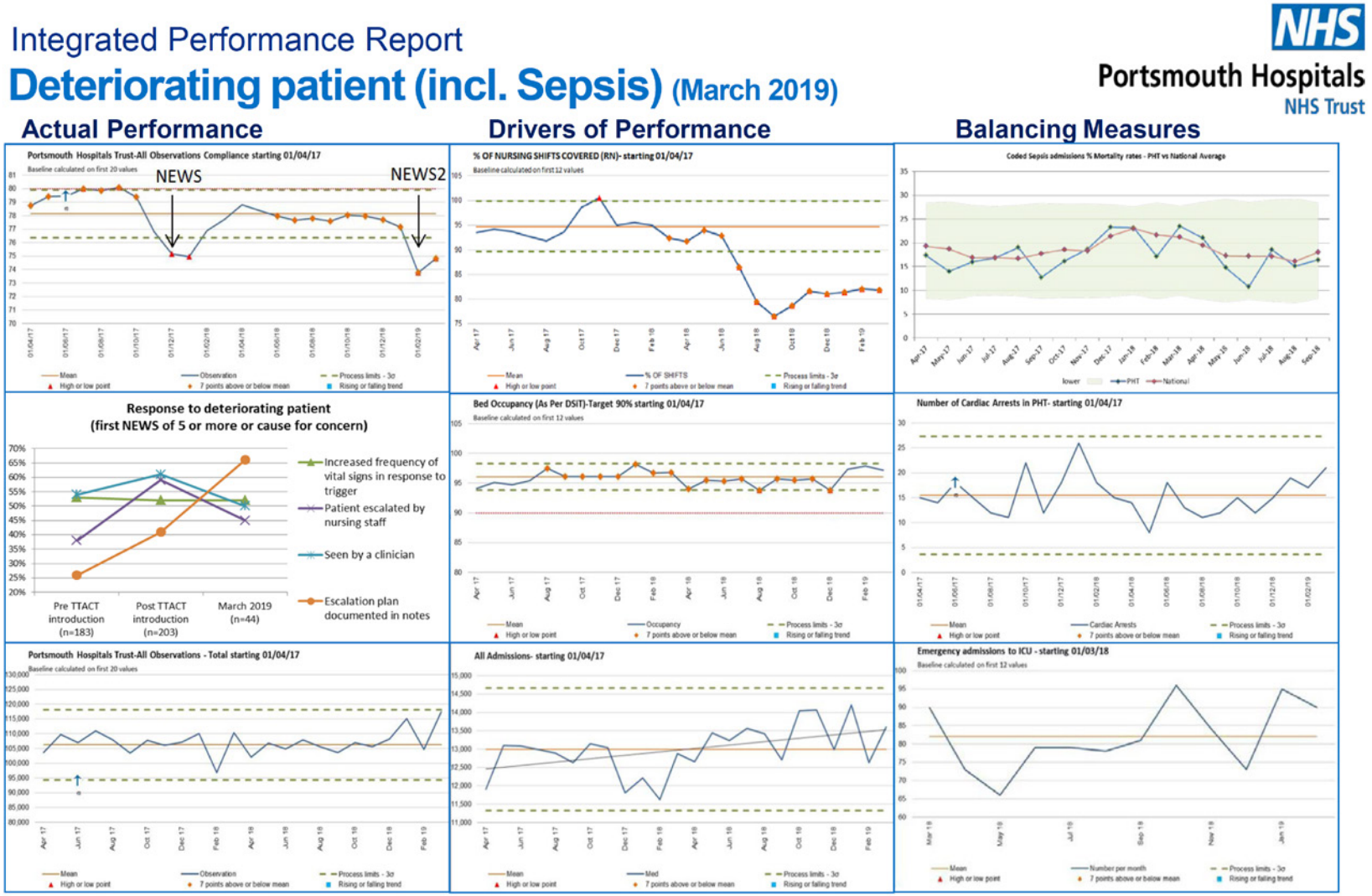
NHS England and NHS Improvement

Publishing Approval Reference : 000669

I pledge to...

#plotthedots

Portsmouth Hospitals NHS Trust are combining a range of SPC charts to tell a story



Kent Community Health NHS Foundation Trust have introduced a summary icon page

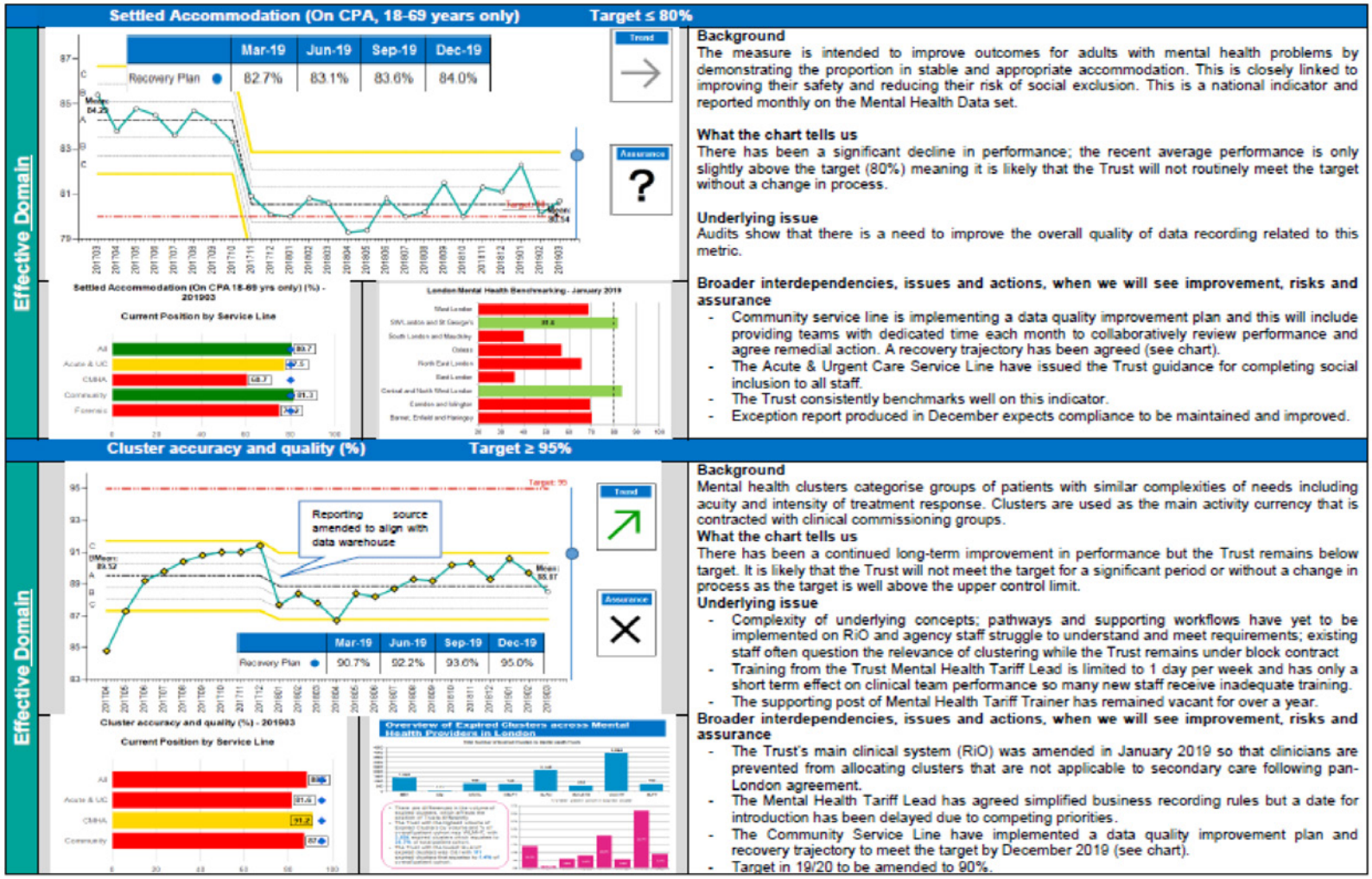
Kent Community Health NHS Foundation Trust - Corporate Scorecard

*NOTE: National Targets are denoted by (N) in the KPI name

	Metric	Actual			Target		Lower	Mean	Upper	Commentary	
4. Develop sustainable services	KPI 4.1 Percentage of LTC/ICT Face to Face Contacts carried out in a clinic (target to increase)	March 2019		3.7%	F	5.0%	2.8%	3.7%	4.6%		KPI is consistently failing the target with the target above the upper limit. This suggest achieving target without a process change will be down to chance and is being reviewed
	KPI 4.2 Bed Occupancy: Occupied Bed Days as a % of available bed days	March 2019		91.2%	?	87.0%	84.1%	89.4%	94.6%		KPI will variably meet the target some months and fail others
	KPI 4.3 Income & Expenditure - Surplus (%)	April 2019	L	1.1%	P	1.0%	1.1%	1.5%	1.9%	KPI is experiencing low negative variation with the current month performing below the lower control limit	KPI is consistently achieving the target as the lower limit is above the target. This suggests performance is unlikely to decrease to below target
	KPI 4.4 Cost Improvement Plans (CIP) Achieved against Plan (%)	April 2019	L	52.7%	?	100.0%	65.3%	83.0%	100.7%	KPI is experiencing low negative variation with the current month performing below the lower control limit	KPI will variably meet the target some months and fail others, expecially early in each financial year
	KPI 4.5 External Agency spend against Trajectory (£000s)	April 2019		£496,424	P	£628,000	£181,262	£399,585	£617,908		KPI is consistently achieving the target as the upper limit is below the target. This suggests performance is unlikely to increase to above target

	Metric	Actual			Target		Lower	Mean	Upper	Commentary	
5. Be The Best Employer	KPI 5.1 Sickness Rate	April 2019		3.85%	?	3.90%	3.81%	4.47%	5.13%		SPC suggests target is unlikely ot be achieved regularly and is being reviewed
	KPI 5.2 Sickness Rate (Stress and Anxiety)	April 2019		1.01%	?	1.15%	0.99%	1.29%	1.59%		KPI will variably meet the target some months and fail others
	KPI 5.3 Turnover (planned and unplanned)	April 2019		17.29%	F	16.47%	17.12%	18.41%	19.70%		KPI is consistently failing the target with the target below the lower limit. This suggest achieving target without a process change will be down to chance and needs review
	KPI 5.4 Mandatory Training: Combined Compliance Rate	April 2019	H	96.0%	P	85.0%	94.0%	95.4%	96.8%	KPI is experiencing high positive variation with the last 7 months performing above the mean	KPI is consistently achieving the target as the lower limit is above the target
	KPI 5.5 Gross Vacancy Factor (% of the budgeted WTE unfilled by permanent workforce)	April 2019		9.7%	?	9.7%	6.8%	9.0%	11.2%		KPI will variably meet the target some months and fail others
	KPI 5.6 Stability (% of workforce who have been with the trust for 12 months or more)	April 2019	H	84.7%	F	85.0%	81.4%	82.8%	84.3%	KPI is experiencing high positive variation with the last 7 months performing above the mean	New target has been set at 85%. While the target currently sits above the upper control limit, current performance should see the upper limit increase above target

South West London and St George's Mental Health NHS Trust have well structured commentary

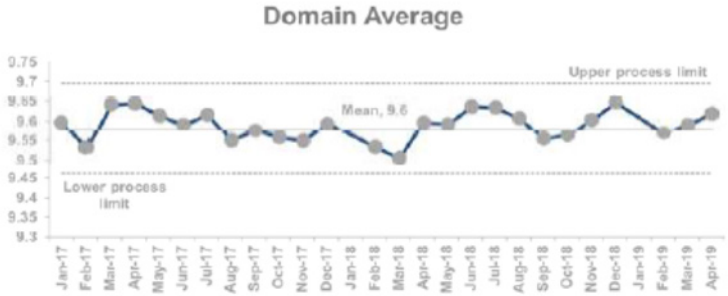


Northumbria Healthcare NHS Foundation Trust are using SPC to better understand the experience of their patients.

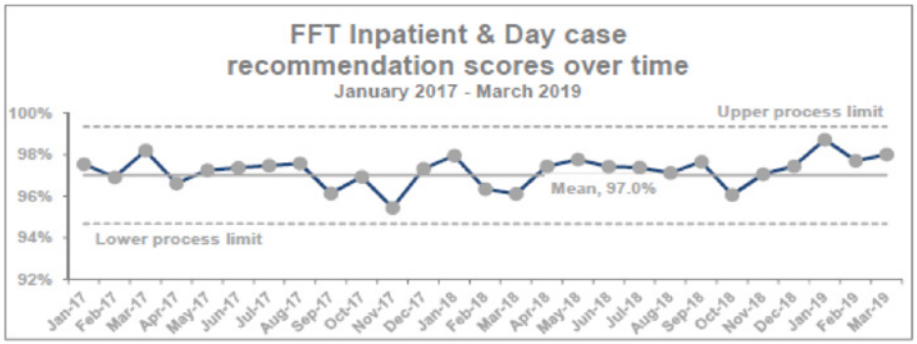
Trust Board Report - Patient Experience Q4 2018/19 Update - May 2019

Real Time Patient Experience Performance

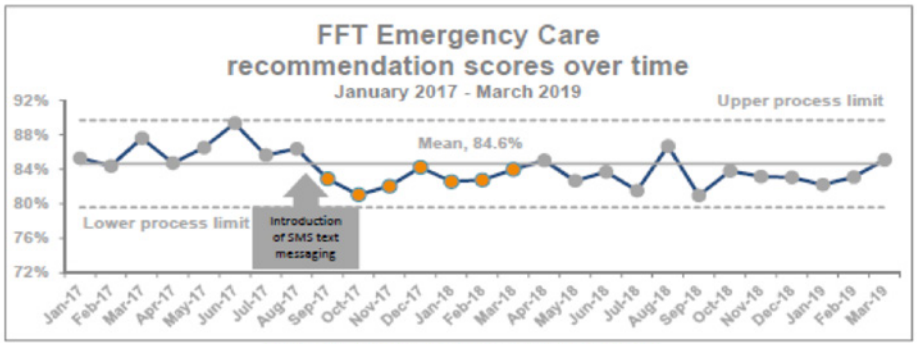
Domain	Q4 Score	Improvement or Decline	Performance over the last 2 years
Coordination	9.35		**Decline:** Jul 18 → Apr 19 (9 Data points below the mean)
Respect & dignity	9.91		**No Change**
Involvement	9.59		**Decline:** Oct 17 → May 18 (7 data points below the mean)
Doctors	9.82		**No Change**
Nurses	9.85		**No Change**
Cleanliness	9.86		**Decline:** Feb 17 (Below the lower process limit) **Improvement:** Mar 17 → Sep 17 (7 data points above the mean) **Improvement:** Nov 17 → Apr 19 (16 data points above the mean)
Pain Control	9.82		**Decline:** Aug 18 → Mar 19 (7 Data points below the mean)
Medicines	8.40		**Improvement:** Apr 18 → Apr 19 (12 data points above the mean)
Noise at Night	9.33		**Improvement:** Nov 17 → Jun 18 (7 data points showing improvement)
Kindness & Compassion	9.91		**No Change**
Domain Average	9.58		**No Change**



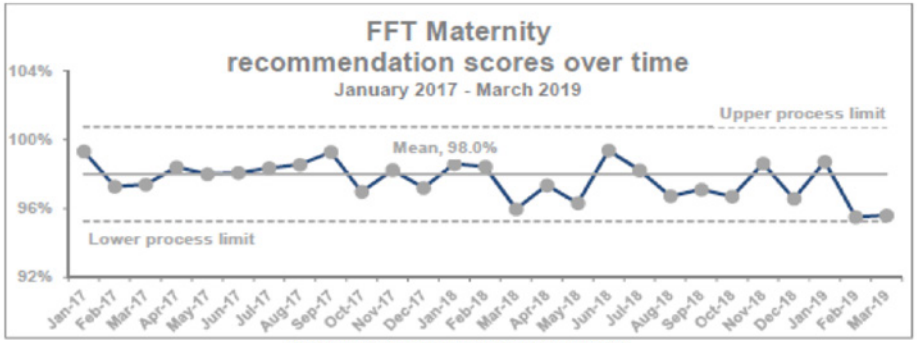
Friends and Family Test



National FFT Inpatient average score 96%



National FFT Emergency Care average score 85%



National FFT Maternity average score 97%