Welcome and thank you for joining us. Bienvenue et merci de vous joindre à nous.
Please turn on your computer speakers to hear today’s session.

If you do not hear music, then please confirm your computer speakers are on and check that your volume is unmute.

If you do not have computer speakers, then please dial 1-855-856-8710 to listen in English via teleconference.

Quant aux participants francophones, veuillez composer le numéro 1-866-269-7155 pour vous connecter en français par téléconférence.
CFHI’s Measurement for Quality Improvement
Webinar Series - Session 3

Analyzing Data Over Time for Quality Improvement: A Focus on Control Charts

January 28, 2015
12:00-1:00 (EST)
Welcome and Introductions

Kaye Phillips, Senior Director of Education, Evaluation and Performance Improvement, CFHI

Melanie Rathgeber, CFHI QI & Measurement Faculty and Principal, Merge Consulting

Trevor Strome, CFHI QI & Measurement Coach and Informatics / Process Improvement Lead, Emergency Program, Winnipeg Regional Health Authority and Assistant Professor, Department of Emergency Medicine, University of Manitoba
Welcome to All Participants

Including...

• CFHI’s EXTRA Program for Healthcare Improvement Fellows

• CFHI’s INSPIRED Approaches to COPD Collaborative

• CFHI’s Partnering with Families and Patients for Quality Improvement Collaborative

• CFHI’s Reducing Antipsychotic Medication use in Long Term Care Collaborative

• And everyone else!
Session Objectives
Participants Will Learn:

1. The differences between a run chart and control chart

2. How to create and analyze control charts

3. Linking data from QI activities with organizational performance data
Review of Measurement for QI – 101
A Simple Run Chart

Data displayed in time order

Data is collected and displayed weekly or monthly.

Centre line = median of the data points or = baseline value
Value of Data Regularly Over Time

Pre-post data.

Data displayed in a run chart over time.

change made between week 7 and 8
Analyzing a Run Chart


The rules tell you whether the data points are distributed randomly, or whether there is a specific pattern which indicates something has actually changed. (p<.05).
The Trend Rule

A Trend: Five or More Consecutive Points All Going in the Same Direction
The Shift Rule

A Shift: Six or More Consecutive Points All On One Side of the Median
Feedback

Voting – have you used run charts and analysis.

a. I have used run charts with analysis of shifts, trends, and other rules
b. I have used run charts with visual analysis only
c. I have not regularly used run charts
Feedback Part 2

For those that have used run charts, please use chat function, to let us know your experience in analyzing the charts.

1. What value do they provide?
2. What challenges in analysing run charts have you experienced?
An Introduction to Control Charts:

Number of Care Plans Updated per Month

UCL
LCL

1/1/10 2/1/10 3/1/10 4/1/10 5/1/10 6/1/10 7/1/10 8/1/10 9/1/10 10/1/10 11/1/10 12/1/10 1/1/11 2/1/11 3/1/11 4/1/11 5/1/11 6/1/11 7/1/11 8/1/11 9/1/11 10/1/11 11/1/11 12/1/11 1/1/12 2/1/12 3/1/12 4/1/12 5/1/12 6/1/12 7/1/12 8/1/12 9/1/12 10/1/12 11/1/12 12/1/12 1/1/13 2/1/13 3/1/13

Canadian Foundation for Healthcare Improvement  Fondation canadienne pour l’amélioration des services de santé
Control Limits: use to identify Special Cause Variation

3 lines on a control chart:
- centre line (mean)
- upper control limit (mean + 3 sigma)
- lower control limit (mean – 3 sigma)

Not the same as confidence intervals
Control Limits: use to identify Special Cause Variation

To calculate limits:

- can use SPC software (calculates limits automatically)

- if not using SPC software, the calculations depend on the type of data you are working with. See calculations in the The Health Care Data Guide.

Control Limits: use to identify Special Cause Variation

Statistical properties:

probability of misinterpretation is low (less than 11% overall; less than 5% for some control charts)
Why would you need a control chart?

Variation

- Intended Variation
- Unintended Variation
  - Common Cause Variation
  - Special Cause Variation
    - desirable
    - undesirable
When to use a control chart rather than a run chart.

1. To determine change quickly (improvement will be picked up more quickly than in a run chart)

2. Different samples sizes in each period

3. To see if results are stable and predictable? Should you undertake an improvement project?

4. Predict performance in coming weeks or months.

5. Show reasons for variation
1. Evidence of Special Cause Variation (Improvement)
2. Different Sample Size for Each Time Period

Percent of COPD clients contacted within 2 days of discharge
3. Is system stable and predictable?
If no, remove special causes before trying to improve the whole system.

Number of Patients Who Cancelled Home Care Appointment

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<th>15</th>
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<td>13.2</td>
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</tr>
</tbody>
</table>

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Center
- UCL: 24.1
- LCL: 2.3

Subgroup
- UCL: 24.1
- LCL: 2.3
4. What will result be next month?

![Number of Patient Falls in LTC Facility](image)

<table>
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<th>March</th>
<th>April</th>
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<td>13.0</td>
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</table>

LCL: 2.3
UCL: 24.1
5. What are the sources of variation?

Percent of Patients Who Rated Their Experience with Discharge Planning as Very Good/Excellent

- ICU
- Emerg
- Surg
- Med

Percentages from 0% to 90%
Analyzing a Control Chart

1. Choose type of chart appropriate for the data (e.g. a P chart or a C chart).

2. Create a control chart once you have about 12 data points.

3. Should have approximately 20 data points before establishing control limits and doing analysis.

4. Analyze using tests to detect special cause variation.

5. Revise control limits as required.
Analyzing a Control Chart

1. Choose type of chart appropriate for the data (e.g. a P chart or a C chart). *Will need to give this instruction to the software.*

2. Create a control chart once you have about 12 data points

3. Should have approximately 20 data points before establishing control limits and doing analysis

4. Analyze using tests to detect special cause variation

5. Revise control limits as required
## Commonly Used Control Charts

<table>
<thead>
<tr>
<th>Type of Data</th>
<th>Type of Chart</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent data</td>
<td>P chart</td>
<td>Percent of patients who received the flu shot.</td>
</tr>
<tr>
<td>Count Data (usually counts something we are trying to reduce)</td>
<td>C chart</td>
<td>Number of complaints received</td>
</tr>
<tr>
<td>Count Data as a Rate (usually infections or injuries)</td>
<td>U chart</td>
<td>Infections per patient days</td>
</tr>
<tr>
<td>Averages (with subgroup size &gt;1)</td>
<td>X bar and S</td>
<td>Length of stay</td>
</tr>
<tr>
<td>Individual Data or Data That Comes PreCalculated</td>
<td>I Chart</td>
<td>Length of Stay for Each patient plotted separately</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average length of stay (when average was pre-calculated and you no longer have the individual values for LOS)</td>
</tr>
</tbody>
</table>
Which Chart Should You Use?

Type one or two measures you are currently collecting and want to analyze on a control chart.

Let’s go through a couple of examples.
Analyzing a Control Chart

1. Choose type of chart appropriate for the data (e.g. a P chart or a C chart)

2. Create a control chart once you have about 12 data points

3. Should have approximately 20 data points before establishing control limits and doing analysis

4. Analyze using tests to detect special cause variation

5. Revise control limits as required
API Rules for Detecting Special Cause

A single point outside the control limits

Six consecutive points increasing (trend up) or decreasing (trend down)

Two out of three consecutive points near a control limit (outer one-third)

Eight or more consecutive points above or below the centerline

Fifteen consecutive points close to the centerline (inner one-third)
Case Study #1a

Percent of cases with urinary tract infection
Case Study #1a: Evidence of a Shift

Percent of cases with urinary tract infection

[Graph showing trend of cases with urinary tract infection over time]
Case Study #1b

Percent of cases with urinary tract infection

![Graph showing percent of cases with urinary tract infection from August 2011 to April 2013.](Image)
Case Study #1b: Evidence of a Trend

Percent of cases with urinary tract infection

[Graph showing a trend with data points from August 2011 to April 2013, with fluctuations and a downward trend from mid-2012 to early 2013.]
Case Study #1c

Percent of cases with urinary tract infection
Case Study #1c: Point Outside the Limits

Percent of cases with urinary tract infection

- Yearly data from August 2011 to April 2013.
Case Study #1d: Two out of three consecutive points are in the outer 1/3rd

Percent of cases with urinary tract infection
Analyzing a Control Chart

1. Choose type of chart appropriate for the data (e.g. a P chart or a C chart)

2. Create a control chart once you have about 12 data points

3. Should have approximately 20 data points before establishing initial limits (freeze baseline limits)

4. Analyze using tests to detect special cause variation

5. Revise control limits as required
Revising Limits As Required

Initial Extended Limits Reveal Improvement

Revised Limits After Improvement

Average Days

C L = 88.16
UL = 97.86
LL = 78.47

C L = 62.1
UL = 71.8
LL = 88.2

Health Care Data Guide, p. 124
Is Special Cause Variation Good or Bad?

For improvement work:

1. **Undesirable**: evidence of SCV in our existing system (baseline) means system is not stable. We want to find out what the SCV is and remove this.

2. **Desirable**: if we start off with a stable system, then we introduce improvement, SCV is evidence of improvement. We want to find out what the SCV is and do more of it.
Using Your Data With Healthcare Performance Improvement Initiatives
Improving a System

• Healthcare fits the classic definition of “system”: “a group of interacting, interrelated, or interdependent elements forming a complex whole.” (IDC, 2012)

• Healthcare consists of many types of organizational units
  – major facilities such as hospitals
  – programs and services
  – units and wards
  – physicians’ practices
Measuring Quality in a System

• Consider the many ways in which an HCO needs to measure quality, and how these quality measures are to be used.

• Even top-performing HCOs are very unlikely to achieve high quality in every aspect of their performance.

• The complexity of healthcare demands that a robust approach to measuring and improving quality be applied.
Successful QI Requires Information and Insight

• Analytics distill data into relevant information for a given improvement initiative that usable by QI teams to guide and gauge effectiveness of their efforts.

• Some of the insight available from analytics tools includes:
  – determining if processes are in control or not (from a statistical process control perspective),
  – determining if changes over a period are merely random variation or in fact statistically significant,
  – and predicting what future performance might be.
How Information Guides Quality Improvement

• Many QI initiatives begin with a “good idea” but are never evaluated.

• Avoid the assumption that changes introduced into processes, workflows, and systems actually will have the desired effect.

• Without a robust system in place to evaluate the impact of changes to processes, the true effect of such changes can never be known.
Using QI Methodologies in Healthcare

• An improvement (or management) methodology is important to the success of transformation initiatives
  – Lean
  – Six Sigma
  – Total quality management (TQM),
  – Numerous variants exist (such as Lean Six Sigma).

• Most effective methodologies have roots in other industries and have been adopted by healthcare
  – May have differing their approaches, tools, and techniques
  – All provide a structured approach for improving quality and performance within a complex organization.
Overview of PDSA, Lean, and Six Sigma

- Perhaps the most commonly used QI frameworks in healthcare are PDSA, Lean, and Six Sigma.
- QI methodologies are not mutually exclusive; in fact, it is prudent to adopt an approach based on the problem being addressed.

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Approach to Improvement</th>
<th>Process Overview</th>
</tr>
</thead>
</table>
| **PDSA**    | Conducting experiments and testing improvements iteratively on a local, small-scale basis. | Plan  
Do  
Study  
Act |
| **Lean**    | Eliminating waste, improving flow, maximizing value-added and minimizing non-value-added activities. | Identify value  
Identify value stream  
Flow  
Pull  
Perfection |
| **Six Sigma** | Reducing variation and eliminating deviation in processes. | Define  
Measure  
Analyze  
Improve  
Control |
Linking Data and Analytics with QI Methodologies

1. Define the problem and desired outcomes
   • Try to address both what and why

2. Determine appropriate metrics and indicators
   • Consider past/baseline performance and real-time monitoring
   • What is needed to drive appropriate action?
   • What data is available or needed

3. Build the appropriate analytical tools
   • Reports / dashboards / alerts
   • Consider the best way to visualize the information given project needs and who is using the information (see next two slides)

4. Disseminate to stakeholders
Relationship (Scatter Plot)
Distribution (Box Plot)

Box Plot - Distribution of Daily Average Length of Stay (LOS) Hours

Avg LOS (Hrs)

Site

COH
OGH
HSC
SGH
SDH
VGH

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Recap: Why Is Measurement Important?

- Many HCOs are well-meaning when initiating Quality Improvement (QI) activities but falter because quality is defined in too broad or general terms loaded with good sentiment but little substance.

- Improvement must be defined in terms that are quantifiable—meaning they can be measured, monitored, analyzed, and acted on.

- Don’t make measurement an after-thought!

- Future presentations in 2015 will provide more detail on how to link analytics and QI methodologies for achieving maximum improvement.
General Questions?

Chat Question:
What do you want future measurement webinars to focus on?
Available Resources for Everyone:

- Understanding Variation to Guide Next Steps in Improvement
- Control Chart Selection Guide

CFHI Collaboratives & EXTRA Fellows: Access to coaching

Instructions on how collaborative team members can access coaching with Melanie and Trevor will be made available through your respective Online Learning Platforms.
Understanding Variation to Guide Next Steps in Improvement

Analyze a Control Chart (apply rules to look for evidence of Special Cause Variation)

- Yes, there is only common cause variation. The system is stable.
- No, the system is not stable. There is evidence of special cause variation.

Is the system stable BEFORE improvement work?

- Is performance acceptable?
- Monitor Performance
- Redesign the system/process to improve performance.
- Learn from and Act on Special Cause(s) investigate the underlying cause of the special cause variation. Remove it.

Control Chart Selection Guide

Type of Data

Count or Classification (Attribute Data)
- Count (nonconformities)
  - Equal area of opportunity
  - Unequal area of opportunity
- Classification (nonconforming)
  - Unequal or equal subgroup size
- C Chart
- U Chart
- P Chart

Continuous (Variable Data)
- Each subgroup has more than one data value
  - Unequal or equal subgroup size (n>1)
  - X Bar and S
- Each subgroup is composed of a single data value
  - Subgroup size of 1 (n=1)
  - I Chart (also knows as X Chart)
  - Individual measurement

Count (nonconformities)
- 1, 2, 3, 4, etc.

Classification (nonconforming)
- either/or, pass/fail, yes/no

Equal area of opportunity
Unequal area of opportunity

Nonconformities per unit
Percent nonconforming

CFHI: Improvement OnCall
Upcoming Sessions....

February 2, 2015: Understanding, Measuring and Improving Patient Experience (part 2)

February 9, 2015: Experience-Based Design: Accelerating Improvement and Adding Value

February 25, 2015: Understanding the ‘Lay of the Land’: Assessing Organizational Improvement Capability
Thank You!

Please complete a short survey available here....