Improvement Science

Step by Step Guide

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NSW GOVERNMENT

CLINICAL EXCELLENCE COMMISSION

Improvement Science Step by Step Guide

More information at CEC Website: http://www.cec.health.nsw.gov.au/quality-improvement/improvement-academy/quality-improvement-tools

Evaluation: Please provide feedback about this document via email to CEC-Academy@health.nsw.gov.au.

QIDS NSW Health Staff can log details about their Quality Improvement Project into the CEC QIDS platform.

NB: Some steps may need to be revisited as your team progresses through this improvement process.

Step 1
Decide on the process that needs improving

Common errors in selecting quality improvement projects

- No one is **interested** in the problem.
- The problem is not a **strategic priority** for the organisation.
- Selecting a **solution** to implement rather than a **problem to investigate**.
- Selecting a process in **transition** – ie manual to electronic process.
- Not defining a **manageable scope** of the project ie too large.
- Selecting a problem **beyond your authority** or outside your area of influence.

Task

Decide and document the process that needs improving:

- What is the problem you want to solve?
- How do you know it's a problem?
- Who else thinks it's a problem?
- Do you have support/approval to use this problem for your quality improvement project?

These can go in the top left corner of your driver diagram.

QIDS: Key information into GENERAL > Title, Standard, Background and Rationale.

Step 2
Form teams:
i) Project sponsor
ii) Project team

Project Sponsors

- **High level person/s** - who do not work directly on the project, but can oversee and provide support and guidance.
- Report project progress to project sponsors on a regular basis (eg every 2 months).

Project Team

- **Gather people with the right expertise:**
  - ✓ People from all **areas of the process** under review.
  - ✓ Ensure it's an **interdisciplinary** team.
  - ✓ Include a **consumer** (or interview consumers).
  - ✓ Include a **quality advisor**.
  - ✓ Appoint a **team leader**.

Task

Document the names/positions of:

i) the people you will have as your project sponsor/s

ii) project team members

These can go in the bottom left corner of your driver diagram.

QIDS: Key information into GENERAL > Team Members.

Step 3
Develop an aim statement

Example

By June 20XX, Ward 6 South will reduce patient fall incidents by 50%.

Remember:

An aim statement should **NOT** include a 'solution'.

When the team has agreement about the process that needs improving, develop an aim statement.

To help shape your aim statement, discuss:

- What are we trying to accomplish?
- What would success look like?
- How will we measure success?

An aim statement needs to follow the SMART criteria and:

- Specific - clearly state **what** you are trying to accomplish.
- Measurable - focus on a **measurable outcome**.
- Achievable - make sure it '**can and should be done**'.
- Result Oriented - set an aspirational, ambitious **stretch goal**.
- Time Scheduled - include a **completion date**

Check that your aim statement specifies a:

- Time frame: By June 30 2022.
- Measurable stretch goal: 100% of patients will…
- Criteria: Will be screened for…
- Scope: The target population - hospital X or ward Y.

Task

Document your SMART Aim statement.

This can go on the left side of your driver diagram.

QIDS: Key information into GENERAL > Project Aim / Goal, Key words.

Step 4
Perform a literature review

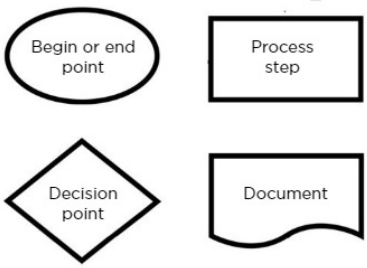
A literature search is essential to help you:
- identify best practices for the problem under review
- prevent reinventing the wheel
- gather potential change ideas and ideas for measures.

What key words will you search on?
- Time efficiency - 1 or 2 team members perform this task.

Task
- What key words will you search on in your literature review?
- How will your literature review be conducted and by whom?
- What resources are available to you that may help your team complete a thorough review?

QIDS: Upload information into TEAM DOCUMENTS

Step 5.1
Flowchart the current process



Remember:
Flowchart the current process - DO NOT chart what you think 'should' happen. You can do that later in the project when you have finally fully implemented change.

A flowchart (also called a process map) is a diagram showing each step and decision in a process. When a team charts a patient journey through the process under review it allows for a common understanding of the steps and decisions made by staff and consumers. A flowchart can also identify gaps, variations, unreliability, bottlenecks, opportunities for improvement as well as highlight the complexity of healthcare systems and processes.

Task
On a new piece of butcher's paper, draw a flowchart of the CURRENT process.
- Chart the process from start to finish.
- Include every step and every decision point. Remember to use the appropriate symbols.
- At each step, ask 'Does this usually happen?'

QIDS: Draw a flowchart - select OTHER DIAGRAMS > New Diagram.

Step 5.2
Collect baseline and diagnostic data

Baseline and diagnostic data: A flowchart can also highlight areas where baseline or historic data may need to be collected to demonstrate:
a) current reliability of particular steps in the process
b) diagnostic data to confirm where, when, why, who, what and how the problem occurs.

Quality tools such as **run charts, pareto charts and histograms** can be used to plot the baseline and diagnostic data. See the chart section later in this document.

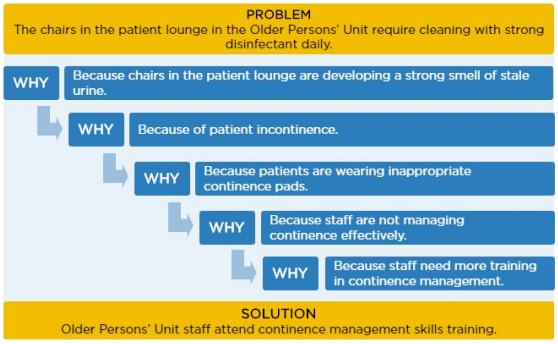
Task
- Review your flowchart, focussing on the process points.
- For each process point, determine the baseline data you would like to collect to gain a better understanding of the process and its current reliability.
- Use the 5Ws and 1H to assist.

Note:
You may find you want to change your Aim Statement / problem to work on after you have completed your flow chart and collected some baseline/diagnostic data as you may discover that the problem may not exist or be as serious as you initially thought.

Step 6.1
Brainstorm the problem causes using *sticky notes*

Brainstorming in silence with *sticky notes* is an effective way of quickly generating ideas from all team members.
- Have the flowchart and any baseline/diagnostic data and literature available for the team to refer to.
- Use one sticky note per idea and as many sticky notes as needed.
- Themes to help brainstorming further: Are any of the causes of the problem to do with: Education, communication, environment, people/staff, materials, equipment/machines, measures, policies, documentation, supplies etc?
- Remind the team to focus on the causes of the problem, not the solution.
- Be specific and use complete sentences rather than words. Eg 'Education not available to patients' rather than 'Education'.

Step 6.2
Brainstorm using the Five Whys



Once you have identified some of the causes of your problem, use the **Five Whys** technique to find the root cause:

1. State the problem.
2. Ask 'WHY' does it exist?
3. Document the answer and again ask 'WHY' does it exist?
4. Repeat until you reach the 'root cause'.

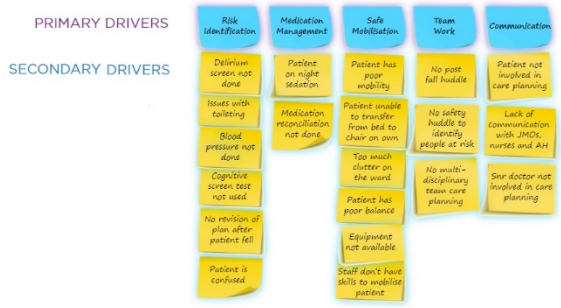
Tips for using the Five Whys:

- When attempting to solve a problem, a common error is to stop too soon when looking for the cause. Be sure to continue asking why until the 'root cause' is identified.
- It is easy to take the first or second simple answer, blinded by the symptoms, or settle for the first 'apparent' cause. Keep in mind that the first cause offered is almost never the real 'root cause'.
- It's important to find the real cause or causes of a problem, not just symptoms. When the root cause is discovered you can take effective action to remove the cause and prevent the problem occurring.

Task

- As a team, brainstorm the causes of the problem using sticky notes. Don't forget to focus on the 'causes' not 'solutions'. Stick the notes on a flat surface.
- Use the Five Whys to identify the root cause of the problem or problems?

Step 7.1
Create an affinity diagram



To create an **affinity diagram** the team needs to **sort the sticky notes into categories**.

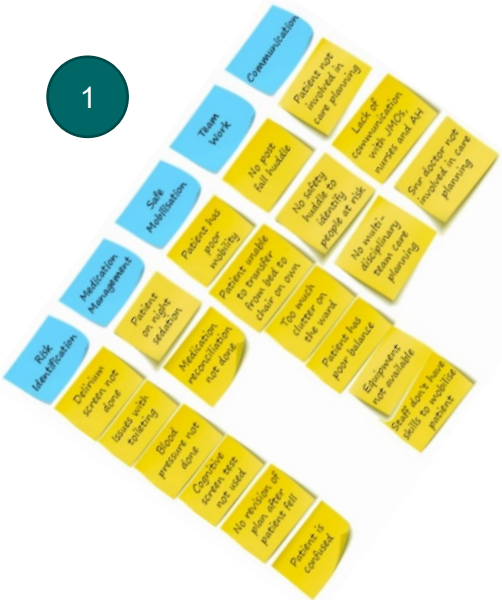
1. Read all the sticky notes and sort them into logical categories (themes/groups). You will generally have between two and eight categories.
2. Re-read all the sticky notes and remove any absolute double-ups and collapse similar ideas together. Make sure team members agree on the double-ups before removing.
3. Assign category headings.

The **category headings** become **primary drivers**.
The **sticky notes** under each heading are your **secondary drivers**.

Task

- Read the sticky notes and sort them into logical categories. Remember to remove double-ups and collapse similar ideas.
- Assign a category heading to each group.

Step 7.2
Spin the affinity diagram to create a driver diagram



Turn your affinity diagram into a driver diagram:

1. Spin the affinity diagram 90 degrees.
2. Re-sort the sticky notes to the correct orientation. The PRIMARY DRIVERS are in column 1 and the SECONDARY DRIVERS are in column 2.
3. To the left of the sticky notes, add the problem, the aim, and team details including project sponsors and team members.
4. Working from left to right, draw relationship arrows:
   - from secondary drivers to relevant primary driver(s)
   - from primary drivers to the aim statement.

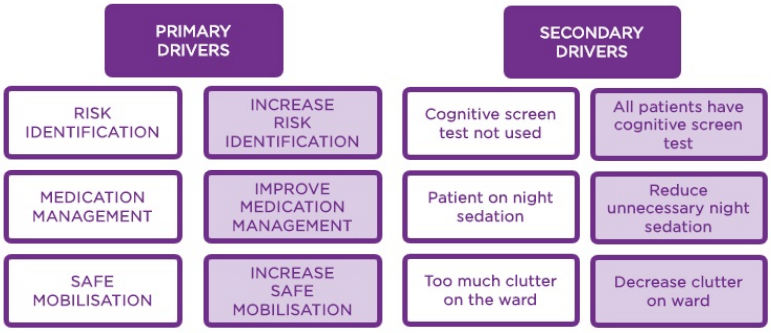
Task

- Spin the affinity diagram to create a driver diagram following the steps above.

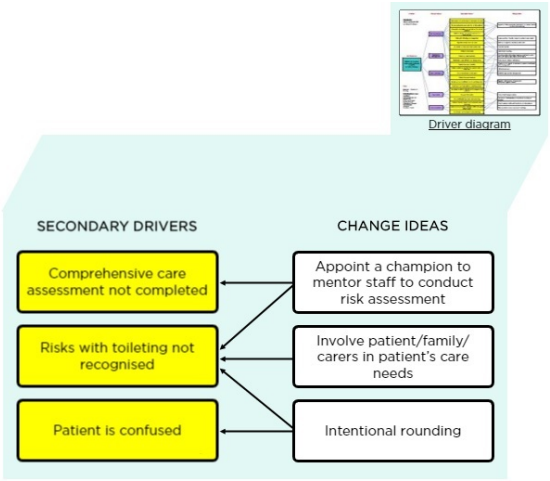
QIDS: Key information into DRIVER DAIGRAM

Step 8 (OPTIONAL)
Re-word each primary and secondary driver

A formal driver diagram has primary and secondary drivers reflecting the action that needs to be taken to affect the aim statement. To achieve this, drivers can be re-worded using words such as improve, increase, decrease, commence and cease.



Step 9
Brainstorm change ideas



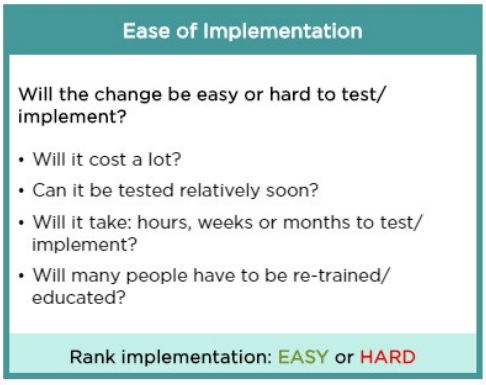
For each secondary driver, the team brainstorms, or researches from literature, specific change ideas (interventions to test via PDSA) to address the driver.

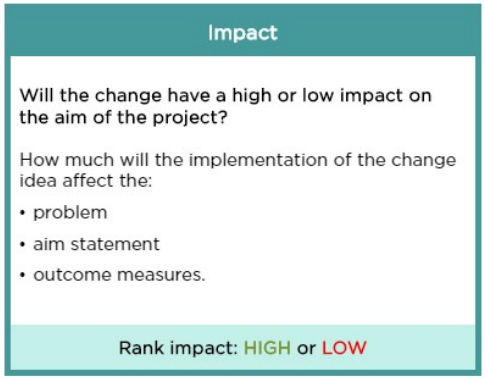
- For each change idea decide exactly:
  - **What** is going to be trialled?
  - **How** it is going to be trialled?
- The ideas are documented on the driver diagram, in a new column, to the right of the secondary drivers.
- Relationship arrows connect the change ideas to the relevant secondary driver. Some change ideas will address more than one driver.

Task

- For each secondary driver on the driver diagram, brainstorm, or research from literature, specific change ideas to address the driver.
- Add a new column, to the right of the secondary drivers titled 'Change Ideas'.
- Add the change ideas in the new column drawing relationship arrows from each change idea to the relevant secondary driver(s).

Step 10
Assess priority of change ideas





After brainstorming, you have many change ideas (possible solutions). The next step is to decide which ideas should be tested via the PDSA cycle as a priority. **Assess each change idea** to determine ease of testing/implementation and impact:

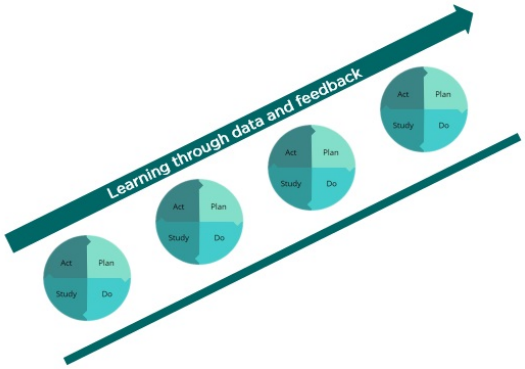
- **Ease of implementation** - will it be **EASY** or **HARD** to implement?
  - Will it cost a lot?
  - Can it be tested relatively soon?
  - Will it take: hours, weeks or months to test/implement?
  - Will many people have to be re-trained/educated?
- **Impact on the aim** - will it have **HIGH** or **LOW** impact on the **Aim Statement**?
  - How much will the change idea **effect** the problem, aim statement and outcome measures?

Note: Just because a change idea may be considered **hard** to implement does not mean it should be a low priority PDSA. Some of the **hard** interventions maybe the most important ones to test.

Task

- Add a new column PDSA PRIORITY to the right of the change ideas on your driver diagram.
- For each change idea, ask:
  - Will the impact on the project aim be HIGH or LOW?
  - Will the ease of implementation or testing be EASY or HARD?
- Record the impact and ease of implementation on the driver diagram.
- Prioritise which change ideas to test via the PDSA cycle, listing the top five.

Step 11
Test change ideas via PDSA cycles



Conduct small tests of change using the PDSA concept on relevant (high priority) change ideas. Start on a very small scale, for example one patient or one staff member then progress to 3 patients, 5 patients etc. **Implementation** of the new process cannot occur until the new process is **highly reliable**.

Four stages of a PDSA:

1. Plan **your change:**
   - **What** you are going to change?
   - **What** do you **predict** will happen?
   - **Who** is going to do it?
   - **When** and **where** will it be done?
   - **Data**: How will you **measure it?**
2. **Carry out the plan** and observe, measure and record the data.
3. **Study the data** and anecdotes and summarise what was learned.
4. **Act on the data:** What changes will you make in the next PDSA cycle?

Task

Plan change idea tests including:

1. Change idea being tested:
2. Cycle/test number:
3. Objective of the test:
4. What is being tested?
5. Prediction of the test (what is predicted to happen when the test is carried out?)
6. Who will be involved in the test, including who will coordinate it:
7. Where will the test be performed?
8. When will the test be performed?
9. Tasks to be completed before the test can commence.
10. Measures/data (How will you know if the test is a success? How will you measure it? What data, feedback will be collected)?

QIDS: Key information into PDSA CYCLES

Step 12
Devise measures

Examples:

Outcome measure:
Number of patient falls per month.
How much: Reduce by 50%.
By when: 12 months.

Process measure:
% of patients who have an assessment on admission.
How much: 100%
By when: 5 months.

Balancing measure:
Staff satisfaction levels.

In order to measure the overall progress of your quality improvement project the following major types of measures need to be considered:

- Outcome measures - have a direct impact on the aim.
  How much and by when?
- Process measures - have an indirect impact on the aim.
  How much and by when?
- Balancing measures – 'knock on' or 'side effects' - factors to watch out for that may be impacting your project or being impacted by your project.

Also consider **diagnostic measures** that assist you to diagnose the causes of/reasons for the problem. These can be graphed in a pareto chart or histogram.

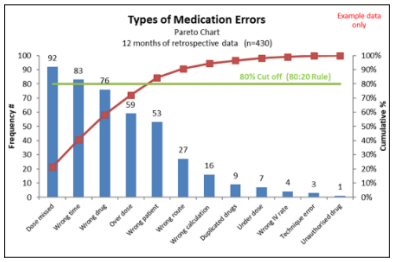
Task

Devise some outcome and process measures for the project and think about whether there are any balancing measures to consider:

- Review your aim statement and devise one or more outcome measures for your improvement project.
- Devise process measures for the change ideas being tested via PDSA cycles.
- Consider any knock-on or side effects of your project and if necessary, devise balancing measures to measure the impact of these.
- Add the measures to your driver diagram.

QIDS: Key information into MEASURES.

Step 13
Collect data and measure impact



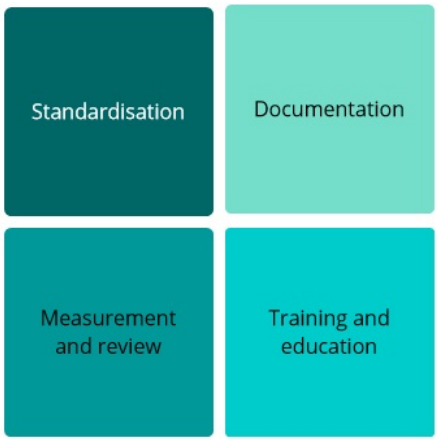
Do you already have some data or do you need to collect it?
How, who, when and where will you collect your data?
Will you use quantitative or qualitative data?

Consider the tools you will use to collect and plot data and help you better understand the process ie:

- Tally sheets - to collect data.
- Run charts or statistical process control charts.
- Pareto charts (for diagnostic stage).
- Histograms (for diagnostic stage).
- Scatter plots (for diagnostic stage).

QIDS: Key information into CHARTS.

Step 14
Sustain the gains and spread the Improvement



Sustain the gains:
Do you have a plan to ensure the improvement is not lost? Do you have a plan to continue with measurement?

Scale up:
Have you tested the new process during the evening and night shift?

Active spread:
- Do you have a plan to roll out your project in other areas?

Passive spread:
- ACI Innovation Exchange http://www.aci.health.nsw.gov.au/ie
- Quality awards
- Present at conference
- Poster
- Journal article

Complete the British NHS Sustainability Survey and score your project? The closer the score to 100, the better chance of successful sustainability.

Review the IHI *Seven Spreadly Sins* to ensure you have the correct approach via http://www.ihi.org/resources/Pages/Tools/IHISevenSpreadlySins.aspx

References:
1) NSW Health GEM Workstar – CPI module.
2) www.ihi.org
3) The Improvement Guide (2nd Edition) by G. Langley, R. Moen, K. Nolan, T. Nolan, C. Norman & L. Provost

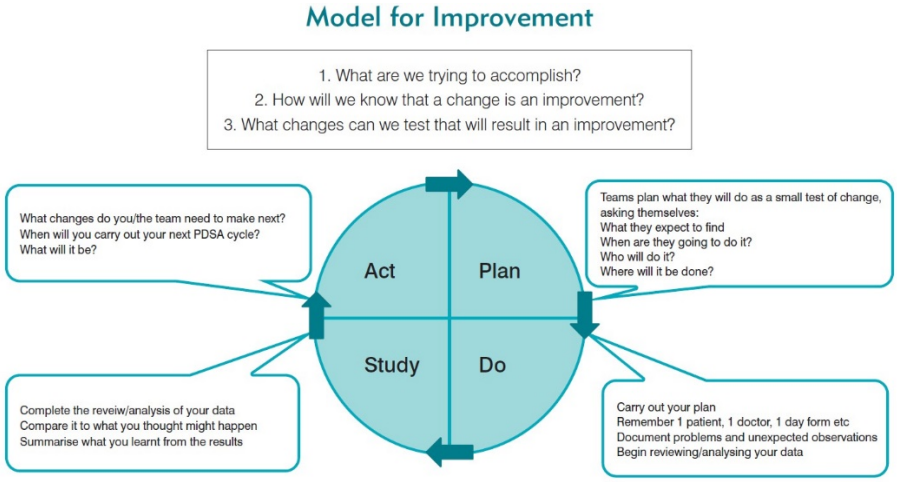
The Model for Improvement and PDSAs

Numerous improvement methodologies are used nationally and internationally, to improve processes of care or patient outcomes. Improvement Science is a commonly used methodology to address identified problems in the clinical area. It involves identifying, defining and diagnosing a problem, before developing change ideas and implementing interventions that may address the identified issues. Change ideas are then tested using small-cycle testing called "Plan, Do, Study, Act" (PDSA) cycles. (1) (2)

It is important to measure the impact of changes in order to verify that your interventions have made a difference. PDSA cycles were originally known as the Shewhart cycle, "Plan, Do, Check, Act", and based on manufacturing models. They were later modified by Edwards Deming to PDSA cycles. (3)

There are three main concepts to consider when undertaking improvement. This is demonstrated well with the Model for Improvement below. (1) (2) This model was developed by Associates for Process Improvement and is used by the Institute for Healthcare Improvement (IHI) as their framework to guide improvement work. (4)

Figure 1: Model for Improvement and PDSA (image adapted) (also see CEC Clinician's Guide to Quality & Safety chapter 5)

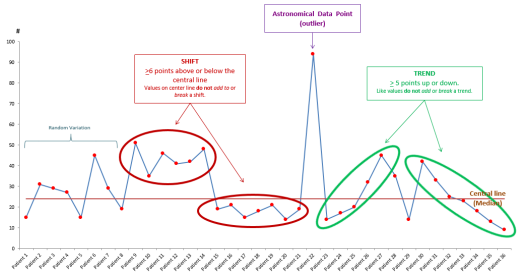


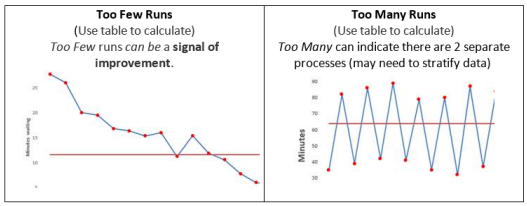
Video
Consider watching these short videos from the IHI:
1. **Model for Improvement Part 1** - 3 minute video http://www.ihi.org/education/IHIOpenSchool/resources/Pages/AudioandVideo/Whiteboard3.aspx
2. **Model for Improvement Part 2** - 3 minute video http://www.ihi.org/education/IHIOpenSchool/resources/Pages/AudioandVideo/Whiteboard4.aspx
3. **PDSA Part 1** - 4 minute video http://www.ihi.org/education/IHIOpenSchool/resources/Pages/AudioandVideo/Whiteboard5.aspx
4. **PDSA Part 2** - 4 minute video http://www.ihi.org/education/IHIOpenSchool/resources/Pages/AudioandVideo/Whiteboard6.aspx

References
- Nolan T, Resar R, Haraden C, Griffi n FA. Improving the Reliability of Health Care. IHI Innovation Series white paper. 2004; Boston: Institute for Healthcare Improvement. Available from: http://www.ihi.org/resources/pages/ihiwhitepapers/improvingthereliabilityofhealthcare.aspx
- Langley GJ, Moen RD, Nolan KM, Nolan TW, Norman CL, Provost LP. The Improvement Guide: A Practical Approach to Enhancing Organizational Performance 2009.
- Moen RD, Norman CL. Circling Back: Clearing up myths about the Deming cycle and seeing how it keeps evolving. Quality Progress. American Society for Quality, November, 2010 Available from: http://www.apiweb.org/circling-back.pdf
- How to Improve [internet]. Cambridge MA: Institute for Healthcare Improvement; 2016. Available from: http://www.ihi.org/resources/Pages/HowtoImprove/default.aspx
- CEC Clinician's Guide to Quality & Safety chapter 5.

Charts to consider for outcome, process, balancing and diagnostic measures
Reference: The Health Care Data Guide - Learning from Data for Improvement by Lloyd Provost & Sandra Murray

Run Chart





A **Run Chart** shows the manner in which measurement (data points) vary over time or between observations. An annotated run chart includes explanations of the shifts or trends in the data points and where change ideas have been tested via PDSA cycles. A Run Chart works best if there are **10** or more data points. There are **Run chart rules** which help you interpret the data:

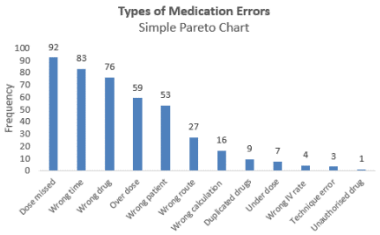
1. Trend: ≥5 data pts up or down. Like values **do not** *add* or *break* a trend.
2. Shift: ≥6 data points above or below the center line. Values on center line **do not** *add to* or *break* a shift.
3. Too many or too few runs: Use table to calculate (see next page). Too few runs can be a signal of improvement. Too many (saw tooth) can indicate there are 2 separate process (may need to stratify data or use 2 separate run charts).
4. Astronomical data point: outlier.

A run chart is an effective tool to graph outcome, process and balancing measures.

See the CEC Website for more information about **Run Charts**, Run Chart Rules and an Excel template for you to download and start plotting your data: https://www.cec.health.nsw.gov.au/Quality-Improvement-Academy/quality-improvement-tools/run-charts

QIDS: Key data into CHARTS then select Run Chart.`

Pareto Chart

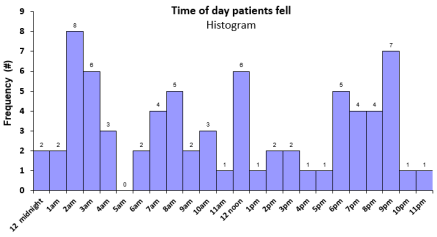


A **Pareto Chart** is a very powerful tool for showing the relative importance of problems. It's a bar chart in descending order. Information can be collected initially in the form of a **Tally Sheet** via an audit and the data displayed in a Pareto Chart. A more complex **Pareto chart** with a cumulative and 80% line can also be used. A Pareto Chart is an effective tool to assist you in **diagnosing the causes of your problem**. It also works best if there are at least **30** observations.

See the CEC Website for more information about **Pareto charts** and an Excel template for you to download and start plotting your data. Pareto chart: https://www.cec.health.nsw.gov.au/Quality-Improvement-Academy/quality-improvement-tools/pareto-charts

QIDS: Key data into CHARTS then select Pareto Chart.

Histogram



A **Histogram** is a bar graph of the frequency distribution of measurements. The information can be collected in the form of a **Tally sheet** initially and then displayed in the form of a Histogram that will effectively highlight the interval that is most frequently occurring. A Histogram works best if there are at least **30** observations. It is an effective tool to assist you in **diagnosing your problem.**

See the CEC Website for more information about **Histograms** and an Excel template for you to download and start plotting your data. Histogram:

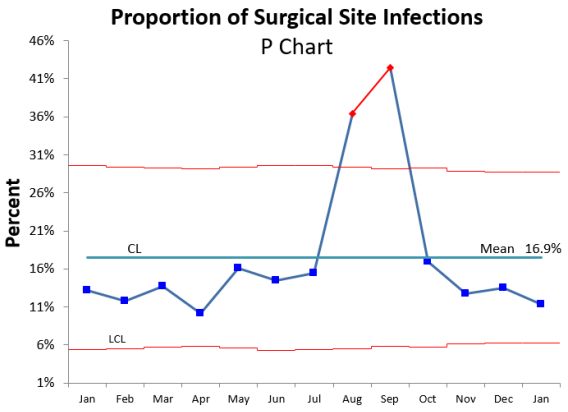
https://www.cec.health.nsw.gov.au/Quality-Improvement-Academy/quality-improvement-tools/histogram

QIDS: Key data into CHARTS then select Histogram.

Monthly Webinar

Dates of monthly webinars to explain run charts, pareto charts and histograms can be found on the calendar on the CEC Website.

Control Chart



APPLIED MEASUREMENT A **Control Chart**, also known as a Shewhart Control Chart or Statistical Process Control Chart (SPCC) is a chart used to determine if a process is in a state of statistical control or how much variation exists in the data / process. Like a Run chart, the Control Chart is a graph of data over time. It uses a center line (mean) and control limits (sigma limits) to determine if the data is displaying *common* or *special* cause. The sigma limits are used to determine the Upper Control Limit (UCL) and Lower Control Limit (LCL) and are usually set at 3 sigma limits above/below the mean (similar to 3 Standard Deviations). A Control Chart works best if there are at least **12** data points (20 data points for I Charts and Xbar&S Chart)). **Control Chart Rules** help you interpret the data:

1. Trend (≥6 consecutive data points all going up or down). Like values **do not** *add* or *break* a trend.
2. Shift (≥8 consecutive data points above or below the center line). Values on center line **do not** *add to* or *break* a shift.
3. Two out of 3 consecutive data points near (outer one-third) of control limit.
4. A single point outside the control limits.
5. Fifteen (15) consecutive data points close to the center line (in inner one-third of chart).

There are specific Control Charts for different types of data / situations:

- **Attribute (discrete) data** (non-conformities or defects): C Chart (# of incidents), U Chart (rate per 1000…), P Chart (%), T Chart (time between rare incidents) and a G Chart (number of events between rare incidents). These charts need at least 12 data points.
- **Continuous data** (measures): I Chart (AKA X Chart) & X Bar & S Chart used to graph data such as time (minutes, hours, days, LOS), $, volume or throughput (# surgeries, patients seen in a clinic), height, weight, temperature etc. These charts need at least 20 data points.

Special software is required to easily produce Control Charts ie: Minitab, IHI QI Charts or QI Macros etc.

Advanced Measurement Workshops are held several times a year at the CEC to teach participants how and when to use Controls Charts and how to interpret the data. Dates of workshops be found on the calendar on the CEC Website

QIDS: Key data into CHARTS then select Control Chart.

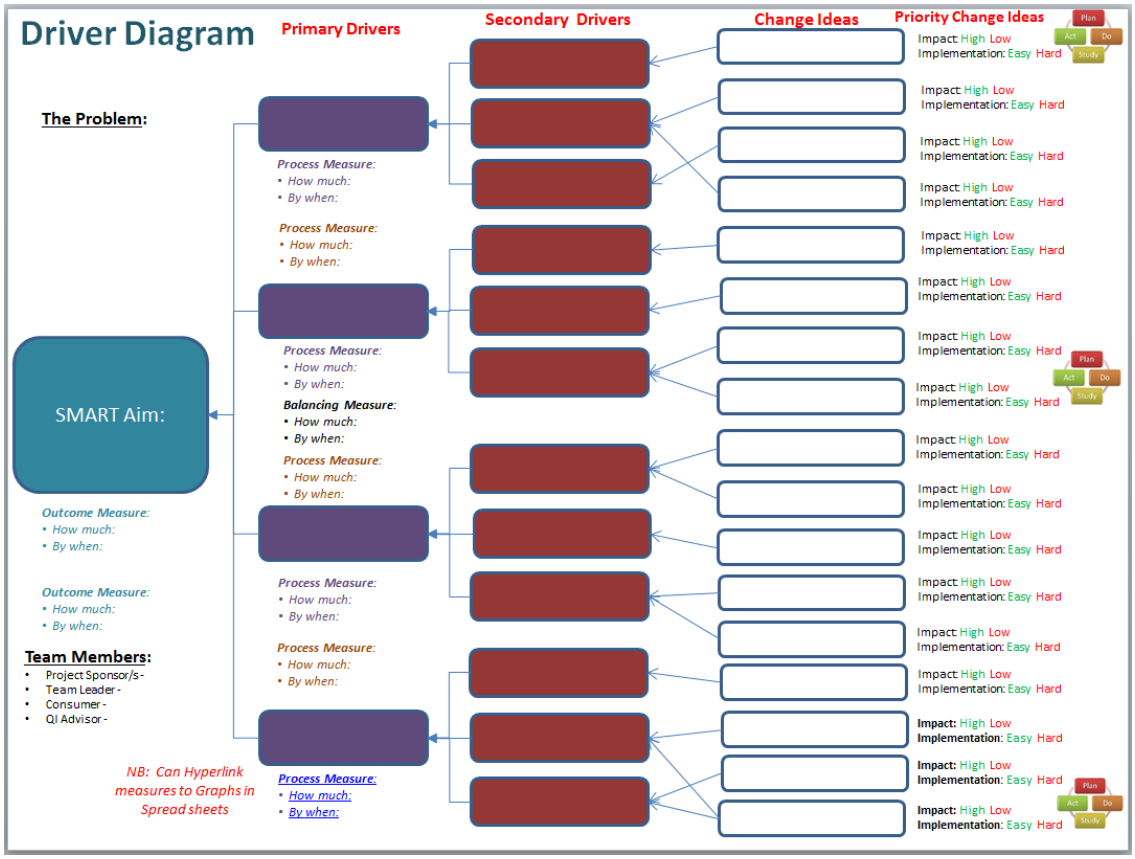
Run Chart Rule: *Too Many* or *Too Few* runs

Table for checking for *Too Many* or *Too Few* runs (*The Health Care Data Guide* by L Provost & S Murray page 80)

TOTAL NUMBER OF DATA POINTS ON CHART (NOT FALLING ON MEDIAN)	LOWER LIMIT FOR NUMBER OF RUNS (FEWER THAN THIS IS *TOO FEW*)	UPPER LIMIT FOR NUMBER OF RUNS (GREATER IS *TOO MANY*)
10	3	9
11	3	10
12	3	11
13	4	11
14	4	12
15	5	12
16	5	13
17	5	13
18	6	14
19	6	15
20	6	16
21	7	16
22	7	17
23	7	17
24	8	18
25	8	18
26	9	19
27	10	19
28	10	20
29	10	20
30	11	21
31	11	22
32	11	23
33	12	23
34	12	24
35	12	24
36	13	25
37	13	25
38	14	26
39	14	26
40	15	27
41	15	27
42	16	28
43	16	28
44	17	29
45	17	30
46	17	31
47	18	31
48	18	32

- **Too few runs** can be a signal of improvement.
- **Too many runs** (saw tooth) can indicate there are two separate process (may need to stratify the data or plot in two separate charts).

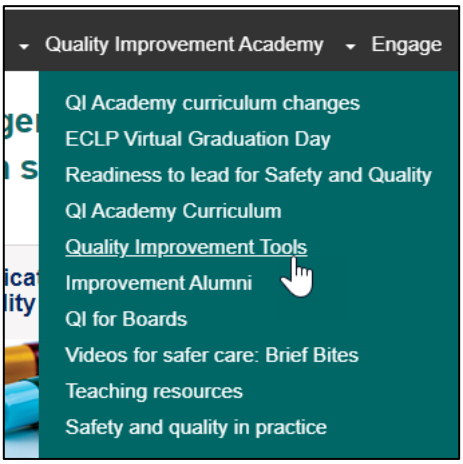
Driver diagram starter kit and template at:
https://www.cec.health.nsw.gov.au/Quality-Improvement-Academy/quality-improvement-tools/driver-diagrams



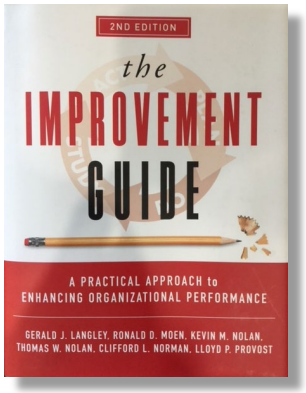
References

- **You Tube videos from NHS Improving Quality:**
  - Driver Diagrams Lesson 1 of 3 - Introduction https://www.youtube.com/watch?v=2mBpJlzzYI8
  - Driver Diagrams Lesson 2 of 3 - Reasons to use driver diagrams https://www.youtube.com/watch?v=xXRym4aFLa4
  - Driver Diagrams Lesson 3 of 3 - How to develop a driver diagram https://www.youtube.com/watch?v=BhY-rw9ejDk
- **Driver Diagram References:**
  - https://webarchive.nationalarchives.gov.uk/20201029185708/https://improvement.nhs.uk/resources/driver-diagrams-tree-diagrams/
  - https://www.weahsn.net/qi-toolkit-driver-diagrams/
- **PDSA References:**
  - http://www.ihi.org/resources/Pages/HowtoImprove/ScienceofImprovementTestingChanges.aspx

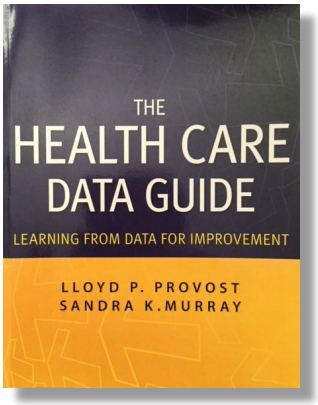
How to find the QI Academy Web pages on the CEC Website www.cec.health.nsw.gov.au



References - Excellent books you may want to consider purchasing if you want to learn more

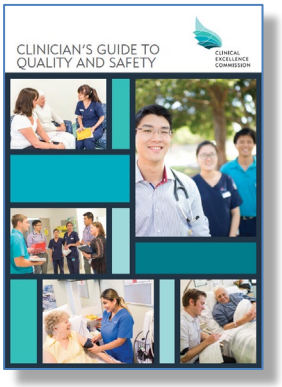


The Improvement Guide (2nd Edition)
by G. Langley, R. Moen, K. Nolan, T. Nolan, C. Norman & L. Provost



The Health Care Data Guide. Learning from Data for Improvement
By Lloyd Provost & Sandra Murray

Other References on the CEC Website



CEC Clinician's Guide to Quality & Safety

CEC Masters Clinician's Guide to Quality & Safety

Major Reference: The Improvement Guide (2nd Edition) by G. Langley, R. Moen, K. Nolan, T. Nolan, C. Norman & L. Provost.
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