Imperial College Healthcare
NHS Trust

Measurement for Improvement

Guides, flowcharts and resources

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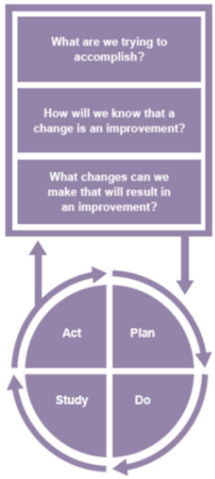
Contents

Quick guide to understanding measurement for improvement

What is measurement for improvement?

Measurement is essential in all QI projects to tell us whether the changes we make are actually improvements. This is the 2nd question in the IHI model for improvement and builds on the original Plan, Do, Study, Act, (PDSA) cycle created by Walter Shewhart in the 1930s.



1.Decide on a clear aim

2.Choose measures

3.Come up with ideas to make changes

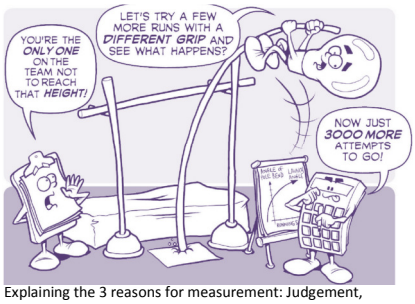
4.Test these ideas using PDSA cycles

The model for improvement

Reasons for measurement

The 3 main reasons for measurement are for research, judgement or, in this case, for improvement. It is important to understand why you are measuring as this influences the way you should think about measurement.

Clinical staff are often familiar with measurement for research whilst service managers may be more familiar with measurement for judgement. Measuring for improvement is different as the aim is not to prove (or disprove) whether clinical interventions work or to provide performance data. This means there is a much more pragmatic approach which does not necessarily require the same level of robustness.



Explaining the 3 reasons for measurement: Judgement, Improvement and research (left to right). *Image from NHS Improving Quality.*

Tip: Do not dismiss data that it is not of "research level quality". In an improvement project the aim is to improve not to achieve data perfection. Remember that collecting just enough data at a minimum quality level is better than collecting no data at all.

Choosing measures

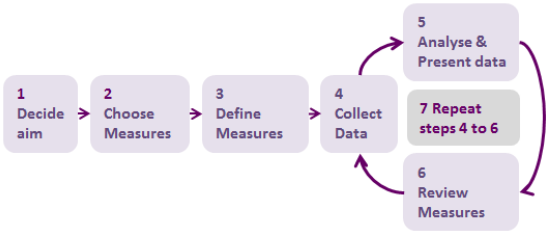
When undertaking an improvement project you should aim to select 3 to 8 measures to tell if your changes are having an improvement. There are 3 types of measures you should include:

1. **Outcome measures:** Measures that directly reflect your project aim *(e.g. if your project aim was to reduce patient harm you could measure % of patients harmed)*
2. **Process measures:** Measures of the processes and systems that influence your aim *(e.g. if your project aim was to reduce patient harm you could measure the number of patient incidents reported on Datix)*
3. **Balancing measures:** Any unintended consequences of the change. A tip is to listen to sceptics of the project and use their concerns to develop balancing measures *(e.g. could measure readmissions if the aim is to reduce length of stay)*

Tip: We advise completing a driver diagram before choosing measures as this gives you a framework for your measures. None of your measures have to be complicated; you want to make things as simple as possible to ensure your focus is still on your project aim. A few good measures are better than lots of "just in case" measures.

7 steps in measurement for improvement

The diagram on the right provides a structure for effective measurement in your project. Make sure you spend time working through this before you start your project and revisit it throughout.



Example: The importance of good measurement can be demonstrated by the proverb ***"you can't fatten a cow by weighing it"***. If the aim of your project is to make the cow heavier, your change ideas would probably involve trying different diets. However, in order to know that your changes are having an improvement, you would need to weigh the cow before you start. This is something that is often overlooked in projects; teams rush into making change ideas but don't consider how they will know they have made a difference.

Collecting, analysing and presenting data

View our flow chart on collecting data which will help you to decide which data is best to collect for your project and also how best to collect it. Once you have collected your data our flow chart on analysing data will help you to decide the best way to present your data.

More tips

- Ensure your project has a **SMART** aim (i.e. an aim that is **S**pecific, **M**easureable, **A**chievable, **R**elevant, **T**ime bound)
- Make use of data that is already available and only collect what you need
- Check the measurement resources on the Source or email us at imperial.dihub@nhs.net

D&I Hub

Steps for successful measurement for improvement

1 Decide Aim	• Measurement is essential in all QI projects to tell us whether the changes we make are actually improvements. • Measurement is self-directed by project teams and used to inform improvement, not judgement, compliance or performance management. • Data is collected, analysed and presented in order to diagnose problems, understand their root causes and to support continuous improvement.

2 Choose measures	• QI uses a mix of measures (aim for 3-6) to see the whole picture:
	  ○ *Outcome* (measure of the project aim)
	  ○ *Process* (measure of the primary or secondary drivers
	  ○ *Balancing* (measure of dependencies)
	• Measure what matters to project stakeholders to provide credibility for the project, demonstrate its impact and support scale-up and spread
	• Use quantitative and qualitative methods to engage hearts and minds

3 Define Measures	• Create operational definitions for each measure to ensure they are:
	  ○ *Repeatable* (collected the same way every time)
	  ○ *Reproducible* (interpreted the same way by different people)
	• Identify clear inclusion and exclusion criteria for each measure
	• Use proxy measures when we can't get at the data we need

4 Collect Data	• Collect only enough data (and accurate enough) to tell us what we need to know – this will vary between small PDSA cycles to large-scale change. • Never collect data just for the sake of it! • Data for improvement needs to be accurate but need not be perfect • Where possible use existing sources of data to avoid duplication • Manual data collection needs a clear plan; agree the w*hat, where, who, when* and *how* before you start. • Use random sampling of large datasets where appropriate

5 Analyse & Present data	• Good measurement helps us identify and explain variation:
	  ○ To understand how a system or process really works
	  ○ To make predictions about future performance of a system
	  ○ To prevent overreacting and underreacting to change
	• Good data analysis presents a narrative about how a process or system is working over time
	• Present data visually and clearly to aid understanding. Be creative about presentation of data to appeal to the hearts and minds of stakeholders

6 Review Measures	• Are your measures telling you what you need to know? • Remember that measurement is only a part of QI – if data is not reviewed and acted upon as part of a project then it is wasted • Stop collecting data as soon as it is no longer useful
7 Repeat steps 4-6	• Repeat the process again (as many times as necessary!)

Measurement checklist

You should work through the measurement checklist before starting to make changes in your QI project.

✓	1. Deciding your aim	
☐	Understand importance	1a. Understand that measurement is vital in QI projects to tell us if changes we are making are having improvements
☐	Measure to improve	1b. Understand that measurement for improvement is different to measurement for research or performance management (judgement). The focus should be on understanding and learning rather than targets or reporting.
☐	Choose a **SMART** aim	1c. Define your aim (make it **S**pecific, **M**easureable, **A**chievable, **R**elevant, **T**ime bound) and be able to explain this clearly to others
☐	Produce driver diagram	1d. Produce a driver diagram for your project. This will make it easier to choose measures by giving you a framework to work from.

✓	2. Choosing your measures	
		In your QI project use a mix of measures (aim for 3-6) to see the whole picture:
☐	Select outcome measure/s	2a. An outcome measure directly reflects your project aim (e.g. if your project aim was to reduce patient harm you could measure % of patients harmed)
☐	Select process measure/s	2b. A measure of the processes that influence your aim (e.g. if your project aim was to reduce patient harm you could measure the number of patient incidents reported on Datix)
☐	Select balancing measure/s	2c. Any unintended consequences of the change. A tip is to listen to sceptics of the project and use their concerns to develop balancing measures (e.g. you could measure readmissions if the aim is to reduce length of stay)
☐	Measure only what you need	2d. Ask yourself why each measure is important - If you can't think of a good enough reason, you can save time by not including it. A few good measures are better than lots of "just in case" measures.

✓	3. Defining your measures	
☐	Create operational def	3a. Create an operational definition for each of your measures to ensure they are **repeatable** (collected the same way every time) and **reproducible** (interpreted the same way by different people)
☐	Define criteria	3b. Identify clear inclusion and exclusion criteria for each measure (e.g. should all patient groups be included - day case, inpatient, outpatient, elective, emergency…?)
☐	Consider calculations	3c. Consider and plan for the calculations involved in your measure. (e.g. to produce a percentage what is the numerator and denominator)

✓	4. Collecting data for your measures	
☐	Determine data type	4a. What type of data do you need to collect? (Patient experience data, incidents, length of stay, survey data…)
☐	Determine data source	4b. Determine your data source. Consider data already available (e.g. Cerner/Datix) or collect manually if not. The Information team can help you locate data. Use this flowchart to help you.
☐	Determine sample size	4c. Do you need all the data available or will you take a sample?
☐	Decide date range	4d. How often will you collect the data (e.g. weekly)? If data is stored electronically (e.g. Cerner/Datix) consider the data range you want the records to start from (e.g. do you want the last year of data available)
☐	Test questionnaires	4e. Don't underestimate the importance of testing manual data collection methods like questionnaires, forms and checklists before you use them more widely. A quick way to do this is to ask colleagues to test them out; this will help you identify and eliminate issues, saving time in the long run.
☐	Understand data quality	4f. Understand that data for QI does not need to be research level quality - it just needs to tell you what you need to know. Anything else can result in time spent not working towards achieving your aim.

✓	5. Analysing & presenting your data	
☐	Who?	5a. Decide who is responsible for the analysis and presentation of your data (and make sure they know this!)
☐	How?	5b. Decide how you will present your data. Use this flowchart to help you. Data over time should be presented in a line graph (run chart or SPC) to clearly see changes over time.
☐	Share results	5c. Continually share your results (graphs, stories, charts, tables, feedback etc) with the project team to keep motivation and momentum as well as to keep communication flowing.

✓	Anything else	
☐	Make a plan	Complete a measurement plan to record your responses to steps 1-5. Make sure to share this with the project team so that everyone knows the plan.
☐	Continually review	Continually review your measurement plan and update as necessary throughout your QI project. You may decide to change your measures or present your data differently to how you originally planned.
☐	Check the Source	The Quality Improvement Source pages have a number of resources including chart templates to help you with measurement. You can also book onto a QI education session for measurement for improvement.

Measurement plan

We've provided an example structure for a measurement plan in the space below. You can use the measurement checklist to help complete this.

Project Title:		**Date:**
Project aim		**Team/s involved:**
Outcome measure/s	**Process measure/s**	**Balancing measure/s**

Definitions

Define the terms used in your aim and measures including clinical language (e.g. what is meant by a 'fall'), words like 'improve' or 'reduce', patient type. Be specific and detailed to make sure you're measures can be repeated and reproduced by anyone.

Data collection plan

Consider: data type / date source / date range of data / testing manual data collection

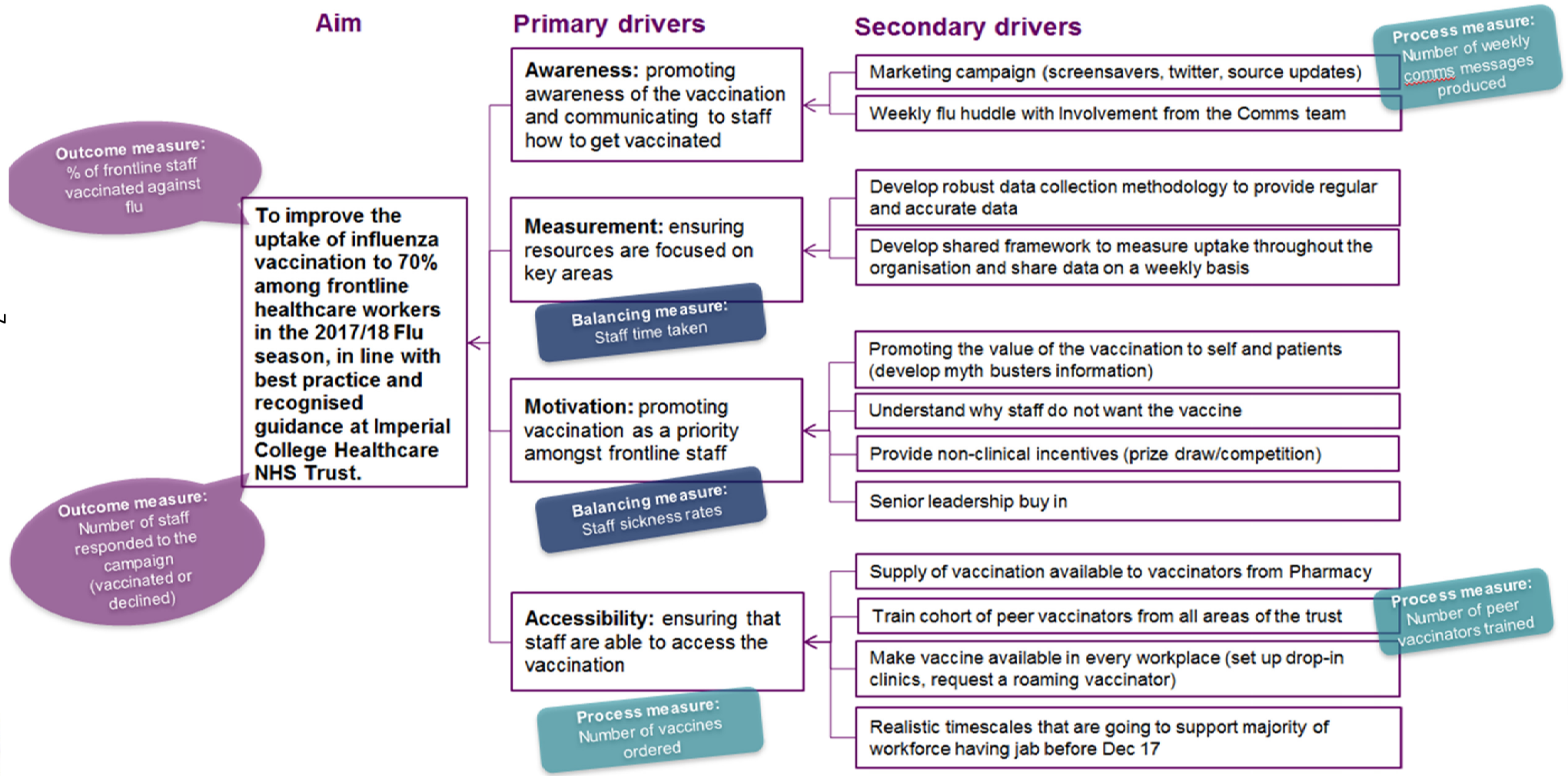
Analysing and presenting data *Calculate, measure and present results*	**Sharing results**
	Daily, weekly, monthly, ad hoc?
	Decision making
	Will this happen at a team meeting, big room, huddle, ward round… Is there a person responsible for the decision making?

Anything else

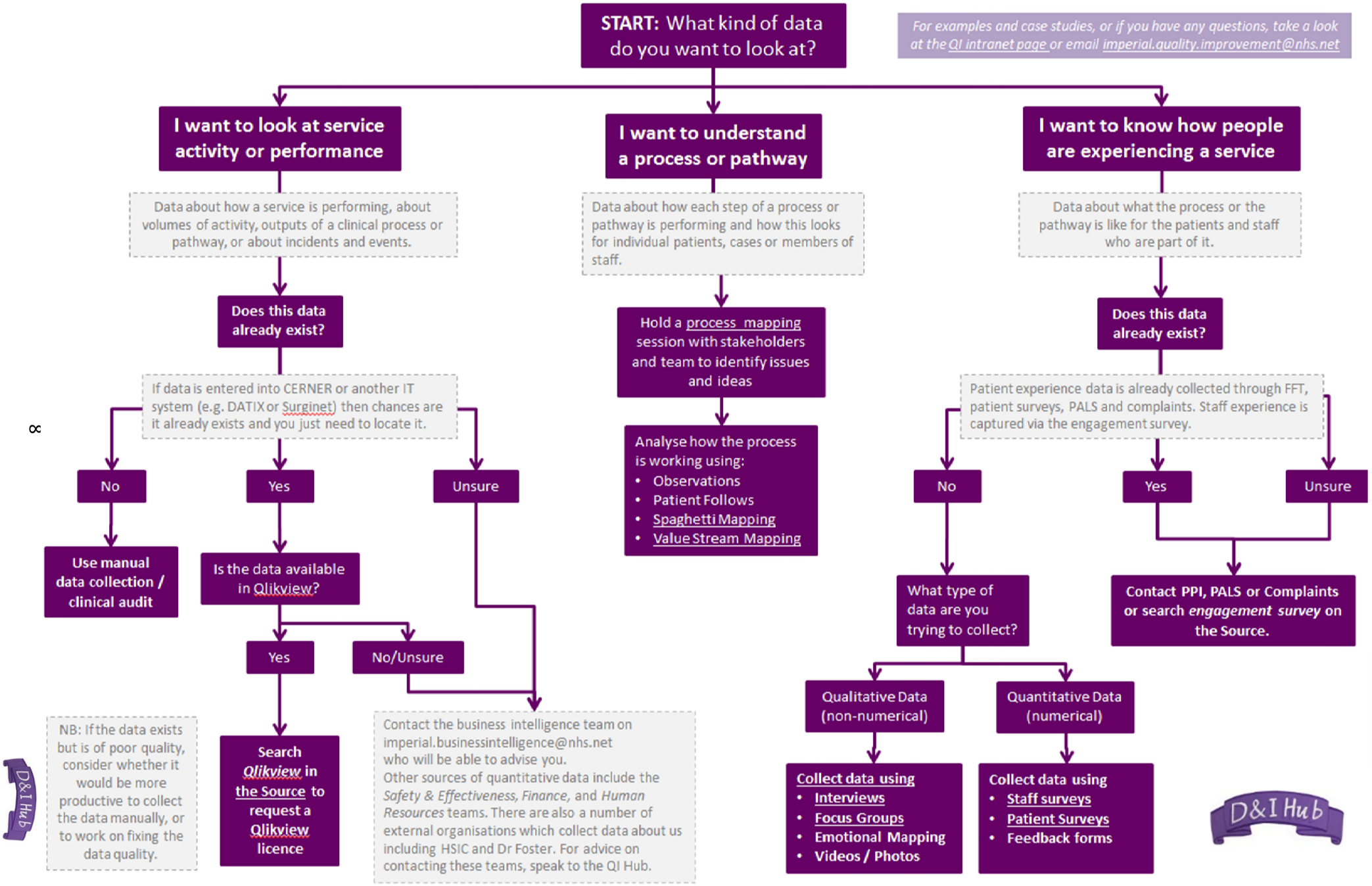
Are there any problems you foresee, any comments you have or any other important information about the measurement in the project?

Example driver diagram with measures

A driver diagram is a visual model that identifies and structures everything that will impact on achieving your aim, making it much easier to plan and to choose measures



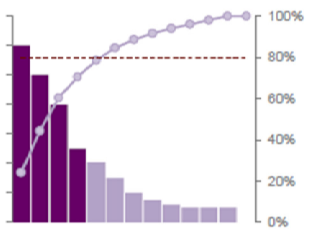
What data should I collect?



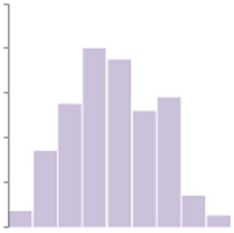
How should I analyse and present my data?

START: What do you want to use your data for?

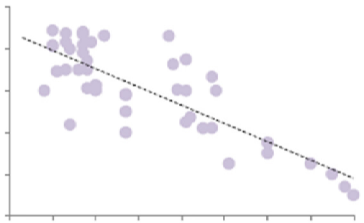
- **To understand how things are now and why this might be the case**
  - What kind of data do you have?
    - **Quantitative (numerical)**
      - What would you like to get from your data?
        - **Prioritising areas of improvement - choosing a focus point that would have the biggest impact**
          - **Pareto Chart** – A bar graph showing variables in order of size/frequency. Pareto's 80/20 principle asserts that a minority of causes usually lead to majority of the results.



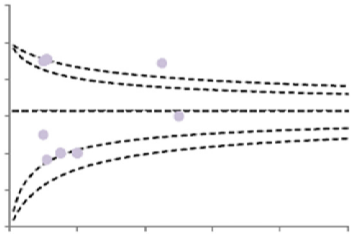
        - **To understand relationships between two processes, showing what happens to one process when another changes**
          - **Histogram** –These are bar charts used to evaluate distribution of data and help understand where the problem areas lie



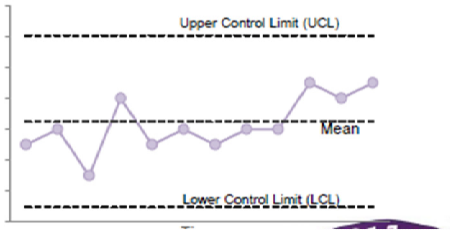
          - **Scatter plot –** Helps to identify strength of relationship between 2 variables



        - **Understand the likely financial benefits of the project**
          - **ROI** – Return on Investment can be calculated using estimated financial benefits and cost of the project
        - **To compare performance against other wards/ sites/ trusts**
          - **Funnel Plots –** A form of control chart, used for statistical comparison, that alters the control limits based on the sample size.



        - **To understand variation in a process**
          - **Statistical Process Control or Run Charts** – A SPC chart is a powerful tool used to distinguish between variations in a measure over time due to common causes and special causes. It can demonstrate whether a change is an improvement. Use a run chart if you have fewer than 12 data points.



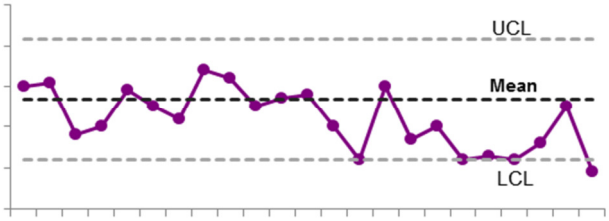
    - **Qualitative (non-numerical)**
      - **Stories** – Use direct quotes or visual media from your qualitative data to tell a story about what is happening and why?
        - *"I felt ignored by the staff in the clinic"*
      - **Thematic analysis** – Use word clouds and sentiment analysis to extract the overall themes from a large volume of qualitative data.

- **To measure whether a change is an improvement**
  - Make sure that your outcome, process and balancing measures all have clear operational definitions so that you are measuring the same way over time
  - How are you planning to measure?
    - **Before and after**
      - What kind of data do you have?
    - **Over time**
      - What would you like to get from your data?

Introduction to Statistical Process Control (SPC) charts

What is a SPC chart?

SPC charts (or Control Charts or Shewhart Charts) are a tool which measure changes over time. They are similar to a line graph but they also contain a mean line, an upper control limit (UCL) and a lower control limit (LCL).



Why should I use a SPC chart?

Using a SPC chart in an improvement project allows you to clearly observe changes over time in addition to being able to distinguish between common and special cause variation. This allows you to know if the changes you are making are having an improvement.

Understanding common and special cause variation

An easy way of understanding variation is to think about the time it takes you to get to work. If it takes you an average of 30 minutes with some days taking slightly longer or shorter you wouldn't think anything of it as these are all within an expected time frame. This is an example of common cause variation which is everyday variation present in a process. However, if one day it takes 75 minutes to get to work due to train delays, this would raise concern as it is clearly above the time expected. This is an example of special cause variation which arises because of a specific circumstance.

It's important to know if the variation displayed is common or special cause as this determines the action you take. If a special cause is present you should identify the cause, learn from it and then take action based upon it. It's important not to under or overreact to variation. The rules on the next page show how to determine if variation is common or special cause.

If you have a measure over time it is preferable to use SPC instead of tables or RAG ratings as you can visually see any changes and patterns in the data.

How do I make a SPC chart?

We have a number of easy to use SPC chart Excel templates available to use on the Source or Life QI. All you need to do is copy your data into the template and it will produce the chart for you. There are various types of SPC chart but, if you're not sure which to use, choose the I-chart.

Important points about SPC charts

We find that project teams sometimes fixate over the calculations involved in a SPC chart; how long their baseline period should be, if the correct chart is being used or if they are even using the SPC chart correctly. This can sometimes halt an improvement project as attention is diverted to this issue. Here are some important points to keep you on track:

- Remember that an improvement project is not a research quality project and the same standards are not expected
- There are a number of methods for calculating the control limits on a SPC chart. The ones we have chosen on our Excel templates are those we recommend using but you can choose to use any from a reputable source.
- Remember that everyone in your team may not want or need to know how an SPC chart's calculations work. Make sure your focus is always on the aim of your project – it's easy to get preoccupied.

Common definitions

Mean: The average of the first 12 (usually) data points on your SPC chart which form the baseline period.

Baseline: The baseline period is the time before you start making improvements. It tells you how your system or process is performing now. By establishing a baseline we can determine if changes are actually an improvement. Baseline data should be collected before improvements are made to enable you to compare data before and after any changes.

Sigma: The UCL and LCL are calculated using a measure of sigma which is similar to standard deviation.

Where to go for further information

- Read our advanced SPC chart guide which covers when to change your baseline and how to react appropriately to variation.
- Check the measurement resources on the Source or email us at imperial.dihub@nhs.net

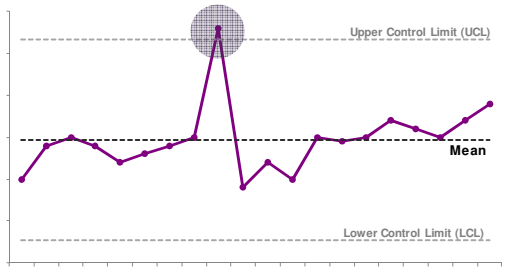
Methods to detect special cause variation on a SPC chart

There are several rules that can be applied to a SPC chart to determine a special cause. Many different rules have been suggested but there are several that are recommended for general use as shown below.

Most common rules observed

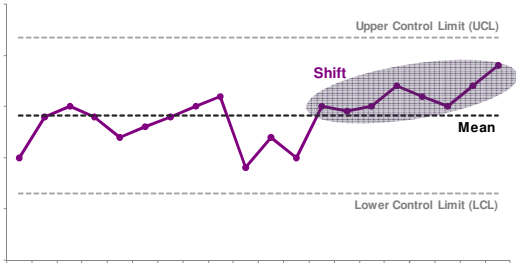
1. A data point outside the control limits

A **single data point** outside the upper or lower control limits. Identifies a sudden change in the measure.



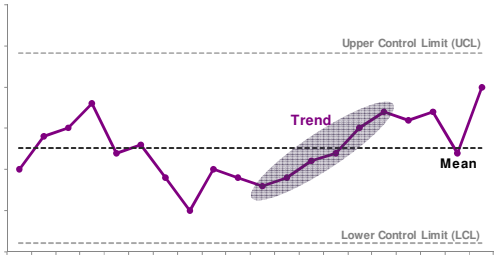
2. A Shift

8 or more consecutive points either above or below the mean. Identifies a small, sustained change in a process.



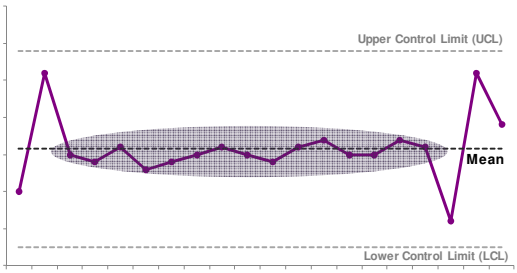
3. A Trend

6 or more consecutive points all going in 1 direction. Identifies a small, consistent drift in a process.



4. 15 consecutive points

15 consecutive points close to the mean line (i.e. the inner one-third of the chart).

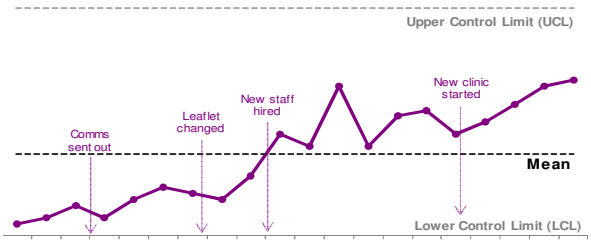


Important points…

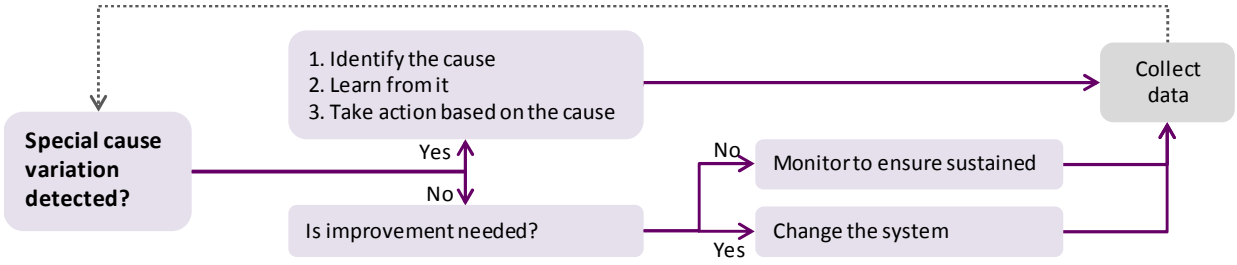
- Special cause variation is neither good or bad; it can be evidence of an improvement, process deterioration or an unintendended consequence of a change that was being tested
- A point exactly on a control limit is not considered outside the limit
- A point exactly on the mean does not cancel out or count towards a shift
- Ties between 2 consecutive points (i.e. equal values) do not add to or cancel out a trend

Remember to annotate your chart

- Annotating your chart shows the story behind your data
- This is helpful when showing your chart to different audiences; it will help them to understand what changes have been made in addition to the impact of these changes



Responding appropriately to variation



Resources

Name	Content	Link
Introduction to measurement for improvement		
Video from the NHS Institute for Innovation and Improvement	Introduces the 7 steps to measurement for improvement in less than 10 minutes.	http://www.cleanvideosearch.com/media/action/yt/watch?v=Za1o77jAnbw
NHS Elect guide on measurement for improvement	A really useful guide if you want all measurement knowledge in one place. Contains useful examples, analogies and images.	http://linkis.com/www.nhselect.nhs.uk/Dy9CH
Choosing and defining measures		
Video from the Institute for Healthcare improvement on choosing measures	Selecting appropriate outcome, process and balancing measures for your project based on an aim.	http://www.ihi.org/education/IHIOpenSchool/resources/Pages/AudioandVideo/Whiteboard15.aspx
QI Games: How do you measure the banana?	Uses a simple way to highlight the importance of defining your measures	http://www.ihi.org/education/IHIOpenSchool/resources/Pages/AudioandVideo/QI-Games-How-Do-You-Measure-the-Banana.aspx
Collecting data		
The 3 faces of performance measurement: Improvement, Accountability and Research	Article that discusses the difference between data for improvement, judgement and research	https://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiZo6yp2PrZAhVBiSwKHR6-Bm8QFggnMAA&url=https%3A%2F%2Fbcpsqc.ca%2Fdocuments%2F2016%2F11%2FSolberg-Three-Faces-of-Measurement.pdf&usg=AOvVaw3Xrs4wcQQnyIQmVca_puaU
Analysing and presenting data		
Paper on the problems using RAG (red, amber, green) ratings to present data	Useful for understanding the issues caused by using RAG ratings and targets to present and analyse your data	http://qualitysafety.bmj.com/content/26/1/81
The importance of data visualisation	Very useful video covering all aspects of data visualisation. Key parts of the video: 7:41 – How to de-clutter your graphs 10:43 – Re-designing a report page 16:48 – Presenting confusing data 22:51 – How to present a busy bar chart	http://www.cleanvideosearch.com/media/action/yt/watch?v=X79o46W5pII&feature=youtu.be
When to use pie charts	Pie charts are a common tool to present data although they are often used badly. This article discusses when it is not appropriate to use pie charts. Scroll down the page to see useful examples.	http://annkemery.com/pie-chart-guidelines/
The chartmaker directory	Interesting compilation of where you can find examples and resources to help you create different graphs and ways of presenting data e.g. word clouds	http://chartmaker.visualisingdata.com/
Infogram	Software to create visual reports and infographics. There is a free version but please note that sensitive/confidential data shouldn't be used as the free version is public.	

For any questions email imperial.dihub@nhs.net or check the measurement resources on the Source