Milestones in the Quality Measurement Journey

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Day 2
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Objectives

At the end of this session, participants will be able to:

- Develop useful operational definitions for your measures
- Develop data collection strategies for your improvement project
- Explain variables and attributes data
- Create and interpret run charts in order to use data to guide improvement
- Identify the differences between run and control charts
- Understand variation conceptually and statistically
- Identify 5 rules for detecting special cause
- Create graphs with substance and integrity
Morning Reflection

Reflection Questions

**Question 1:** What is one thing you learned about the Science of Improvement that you did not know?

**Question 2:** What is one thing about the Science of Improvement that you need to study further?
Today’s Topics

- Assessing your Measurement Skills & Knowledge
- Why are you measuring?
- Milestones in the Quality Measurement Journey
  - Selecting measures
  - Building Operational Definitions
  - Data collection strategies and methods
- Understanding Variation (conceptually and statistically)
- Run Chart construction and interpretation
- Linking measurement to improvement strategies

Exercise
Measurement Self-Assessment

This self-assessment is designed to help quality facilitators and improvement team members gain a better understanding of where they personally stand with respect to the milestones in the Quality Measurement Journey (QMJ). What would your reaction be if you had to explain why it is preferable to plot data over time rather than using aggregated statistics and tests of significance? Can you construct a run chart or help a team decide which measure is more appropriate for their project?

You may not be asked to do all of the things listed below today or even next week. But, if you are facilitating a QI team or expect to be able to demonstrate improvement, sooner or later these questions will be posed. How will you deal with them?

The place to start is to be honest with yourself and see how much you know about concepts and methods related to the QMJ. Once you have had this period of self-reflection, you will be ready to develop a learning plan for yourself and those on your improvement team.

**Exercise**

**Measurement Self-Assessment**

Use the following Response Scale. Select the one response which best captures your opinion.

1. I'd definitely have to call in an outside expert to explain and apply this topic/method.
2. I'm not sure I could apply this appropriately to a project.
3. I am familiar with this topic but would have to study it further before applying it to a project.
4. I have knowledge about this topic, could apply it to a project but would not want to be asked to teach it to others.
5. I consider myself an expert in this area, could apply it easily to a project and could teach this topic/method to others.


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**Worksheet #1: Measurement Self-Assessment**


<table>
<thead>
<tr>
<th>Measurement Topic or Skill</th>
<th>Response Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Help people in my organization understand where and how measurement fits into our quality journey</td>
<td></td>
</tr>
<tr>
<td>2. Facilitate the development of clear Aim Statements</td>
<td></td>
</tr>
<tr>
<td>3. Move teams from concepts to specific quantifiable measures</td>
<td></td>
</tr>
<tr>
<td>4. Building clear and unambiguous operational definitions for our measures</td>
<td></td>
</tr>
<tr>
<td>5. Develop data collection plans (including stratification and sampling strategies)</td>
<td></td>
</tr>
<tr>
<td>6. Explain why plotting data over time (dynamic display) is preferable to using aggregated data and summary statistics (static display)</td>
<td></td>
</tr>
<tr>
<td>7. Explain the differences between random and non-random variation</td>
<td></td>
</tr>
<tr>
<td>8. Construct run charts (including locating the median)</td>
<td></td>
</tr>
<tr>
<td>9. Explain the reasoning behind the run chart rules</td>
<td></td>
</tr>
<tr>
<td>10. Interpret run charts by applying the run chart rules</td>
<td></td>
</tr>
<tr>
<td>11. Explain the various types of control charts and how they differ from run charts</td>
<td></td>
</tr>
<tr>
<td>12. Construct the various types of control charts</td>
<td></td>
</tr>
<tr>
<td>13. Explain the control chart rules for special causes and interpret control charts</td>
<td></td>
</tr>
<tr>
<td>14. Help teams link measurement to their improvement efforts</td>
<td></td>
</tr>
</tbody>
</table>
How will we know that a change is an improvement?

1. By understanding the variation that lives within your data

2. By making good management decisions on this variation (i.e., don’t overreact to a special cause and don’t think that random movement of your data up and down is a signal of improvement).
Remember the Old Way, New Way?

Old Way (Quality Assurance)
- Better Quality
- No action taken here
- Requirement, Specification or Threshold
- Reject defectives

New Way (Quality Improvement)
- Better Quality
- Action taken on all occurrences

Why are you measuring?

Research? Judgment? Improvement?

The answer to this question will guide your entire quality measurement journey!

Source: Robert Lloyd, Ph.D.
Three approaches to research:

1. Research for Efficacy
   (experimental and quasi-experimental designs/clinical trials, p-values)

2. Research for Efficiency

3. Research for Effectiveness

"We are increasingly realizing not only how critical measurement is to the quality improvement we seek but also how counterproductive it can be to mix measurement for accountability or research with measurement for improvement."
The Three Faces of Performance Measurement

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Improvement</th>
<th>Accountability (Judgment)</th>
<th>Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aim</td>
<td>Improvement of care (efficiency &amp; effectiveness)</td>
<td>Comparison, choice, reassurance, motivation for change</td>
<td>New knowledge (efficacy)</td>
</tr>
<tr>
<td>Methods:</td>
<td>Test observable</td>
<td>No test, evaluate current performance</td>
<td>Test blinded or controlled</td>
</tr>
<tr>
<td>• Test Observability</td>
<td>Accept consistent bias</td>
<td>Measure and adjust to reduce bias</td>
<td>Design to eliminate bias</td>
</tr>
<tr>
<td>• Bias</td>
<td>“Just enough” data, small sequential samples</td>
<td>Obtain 100% of available, relevant data</td>
<td>“Just in case” data</td>
</tr>
<tr>
<td>• Sample Size</td>
<td>Flexible hypotheses, changes as learning takes place</td>
<td>No hypothesis</td>
<td>Fixed hypothesis (null hypothesis)</td>
</tr>
<tr>
<td>• Flexibility of Hypothesis</td>
<td>Run &amp; Control charts</td>
<td>No change focus (maybe compute a percent change or rank order the results)</td>
<td>Enumerative Statistics (t-test, F-test, chi square, p-values)</td>
</tr>
<tr>
<td>• Testing Strategy</td>
<td>Sequential tests</td>
<td>No tests</td>
<td>One large test</td>
</tr>
<tr>
<td>• Determining if a change is an improvement</td>
<td>Analytic Statistics (statistical process control)</td>
<td>No change focus (maybe compute a percent change or rank order the results)</td>
<td>Enumerative Statistics (t-test, F-test, chi square, p-values)</td>
</tr>
<tr>
<td>• Confidentiality of the data</td>
<td>Data used only by those involved with improvement</td>
<td>Data available for public consumption and review</td>
<td>Research subjects’ identities protected</td>
</tr>
</tbody>
</table>

Example of Data for Judgement

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Satisfaction Rating, Percent Who Would Recommend (includes inpatient, outpatient, ED, and Home Health)</td>
<td>60%</td>
<td>85%</td>
<td>37.75%</td>
<td>68.98%</td>
<td>57.15%</td>
<td>56.28%</td>
</tr>
<tr>
<td>Wait for 3rd Next Available Appointment, Percent of Areas with Appointment Available in Less than or Equal to 7 Business Days (n=44)</td>
<td>69%</td>
<td>100%</td>
<td>62.5%</td>
<td>81.21%</td>
<td>54.3%</td>
<td>61.32%</td>
</tr>
<tr>
<td>Patient Safety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Events per 10,000 Adjusted Patient Days</td>
<td>0.24</td>
<td>0.26</td>
<td>0.47</td>
<td>0.21</td>
<td>0.31</td>
<td>0.26</td>
</tr>
<tr>
<td>Percent Mortality</td>
<td>3.50</td>
<td>3.00</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>3.88</td>
</tr>
<tr>
<td>Total Infections per 1000 Patient Days</td>
<td>2.42</td>
<td>2.07</td>
<td>3.07</td>
<td>4.03</td>
<td>4.53</td>
<td>4.68</td>
</tr>
<tr>
<td>Clinical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent Unplanned Readmissions</td>
<td>2.5%</td>
<td>1.6%</td>
<td>6.1%</td>
<td>4.8%</td>
<td>4.0%</td>
<td>4.1%</td>
</tr>
<tr>
<td>Percent of Eligible Patients Receiving Perfect Care: Evidence-Based Care (Inpatient and ED)</td>
<td>98%</td>
<td>100%</td>
<td>46%</td>
<td>74.1%</td>
<td>89.9%</td>
<td>98.7%</td>
</tr>
<tr>
<td>Employee Perspective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent Voluntary Employee Turnover</td>
<td>5.88%</td>
<td>5.00%</td>
<td>5.00%</td>
<td>6.24%</td>
<td>5.13%</td>
<td>5.22%</td>
</tr>
<tr>
<td>Employee Satisfaction: Average Rating Using 1-5 Scale (5 Best Possible)</td>
<td>4.60</td>
<td>4.25</td>
<td>3.90</td>
<td>3.80</td>
<td>3.96</td>
<td>3.95</td>
</tr>
<tr>
<td>Operational Performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent Occupancy</td>
<td>38.8%</td>
<td>90.0%</td>
<td>91.3%</td>
<td>84.6%</td>
<td>87.5%</td>
<td>87.0%</td>
</tr>
<tr>
<td>Average Length of Stay</td>
<td>4.50</td>
<td>3.80</td>
<td>3.90</td>
<td>4.30</td>
<td>4.60</td>
<td>4.67</td>
</tr>
<tr>
<td>Community Perspective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of Budget Allocated to Non-reimbursed Care</td>
<td>7.06%</td>
<td>7.00%</td>
<td>5.91</td>
<td>7.06%</td>
<td>6.93%</td>
<td>6.97%</td>
</tr>
<tr>
<td>Percent of Budget Spent on Community Health Promotion Programs</td>
<td>5.00%</td>
<td>3.00%</td>
<td>0.32%</td>
<td>0.32%</td>
<td>0.28%</td>
<td>0.21%</td>
</tr>
<tr>
<td>Financial Perspective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Margin:Percent</td>
<td>1.2%</td>
<td>1.5%</td>
<td>-0.5%</td>
<td>0.7%</td>
<td>0.9%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Monthly Revenue (Millions)—change to show red—but sp cause good related to occupancy</td>
<td>25.8</td>
<td>20.6</td>
<td>17.4</td>
<td>18.9</td>
<td>17.5</td>
<td>18.3</td>
</tr>
</tbody>
</table>

Source: Provost, Murray & Britto (2010)
How Is Error Rate Doing?

How is Perfect Care Doing?

Source: Provost, Murray & Britto (2010)
20-20 Hindsight

“Managing a process on the basis of monthly (or quarterly) averages is like trying to drive a car by looking in the rear view mirror.”

D. Wheeler
Understanding Variation, 1993.

The way you present data also makes a difference!

Control Chart - p-chart
11552 - Vaginal Birth After Cesarean Section (VBAC) Rate

Data for Improvement

These data points are seen as being “outliers”

Data for Judgment

These data points are all common cause variation
“Dashboard” for Judgement

Displaying Data for Improvement

- Quality “Ticker”
  - Days since last adverse event
  - Updated daily

- Control Charts for active projects

- Quality and Safety News
  - Congratulations
  - Thanks
  - Upcoming initiatives

- Quality data included in monthly provider and weekly nursing email communication.
So, how do you view the Three Faces of Performance Measurement?

As…

As a…

Or,

Relating the Three Faces of Performance Measurement to your work

The three faces of performance measurement should not be seen as mutually exclusive silos. This is not an either/or situation.

All three areas must be understood as a system. Individuals need to build skills in all three areas.

Organizations need translators who and be able to speak the language of each approach.

The problem is that individuals identify with one of the approaches and dismiss the value of the other two.
Here are a few key points to consider…

- Limits to traditional statistical methods are not well known and often minimized.
- Improvement methods are powerful and rigorous, yet frequently misunderstood and under-applied in healthcare settings.
- The purpose, context and questions you are trying to answer should always dictate the measures and methods used.

An interesting perspective…

This book shows, field by field, how “statistical significance,” a technique that dominates many sciences, has been a huge mistake.

The authors find that researchers in a broad spectrum of fields, from agronomy to zoology, employ “testing” that doesn’t test and “estimating” that doesn’t estimate.

This book shows how wide the disaster is and how bad fit is for advancing science. Finally, it traces the problem to its historical, sociological and philosophical roots.
Dialogue:
Why are you measuring?

- How much of your institution’s energy is aimed at improvement, accountability and/or research?
- Does one form of performance measurement dominate your journey?
- Do you think the three approaches can be integrated or are they in fact separate and distinct silos?
- How many “translators” exist within your institution? Are people being developed for this role?

So, the Question of the Day is…

How can we design a set of measures that will guide our improvement work and show meaningful results without wasting everyone’s time?
AIM* (How good? By when?)

Concept
Measure
Operational Definitions
Data Collection Plan
Data Collection
Analysis

**Milestones in the Quality Measurement Journey**

AIM* – reduce patient falls by 37% by the end of the year

Concept – reduce patient falls
Measures – Inpatient falls rate (falls per 1000 patient days)
Operational Definitions - # falls/inpatient days
Data Collection Plan – monthly; no sampling; all IP units
Data Collection – unit submits data to Quality Improvement Dept. for analysis
Analysis – control chart

**The Quality Measurement Journey**

Milestones in the Quality Measurement Journey

- AIM* (How good? By when?)
- Concept
- Measure
- Operational Definitions
- Data Collection Plan
- Data Collection
- Analysis


Moving from a Concept to Measure

“Hmmmm...how do I move from a concept to an actual measure?

Every concept can have MANY measures. Which one is most appropriate?
Every concept can have many measures


<table>
<thead>
<tr>
<th>Concept</th>
<th>Potential Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Health</td>
<td>Weight change during admission</td>
</tr>
<tr>
<td></td>
<td>Body Mass Index</td>
</tr>
<tr>
<td></td>
<td>Q Risk (diabetic &amp; CV risk assessments)</td>
</tr>
<tr>
<td></td>
<td>Smoking status</td>
</tr>
<tr>
<td></td>
<td>Exercise tolerance</td>
</tr>
<tr>
<td>Patient Falls</td>
<td>Percent of patients who fell</td>
</tr>
<tr>
<td></td>
<td>Fall rate per 1000 patient days</td>
</tr>
<tr>
<td></td>
<td>Number of falls</td>
</tr>
<tr>
<td></td>
<td>Days between a fall</td>
</tr>
<tr>
<td>Service User Satisfaction</td>
<td>Satisfaction score during/after contact with service</td>
</tr>
<tr>
<td></td>
<td>Number of complaints/compliments</td>
</tr>
<tr>
<td></td>
<td>Friends and Family Test</td>
</tr>
<tr>
<td></td>
<td>Content of suggestions</td>
</tr>
</tbody>
</table>

A classic approach to developing measures


Dr. Avedis Donabedian
(1919-2000)

Structure + Process = Outcomes
### Three Types of Measures

- **Outcome Measures:** Voice of the service user/staff member/customer. How is the system performing? What is the result?

- **Process Measures:** Voice of the workings of the system. Are the parts or steps in the system performing as planned?

- **Balancing Measures:** Looking at a system from different directions/dimensions. What happened to the system as we improved the outcome and process measures? (e.g. unanticipated consequences, other factors influencing outcome)

### Potential Set of Measures for Improvement in the Accident & Emergency (A&E)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Outcome Measures</th>
<th>Process Measures</th>
<th>Balancing Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve waiting time and service user satisfaction with Mental Health Liaison Team in the local A&amp;E</td>
<td>Total Length of Stay in the A&amp;E Patient Satisfaction Scores</td>
<td>Time to registration Patient / staff comments on flow % patient receiving discharge materials Availability of antibiotics</td>
<td>Volumes % Leaving without being seen Staff satisfaction - A&amp;E psychiatry team - Inpatient unit colleagues - A&amp;E colleagues Cost</td>
</tr>
</tbody>
</table>
Balancing Measures: Looking at the System from Different Dimensions

- Outcome (quality, time)
- Transaction (volume, no. of patients)
- Productivity (cycle time, efficiency, utilisation, flow, capacity, demand)
- Financial (charges, staff hours, materials)
- Appropriateness (validity, usefulness)
- Patient satisfaction (surveys, customer complaints)
- Staff satisfaction

Balancing Measures help you capture Unintended Consequences

Building a Cascading System of Measures

Look at your system of measures as a cascade!
At what level are you measuring?

- **System or Hospital**
  - Macrosystems
  - e.g. division, facility, region

- **Nursing Division**
  - Mesosystems
  - e.g. clinical dept, pathology, IT

- **Frontline Nursing Units**
  - Microsystems
  - e.g. unit, clinic, surgical team

Which way do your measures flow?

The key question, however, is do you fully understand your measurement system and which aspects of the system you want to improve?

If you do start drilling down from the...

- **Macro**
  - **Meso**
  - **Micro levels**...

...then make sure there are ways to elevate local (micro level) measures and the local learning back up to the macro level.
A Cascading Approach to Measurement

- Complication rates
- Percent compliance with "bundles"
- Physical observations bundle
- Cardiac investigations bundle
- Pathology investigations bundle

Percent service users on antipsychotics with baseline investigations

A Cascading Approach to Measurement

- Teacher Retention
- Student achievement
- Teacher Satisfaction
- Hiring
- Onboarding
- Professional Development
- Feedback
Don’t Ignore the Pace of Work & Change

Macro Level (Outcomes)
- SLOWER TO CHANGE

Meso Level (Outcomes and Processes)
- MODERATE CHANGE

Micro Level (Processes)
- FASTER TO CHANGE

The Planning Horizon

Macro Level (Outcomes)
- Qtr – Year – Beyond

Meso Level (Outcomes and Processes)
- Weeks - Months

Micro Level (Processes)
- Minutes to Weeks

Adapted from Cliff Norman, Profound Knowledge Products & API
An Operational Definition...

... is a description, in quantifiable terms, of what to measure and the steps to follow to measure it consistently.

- It gives communicable meaning to a concept
- Is clear and unambiguous
- Specifies measurement methods and equipment
- Identifies criteria

Components of Operational Definition

Developing an operational definition requires agreement on two things:

1. A method of measurement
   - Which device? (clock, wristwatch, stopwatch?)
   - To what degree of precision (nearest hour, 5 minutes, minute, second?)
   - For time based measurements, what are the start and end points

2. A set of criteria for judgment
   - What is “late”, “error”, “a fall”?
   - What counts as an adverse event, like a CLABSI?

Failure to develop a clear Operational Definition often leads to confusion and misunderstanding

How do you define these concepts?

A “fair tax”     A “tax loophole”
A “good vacation” A “great movie”
Rural, Urban or Suburban
The “rich”      The “poor”       The “middle class”
“Jump start” the economy
“Global Warming”
What does it mean to “go wireless”?  

What is a goal?  
The whole ball or half the ball?
World Cup Update!

What is the operational definition of “the end of the match?”

September 23, 1999
An expensive operational definition problem!

NASA lost a $125 million Mars orbiter because one engineering team used metric units (newton-seconds) to guide the spacecraft while the builder (Lockheed Martin) used pounds-second to calibrate the maneuvering operations of the craft.

Information failed to transfer between the Mars Climate Orbiter spacecraft team at Lockheed Martin in Colorado and the mission navigation team in California. The confusion caused the orbiter to encounter Mars on a trajectory that brought it too close to the planet, causing it to pass through the upper atmosphere and disintegrate.
Traditionally we had…

…the 9 planet operational definition of the solar system.

But, in 2006
the 8 planet operational definition emerged!

NOTE: On February 18, 1930 Mr. Clyde Tombaugh of Streator, Illinois discovered the planet Pluto. In 2006 the however, the International Astronomical Union reclassified Pluto as a “dwarf planet.”
The Operational Definition of a Planet includes three criteria:
1. It must orbit the sun,
2. It must be more or less round,
3. It must “clear the neighborhood” around its orbit.

Pluto meets the first two, but falls short of the third, crossing the orbit of Neptune and those of other objects in the Kuiper belt where Pluto is located.

July 14, 2015
New Horizons spacecraft, which has traveled more than 9 years and 3+ billion miles, took this photo of Pluto at the moment of its closest approach at 0749 EDT. It is the most detailed image of Pluto ever sent to Earth.

Percival Lowell and Clyde Tombaugh would be very proud even though the revised operational definition demoted Pluto to a dwarf planet.

How do you define the following healthcare concepts?

- Medication error
- Co-morbid conditions
- Teenage pregnancy
- Cancer waiting times
- Health inequalities
- Asthma admissions
- Childhood obesity
- Patient education
- Health and wellbeing
- Adding life to years and years to life
- Children’s palliative care
- Safe services
- Smoking cessation
- Urgent care
- Complete history & physical
- Delayed discharges
- End of life care
- Falls (with/without injuries)
- Childhood immunizations
- Complete maternity service
- Patient engagement
- Moving services closer to home
- Successful breastfeeding
- Ambulatory care
- Access to health in deprived areas
- Diagnostics in the community
- Productive community services
- Vascular inequalities
- Breakthrough priorities
- Surgery start time
Example Medication Error Operational Definition

**Measure Name:** Percent of medication errors

**Numerator:** Number of outpatient medication orders with one or more errors. *An error is defined as:* wrong med, wrong dose, wrong route or wrong patient.

**Denominator:** Number of outpatient medication orders received by the family practice clinic pharmacy.

**Data Collection:**
- This measure applies to all patients seen at the clinic
- The data will be stratified by type of order (new versus refill) and patient age
- The data will be tracked daily and grouped by week
- The data will be pulled from the pharmacy computer and the CPOE systems
- Initially all medication orders will be reviewed. A stratified proportional random sample will be considered once the variation in the process is fully understood and the volume of orders is analyzed.

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**Exercise: Operational Definitions**


2. Measure your banana using the definition, and write down the result *and keep it secret!*

3. Pass your definition and banana to another table. They will use your definition to measure.

4. Compare results.
Exercise
Building an Operational Definition

• Select **one measure** that you currently track or one that you expect to start tracking in the near future.

• Write a clear operational definition for this measure.

• If you gave the definition of your measure to another person would they know *precisely* what you are attempting to measure?

Are you clear about the measurement steps required to obtain data?

• Use Page 1 of the **Operational Definition Worksheet** to record your responses (next page).

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**Operational Definition Worksheet**

**TOPIC FOR IMPROVEMENT:** ____________________________________________________________

Date: ____________________ Contact person: ___________________________________________

**MEASURE NAME** (The measure name should be something that is quantifiable, e.g., a count, a percent, a rate, a score, an index or composite measure, days between an event or successful cases between a case that does not meet criteria for being successful.)

**OPERATIONAL DEFINITION**

Define the specific components of this measure. Specify the numerator and denominator if it is a percent or a rate. If it is an average, identify the calculation for deriving the average. Include any special equipment needed to capture the data. If it is a score (such as a patient satisfaction score) describe how the score is derived. When a measure reflects concepts such as accuracy, complete, timely, or an error, describe the criteria to be used to determine "accuracy."

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DATA COLLECTION PLAN
Who is responsible for actually collecting the data?
How often will the data be collected? (e.g., hourly, daily, weekly or monthly?)
What are the data sources (be specific)?
What is to be included or excluded (e.g., only inpatients are to be included in this measure or only stat lab requests should be tracked).
How will these data be collected?
Manually ______  From a log ______  From an automated system

BASELINE MEASUREMENT
What is the actual baseline number? ______________________________________________
What time period was used to collect the baseline? ___________________________________

TARGET(S) OR GOAL(S) FOR THIS MEASURE
Do you have target(s) or goal(s) for this measure?
Yes ___  No ___
Specify the External target(s) or Goal(s) (specify the number, rate or volume, etc., as well as the source of the target/goal.)
Specify the Internal target(s) or Goal(s) (specify the number, rate or volume, etc., as well as the source of the target/goal.)

### Dashboard Summary Worksheet

**Name of team:** Ward 20 Medication Reconciliation Team  
**Date:** 1 August 2015

<table>
<thead>
<tr>
<th>Measure Name (Be sure to indicate if it is a count, percent, rate, days between, etc.)</th>
<th>Operational Definition (Define the measure in very specific terms. Provide the numerator and the denominator if a percentage or rate. Be as clear and unambiguous as possible)</th>
<th>Data Collection Plan (How will the data be collected? Who will do it? Frequency? Duration? What is to be excluded?)</th>
</tr>
</thead>
</table>
| Percent of inpatient medication orders with an error | **Numerator:** Number of inpatient medication orders with one or more errors  
**Denominator:** Number of inpatient medication orders received by the pharmacy | • This measure applies to all inpatient units  
• The data will be stratified by shift and by type of order (stat versus routine)  
• The data will be tracked daily and grouped by week  
• The data will be pulled from the pharmacy computer and the CPOE systems  
• Initially all medication orders will be reviewed. A stratified proportional random sample will be considered once the variation in the process is fully understood and the volume of orders is analyzed. |


---

### Milestones in the Quality Measurement Journey

AIM* (How good? By when?)

- Concept
- Measure
- Operational Definitions
- Data Collection Plan
- Data Collection
- Analysis

Now that you have selected and defined your measures, it is time to head out, cast your net and actually gather some data!

Key Data Collection Strategies

**Stratification**

- Separation & classification of data according to predetermined categories
- Designed to discover patterns in the data
- For example, are there differences by shift, time of day, day of week, severity of patients, age, gender or type of procedure?
- Consider stratification **BEFORE** you collect the data
When you can’t gather data on the entire population due to time, logistics or resources, it is time to consider sampling.

The Relationships Between a Sample and the Population

What would a “good” sample look like?

Population

Negative Outcome  Positive Outcome
The Relationships Between a Sample and the Population

Ideally a “good” sample will have the same shape and location as the total population but have fewer observations (curve A).

Sampling Bias

But a sample improperly pulled could result in a positive sampling bias (curve B) or a negative sampling bias (curve C).

How do you draw your samples?
Sampling Methods


**Probability Sampling Methods**
- Simple random sampling
- Stratified random sampling
- Stratified proportional random sampling
- Systematic sampling
- Cluster sampling

**Non-probability Sampling Methods**
- Convenience sampling
- Quota sampling
- Judgment sampling

---

**Sampling Options**

**Simple Random Sampling**

![Simple Random Sampling Diagram]

**Proportional Stratified Random Sampling**

![Proportional Stratified Random Sampling Diagram]

**Judgment Sampling**

![Judgment Sampling Diagram]
Judgment Sampling

Especially useful for PDSA testing. Someone with process knowledge selects items to be sampled.

**Characteristics of a Judgment Sample:**

- Include a wide range of conditions
- Selection criteria may change as understanding increases
- Successive small samples instead of one large sample

Judgment Sampling takes advantage of the knowledge of those who own the process

*We are absolutely crazy around here between 9 and 11 AM!*

*But, things are pretty quiet after 3 PM.*

*What do I know? I usually work afternoon shift and that is a different process altogether!*
How often and for how long do you need to collect data?

**Frequency** – the period of time in which you collect data (i.e., how often will you dip into the process to see the variation that exists?)
- Moment by moment (continuous monitoring)?
- Every hour?
- Every day? Once a week? Once a month?

**Duration** – how long you need to continue collecting data
- Do you collect data on an on-going basis and not end until the measure is always at the specified target or goal?
- Do you conduct periodic audits?
- Do you just collect data at a single point in time to “check the pulse of the process”

Do you need to pull a sample or do you take every occurrence of the data (i.e., collect data for the total population)

The need to know, the criticality of the measures and the amount of data required to make conclusions should drive your decisions about the frequency and duration of data collection and whether or not you need to sample.
Exercise: Data Collection Strategies  
(frequency, duration and sampling)

• This exercise has been designed to test your knowledge of and skill with developing a data collection plan.
• In the table on the next page is a list of eight measures.
• For each measure identify:
  – The frequency and duration of data collection.
  – Whether you would pull a sample or collect all the data on each measure.
  – If you would pull a sample of data, indicate what specific type of sample you would pull.
• Spend a few minutes working on your own then compare your ideas with others at your table.

Exercise: Data Collection Strategies  
(frequency, duration and sampling)

The need to know, the criticality of the measure and the amount of data required to make a conclusion should drive the frequency, duration and whether you need to sample decisions.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Frequency and Duration</th>
<th>Pull a sampling or take every occurrence?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vital signs for a patient connected to full telemetry in the ICU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood pressure (systolic and diastolic) to determine if the newly prescribed medication and dosage are having the desired impact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent compliance with a hand hygiene protocol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholesterol levels (LDL, HDL, triglycerides) in a patient recently placed on new statin medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient satisfaction scores on the inpatient wards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central line blood stream infection rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of inpatients readmitted within 30 days for the same diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of surgical patients given prophylactic antibiotics within 1 hour prior to surgical incision</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Quality Measurement Journey

- AIM (Why are you measuring?)
- Concept
- Measure
- Operational Definitions
- Data Collection Plan
- Data Collection
- Analysis


You have performance data!
Now, what do you do with it?
“If I had to reduce my message for management to just a few words, I’d say it all had to do with reducing variation.”

W. Edwards Deming

The Problem!

Aggregated data presented in tabular formats or with summary statistics, will not help you measure the impact of process improvement efforts.

Aggregated data can only lead to judgment, not to improvement.
Percent of A&E patients Seen by a Physician within 10 min

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3-Oct</td>
<td>88%</td>
</tr>
<tr>
<td>2</td>
<td>10-Oct</td>
<td>88%</td>
</tr>
<tr>
<td>3</td>
<td>17-Oct</td>
<td>94%</td>
</tr>
<tr>
<td>4</td>
<td>24-Oct</td>
<td>71%</td>
</tr>
<tr>
<td>5</td>
<td>1-Nov</td>
<td>98%</td>
</tr>
<tr>
<td>6</td>
<td>8-Nov</td>
<td>73%</td>
</tr>
<tr>
<td>7</td>
<td>15-Nov</td>
<td>78%</td>
</tr>
<tr>
<td>8</td>
<td>22-Nov</td>
<td>67%</td>
</tr>
<tr>
<td>9</td>
<td>29-Nov</td>
<td>69%</td>
</tr>
<tr>
<td>10</td>
<td>6-Dec</td>
<td>87%</td>
</tr>
<tr>
<td>11</td>
<td>13-Dec</td>
<td>83%</td>
</tr>
<tr>
<td>12</td>
<td>20-Dec</td>
<td>68%</td>
</tr>
<tr>
<td>13</td>
<td>3-Jan</td>
<td>63%</td>
</tr>
<tr>
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</tr>
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<td>21-Feb</td>
<td>89%</td>
</tr>
<tr>
<td>21</td>
<td>28-Feb</td>
<td>95%</td>
</tr>
<tr>
<td>22</td>
<td>6-Mar</td>
<td>95%</td>
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Source: R. Lloyd

Did we improve?  
What will happen next?  
Should we do something?

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Source: R. Lloyd

Did we improve?  
What will happen next?  
Should we do something?
Change made between week 7 and week 8
Was the change an improvement?

Case 1

Case 2

Case 3

Case 4

Case 5

Case 6

Was the change an improvement?
People unclear of the concept!

“...and then another decrease in the percent compliance with hand hygiene this month. But, I have a really good feeling about next month!”
**San Francisco Chronicle**

**Panic Hammers Market**

Dow falls 513, with tech stocks leading way

Chronicle Staff and wire reports

New York

The Dow Jones industrial average suffered its second-largest point drop ever today, tumbling 513.83 points, or 6.47 percent, to finish at 7,282.97, a day after a smaller loss. The moves came as a mix of investor skepticism that technology will show signs of life next year and renewed investor concern over the economy.

For the day, the Dow Jones industrials dropped 513.83 points to 7,282.97, a loss of 6.47 percent. The tech-heavy Nasdaq composite index fell by 168.40 points to 1,684.00, a drop of 9.04 percent.

---

**San Francisco Examiner**

**Stocks bounce back**

Mayor to Muni: Keep riders informed

Operators will give delayed passengers reason, prognosis

By Rachel Gordon

Managing Editor

Operator will give delayed passengers reason, prognosis

Mayor Frank Jordan said Tuesday that San Francisco Muni operators should inform riders of delays and the reasons for them.

"It's very important that we keep our riders informed," Jordan said.

He said operators should provide the extra details that riders need, such as why a bus or train is running late.

The mayor said he would meet with Muni officials to discuss the implementation of his policy and to look for ways to improve communication with riders.

---

**San Francisco Chronicle**

**Tech’s filthy rich take a bath**

What top officers lost in 11 days

Bargain hunters drive Dow up 288, second-biggest point gain ever

NEW YORK (AP) — Stocks moved Tuesday in Wall Street's biggest trading day in the New York Stock Exchange's history, as investors looked for signs of a recovery after last week's historic decline.

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The average of a set of numbers can be created by many different distributions.

Sometimes the data you observe do not fit your view of reality!
What messages do these data send?

If you don’t understand the variation that lives in your data, you will be tempted to ...

- Deny the data (It doesn’t fit my view of reality!)
- See trends where there are no trends
- Try to explain natural variation as special events
- Blame and give credit to people for things over which they have no control
- Distort the process that produced the data
- Kill the messenger!
Distorting the Data!

“You’ll be happy to see that I’ve finally managed to turn things around!”

Deming’s Cycle of Fear


Increased Fear → Kill the Messenger → Filtered Information → Micro-management → Increased Fear
The key to understanding quality performance, therefore, lies in understanding variation over time not in preparing aggregated data and calculating summary statistics!

“A phenomenon will be said to be controlled when, through the use of past experience, we can predict, at least within limits, how the phenomenon may be expected to vary in the future”

Dr. Walter A Shewhart

W. Shewhart. Economic Control of Quality of Manufactured Product, 1931
“What is the variation in one system over time?”
Walter A. Shewhart - early 1920's, Bell Laboratories

Every process displays variation:
- **Controlled variation**
  - stable, consistent pattern of variation
  - “chance”, constant causes

- **Special cause variation**
  - “assignable” pattern changes over time

**Types of Variation**

**Common Cause Variation**
- Is inherent in the design of the process
- Is due to regular, natural or ordinary causes
- Affects all the outcomes of a process
- Results in a “stable” process that is predictable
- Also known as random or unassignable variation

**Special Cause Variation**
- Is due to irregular or unnatural causes that are not inherent in the design of the process
- Affect some, but not necessarily all aspects of the process
- Results in an “unstable” process that is not predictable
- Also known as non-random or assignable variation
Common Cause Variation

- Points equally likely above or below center line
- There will be a high data point and a low, but this is expected
- No trends or shifts or other patterns

A Stable Process is Predictable

Thus you can confidently:
- Counsel patients about what to expect
- Plan for the future
- Inform management
- Use PDSA testing to improve it!
Where do special causes come from?

- **Inherent instability in the process**
  - Lack of standardization – a chaotic process
  - Changes in personnel, equipment, management, etc.

- **Unusual extrinsic events**
  - Catastrophes, breakdowns, accidents, personnel issues

- **Entropy**
  - Equipment wear, lack of focus, habit, emerging culture

- **Intentional changes** – part of an improvement initiative

Two Types of Special Causes

**Unintentional**
When the system is out of control and unstable

**Intentional**
When we’re trying to change the system

Courtesy of Richard Scoville, PhD, IHI Improvement Advisor
Is this common cause or special cause?

Courtesy of Richard Lendon, Clinical Lead for High Impact Changes, NHS, UK
A demonstration of Common & Special Causes of Variation

A classic example of common and special causes of variation!
Point … Variation exists!

**Common Cause** does not mean “Good Variation.” It only means that the process is **stable** and **predictable**. For example, if a patient’s systolic blood pressure averaged around 165 and was usually between 160 and 170 mmHg, this might be stable and predictable but completely unacceptable.

Similarly **Special Cause** variation should not be viewed as “Bad Variation.” You could have a special cause that represents a very good result (e.g., a low turnaround time), which you would want to emulate. Special Cause merely means that the process is **unstable** and **unpredictable**.

---

**Normal Sinus Rhythm (a.k.a. Common Cause Variation)**

**Atrial Flutter Rhythm (a.k.a. Special Cause Variation)**
# Appropriate Management Response to Common & Special Causes of Variation

<table>
<thead>
<tr>
<th>Is the process stable?</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of variation</td>
<td>Only Common</td>
<td>Special + Common</td>
</tr>
<tr>
<td>Right Choice</td>
<td>Change the process</td>
<td>Investigate the origin of the special cause</td>
</tr>
<tr>
<td>Wrong Choice</td>
<td>Treat normal variation as a special cause (tampering)</td>
<td>Change the process</td>
</tr>
<tr>
<td>Consequences of making the wrong choice</td>
<td>Increased variation!</td>
<td>Wasted resources! (time, effort, morale, money)</td>
</tr>
</tbody>
</table>


## 2 Questions ...

1. Is the process **stable**?  
   If so, it is **predictable**.

2. Is the process capable?

   The chart will tell you if the process is stable and predictable.
   
   You have to decide if the output of the process is capable of meeting the target or goal you have set!
Attributes of a Leader Who Understands Variation

Leaders understand the different ways that variation is viewed.

They explain changes in terms of common causes and special causes.

They use graphical methods to learn from data and expect others to consider variation in their decisions and actions.

They understand the concept of stable and unstable processes and the potential losses due to tampering.

Capability of a process or system is understood before changes are attempted.

Understanding Variation Statistically

See Appendix C for a review of some of these principles.

**STATIC VIEW**
- Descriptive Statistics
  - Mean, Median & Mode
  - Minimum/Maximum/Range
  - Standard Deviation
  - Bar graphs/Pie charts

**DYNAMIC VIEW**
- Run Chart
- Control Chart
  - (plot data over time)
- Statistical Process Control (SPC)
The SPC Pioneers

W. Edwards Deming (1900 - 1993)
Walter Shewhart (1891 – 1967)
Joseph Juran (1904 - 2008)

How do we analyze variation for quality improvement?

Run and Control Charts are the best tools to determine:

1. The variation that lives in the process
2. if our improvement strategies have had the desired effect.
1. Make process performance visible

2. Determine if a change is an improvement

3. Determine if we are holding the gains

Three Uses of SPC Charts

Understanding Variation with Run Charts
How many data points do I need?

Ideally you should have between 10 – 15 data points before constructing a run chart

- If you are just starting to measure, plot the dots and make a line graph.
- Once you have 8-10 data points, make a run chart.

Elements of a Run Chart

The centerline (CL) on a Run Chart is the Median

Four simple run rules are used to determine if special cause variation is present
Selecting a Centerline

Mean? Median? Mode?

Why Median Rather Than Mean?

Mean = arithmetic average of data  Median = middle value of ordered data

\[(n + 1)/2 = \text{Median Position which leads you to the Median Value}\]

- \[8,10,11,14,16,18,20\]
  - Mean = 13.8
  - Median Position =
  - Median = 14

- \[8,10,11,14,16,18,95\]
  - Mean = 24.5
  - Median Position =
  - Median = 14

- \[1,10,11,14,16,18,20\]
  - Mean = 12.8
  - Median Position =
  - Median = 14

But how do you compute the Median when you have an even number of data points?
The Median with an even number of data points?

\[(n + 1)/2 = \text{Median Position which leads you to the Median Value}\]

- 8,10,11,14,16,18,20,35\hspace{1cm}\text{Mean} = 16.5
  \hspace{1cm}\text{Median} = 15

- 8,10,11,14,16,18,30,95\hspace{1cm}\text{Mean} = 25.3
  \hspace{1cm}\text{Median} = 15

- 1,10,11,14,14,18,19,20\hspace{1cm}\text{Mean} = 13.4
  \hspace{1cm}\text{Median} = 14

\[\text{(n + 1)/2 = Median Position which leads you to the Median Value}\]

Run Chart

How do you find the median?  \hspace{1cm} \frac{(n + 1)}{2} \hspace{1cm} \frac{(29 + 1)}{2} = \frac{30}{2} = 15

The Median Lives here at the 15\textsuperscript{th} data point

But, the Median Value = 4.6
How do we analyze a Run Chart

“How will I know what the Run Chart is trying to tell me?”

It is actually quite easy:
1. Determine the number of runs.
2. Then apply the 4 basic run chart rules decide if your data reflect random or non-random variation.

First, you need to determine the number of Runs

What is a Run?
• One or more consecutive data points on the same side of the Median
• Do not include data points that fall on the Median

How do we count the number of runs?
• Draw a circle around each run and count the number of circles you have drawn
• Count the number of times the sequence of data points (the line on the chart) crosses the Median and add “1”
• The two counts should be the same!
Run Chart: Medical Waste
Determine the number of runs on this chart

Points on the Median
(don't count these when counting the number of runs)

14 runs
Rules to Identify non-random patterns in the data displayed on a Run Chart

- Rule #1: A shift in the process, or too many data points in a run (6 or more consecutive points above or below the median)

- Rule #2: A trend (5 or more consecutive points all increasing or decreasing)

- Rule #3: Too many or too few runs (use a table to determine this one)

- Rule #4: An “astronomical” data point

Non-Random Rules for Run Charts

This is NOT a trend!

Probability of a “trend”

Why do we need 5 data points for a trend?

What is the probability of a coin landing heads or tails?

One head or tail = .5
.5 x .5 = .25
.5 x .5 x .5 = .125
.5 x .5 x .5 x .5 = .0625
.5 x .5 x .5 x .5 x .5 = .03125
.5 x .5 x .5 x .5 x .5 x .5 = .015625
Non-Random Rules for Run Charts

A Shift: 6 or more

A Trend 5 or more

Rule 3: Too few or too many runs

Use this table by first calculating the number of "useful observations" in your data set. This is done by subtracting the number of data points on the median from the total number of data points. Then, find this number in the first column. The lower number of runs is found in the second column. The upper number of runs can be found in the third column. If the number of runs in your data falls below the lower limit or above the upper limit then this is a signal of a special cause.

<table>
<thead>
<tr>
<th># of Useful Observations</th>
<th>Lower Number of Runs</th>
<th>Upper Number of Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>16</td>
<td>5</td>
<td>13</td>
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<tr>
<td>17</td>
<td>5</td>
<td>13</td>
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<tr>
<td>18</td>
<td>6</td>
<td>14</td>
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<tr>
<td>19</td>
<td>6</td>
<td>15</td>
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<tr>
<td>20</td>
<td>6</td>
<td>16</td>
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<tr>
<td>21</td>
<td>7</td>
<td>16</td>
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<td>18</td>
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<td>26</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>27</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>28</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>29 Total data points</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td>11</td>
<td>21</td>
</tr>
</tbody>
</table>


So, for 27 useful observations we should have between 10 and 19 runs.
Non-Random Rules for Run Charts


Rule #4: An Astronomical Data Point

25 Men and a Test

What do you think about this data point?
Is it astronomical?
Run Chart Interpretation: Medical Waste

Total data points = 29
Data points on the Median = 2
Number of “useful observations” = 27
(should have between 10 & 19 runs)
The number of runs = 14
Number of times the data line crosses the Median = 13 + 1 = 14

Are there any non-random patterns present?

“Practice isn’t the thing you do once you’re good. It’s the thing you do that makes you good.” - Malcolm Gladwell

So, let’s identify some non-random patterns...
Test #1: 
% of patients with Length of Stay shorter than six days

% of patients with Length of Stay shorter than six days

Rules 1 & 3

Rule 1: not OK
Rule 2: OK
Rule 3: 2 runs (6-14 runs), not OK
Rule 4: OK

Median = 52

18 useful observations
Average Length of Stay

Rule 2: not OK (trend)

Rule 3: 12 runs (7-17 runs), OK

Rule 4: OK

22 useful observations

Rule 1: OK
24 useful observations
8 runs - ok (8 to 18 runs)
22 useful observations (2 on the median)
4 runs – NOT ok (7 to 17 runs)
20 useful observations  (4 on the median)
9 runs – ok (6 to 16 runs)
Analyze this Run Chart

% Timely Reperfusion

Date
1/99 2 3 4 5 6 7 8 9 10 11 12
1/00 2 3 4 5 6 7 8 9 10 11 12
1/01 2 3 4 5 6 7 8 9 10 11 12
1/02 2 3 4 5 6 7 8 9 10 11 12
1/03 2 3 4 5 6 7 8 9 10 11 12
1/04 2 3 4 5 6 7 8 9 10 11 12
1/05 2 3 4 5 6 7 8 9 10 11 12
1/06 2 3 4 5 6 7 8 9 10 11 12
1/07 2 3 4 5 6 7 8 9 10 11 12
1/08 2 3 4 5 6 7 8 9 10 11 12
1/09 2 3 4 5 6 7 8 9 10 11 12
1/10 2 3 4 5 6 7 8 9 10 11 12
1/11 2 3 4 5 6 7 8 9 10 11 12
1/12 2 3 4 5 6 7 8 9 10 11 12

Run Chart

percent
15 20 25 30 35 40 45 50 55 60
Months
1/99 2 3 4 5 6 7 8 9 10 11 12
1/00 2 3 4 5 6 7 8 9 10 11 12
1/01 2 3 4 5 6 7 8 9 10 11 12
1/02 2 3 4 5 6 7 8 9 10 11 12
1/03 2 3 4 5 6 7 8 9 10 11 12
1/04 2 3 4 5 6 7 8 9 10 11 12
1/05 2 3 4 5 6 7 8 9 10 11 12
1/06 2 3 4 5 6 7 8 9 10 11 12
1/07 2 3 4 5 6 7 8 9 10 11 12
1/08 2 3 4 5 6 7 8 9 10 11 12
1/09 2 3 4 5 6 7 8 9 10 11 12
1/10 2 3 4 5 6 7 8 9 10 11 12
1/11 2 3 4 5 6 7 8 9 10 11 12
1/12 2 3 4 5 6 7 8 9 10 11 12

What about the Run Chart Rules?

8 Runs
### Length of Stay for COPD

#### COPD Length of Stay

**Is this a Run Chart? If not, what is it?**

![Chart showing COPD Length of Stay](image)

1. **Finding the Median**
   
   
   \[(N + 1) / 2 = \text{Median Position}\]

2. **Determine the “useful observations”**

3. **Apply the 4 run test rules**

   - Find the Median
   - Determine the “useful observations”
   - Apply the 4 run test rules

**Let’s make it a Run Chart!**

**COPD Length of Stay**

**Finding the Median**

\[(N + 1) / 2 = \text{Median Position}\]

**33 data points with 2 on the median**

**Therefore we have 31 useful observations**

1. **Month**
   - Apr-02
   - Jun
   - Aug
   - Oct
   - Dec
   - Feb

2. **Days**
   - 0.0
   - 2.0
   - 4.0
   - 6.0
   - 8.0
   - 10.0
   - 12.0
   - 14.0

3. **Chart Notes**
   - April 2002 to December 2004
   - Days spent in hospital for COPD
Now, let’s analyse the Run Chart!

COPD Length of Stay

How many runs on this chart? Are any non-random patterns present?

1. Find the Median
2. Determine the “useful observations”
3. Apply the 4 run test rules

Conclusions?

Identifying the number of runs...

12 runs (should be between 11 and 21 runs)
Are there more than 6 points in a run above or below the median?
Are there 5 data points constantly increasing?
• Make a run chart with the data shown in the table to the left.
• Decide how you want to lay out the X (horizontal) axis and Y (vertical) axis.
• Plot the data points.
• Calculate the median. Hint: use the \((n + 1)/2\) formula to find the median position first.
• Then determine the median value.
• Determine the number of runs on the chart.
• Apply the run chart rules and interpret the results
• **DO NOT use your calculator or Excel!!!**

**Measure** is the percent compliance with proper hand hygiene by week.

\[
N = \text{number of properly completed hand washings}
\]

\[
D = \text{total number of hand washing observations}
\]

<table>
<thead>
<tr>
<th>Week</th>
<th>Percent Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>79</td>
</tr>
<tr>
<td>2</td>
<td>82</td>
</tr>
<tr>
<td>3</td>
<td>86</td>
</tr>
<tr>
<td>4</td>
<td>84</td>
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<td>5</td>
<td>85</td>
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<td>79</td>
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<td>86</td>
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<td>9</td>
<td>82</td>
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<td>10</td>
<td>74</td>
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<td>11</td>
<td>85</td>
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<td>81</td>
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<td>84</td>
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<td>70</td>
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<tr>
<td>26</td>
<td>85</td>
</tr>
<tr>
<td>27</td>
<td>77</td>
</tr>
</tbody>
</table>

**Exercise**

**Percent Compliance with Proper Hand Hygiene**

\[
\text{Median} = 81 \quad (27+1) = 28/2 = 14
\]

**How many runs on this chart**
Exercise
Percent Compliance with Proper Hand Hygiene

Apply the rules and interpret the chart.
NOTE: 27 data points with 3 on the median gives you 24 “useful observations.”
For 24 useful observations you expect between 8 and 18 runs.

A Final Thought!

How will we know that a change is an improvement?

Annotations
1: AMU
2: AMU excl herbal/OTC
3: after pharmacy intervention on AMU
4: 15.91 before pharmacy intervention
5: 12.41 before pharmacy intervention
6: 14.47 pre pharmacy intervention
7: 23.26% pre pharmacy intervention
8: 18.6 before pharmacy
9: 27.05 before pharmacy

Source: Conway and Denbighshire NHS Trust
Percent Unreconciled Medications
Deciding if things have changed

Annotations
1: AMU
2: AMU
3: excl herbal/OTC
4: after pharmacy intervention on AMU
5: 15.91 before pharmacy intervention
6: 12.41 before pharmacy intervention
7: 14.47 pre pharmacy intervention
8: 23.26% pre pharmacy intervention
9: 18.6 before pharmacy
10: 27.05 before pharmacy

Extend the centerline (median) as a reference point for the new results

Source: Conwy and Denbighshire NHS Trust
Percent Unreconciled Medications

Now, we plot the new data and use the run chart rules to determine if a true change has occurred.

Source: Conwy and Denbighshire NHS Trust
Percent Unreconciled Medications
Your next move…

…to gain more knowledge about Shewhart Charts (a.k.a. control charts)

Why are Shewhart Charts preferred over Run Charts?

**Because Control Charts…**

1. Are more sensitive than run charts:
   - A run chart cannot detect special causes that are due to point-to-point variation (median versus the mean)
   - Tests for detecting special causes can be used with control charts

2. Have the added feature of control limits, which allow us to determine if the process is stable (common cause variation) or not stable (special cause variation).

3. Can be used to define process capability.

4. Allow us to more accurately predict process behavior and future performance.
Elements of a Shewhart Control Chart

- **X (Mean)**
- **(Upper Control Limit)**
  - UCL = 44.855
- **(Lower Control Limit)**
  - LCL = 13.645

The choice of a Control Chart depends on the Type of Data you have collected

**Continuous (Variables) Data**
- Time, money, scaled data (temperature, length, volume), workload or productivity (throughput, counts)

**Attributes Data**
- **Defectives** (classification)
  - percent that meet a particular criteria (OK vs not OK)
  - % of staff who receive Qi training
  - % of new inpatients with a skin assessment completed within 12 hours

- **Defects (count)**
  - data are counted, not measured. Must be whole numbers.
  - (e.g., number of errors, falls or incidents)
Let’s identify your measures...

There Are 5 Basic Control Charts

**Variables Charts**
- I chart  
  (individual measurements)
- X & S chart  
  (average & SD chart)

**Attributes Charts**
- C chart  
  (number of defects)
- U chart  
  (defect rate)
- P chart  
  (proportion or percent of defectives)

Type of data

Attributes Data
- Numbers of items that passed or failed
- Data must be whole number when originally collected

Continuous (variables) Data
- Measurement, on some time of scale
- Time, money, height/weight, throughput (workload, productivity)

Count
- 1, 2, 3, 4 etc. (errors, falls, incidents)
- Numerator can be greater than denominator

Classification
- Either/or, pass/fail, yes/no
- Percentage or proportion
- Equal area of opportunity
- Unequal area of opportunity

Each dot on the chart consists of a single observation of data (i.e., cost for one procedure, waiting time for one patient or the total number of clinic visits for each day)

Equal or unequal subgroup size

Subgroup size of 1 (n=1)

Each dot on the chart consists of multiple data values

X-bar plots the average of all the data values
- S plots the standard deviation of the data values
- Equal or unequal subgroup size (n>1)

Rules for Detecting Special Causes

- 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)
Using a Control Chart
(Wait Time to See the Doctor)

Intervention
Baseline Period

Freeze the Control Limits and Centerline, extend them and compare the new process performance to these reference lines to determine if a special cause has been introduced as a result of the intervention.

Freeze the Control Limits and compare the new process performance to the baseline using the UCL, LCL and CL from the baseline period as reference lines.

A Special Cause is detected
A run of 8 or more data points on one side of the centerline reflecting a shift in the process.

Using a Control Chart
(Wait Time to See the Doctor)
Using a Control Chart
(Wait Time to See the Doctor)

This really is child’s play!
The Charts Don’t Tell You…

• The reasons(s) for a Special Cause.

• Whether or not a Common Cause process should be improved (is the performance of the process acceptable?)

• How the process should actually be improved or redesigned.
A Simple Improvement Plan

1. Which process do you want to improve or redesign?

2. Does the process contain common or special cause variation?

3. How do you plan on actually making improvements? What strategies do you plan to follow to make things better?

4. What effect (if any) did your plan have on the process performance?

SPC methods and tools will help you answer Questions 2 & 4. YOU need to figure out the answers to Questions 1 & 3.

Simple Hints To Improve Measurement

From a presentation by Don Berwick, M.D., Quality Management Network Meeting, Boston, July 28, 1995.

Graph data over time
Local collection/local use
Develop knowledge of "tampering"
Use "fast feedback"
Develop views of the whole
Use the entire range of data
Foster immediate recovery
Create an environment for reflection
Encourage the public posting of results
Make predictions and see how well they work
Use small samples vigorously
Finally, remember that data is a necessary part of the Sequence of Improvement

Appendices

• Appendix A: General References on Quality
• Appendix B: References on Measurement
• Appendix C: Basic “sadistical” principles
“Quality begins with intent, which is fixed by management.”

W. E. Deming, Out of the Crisis, p.5

Appendix A
General References on Quality


Appendix B
References on Measurement


Appendix B
References on Measurement (cont.)


### Appendix C

**A few basic “sadistical” principles**

#### Descriptive Statistics related to depicting variation

<table>
<thead>
<tr>
<th>Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>The <strong>sum of the deviations</strong> ((x_i - \bar{x})) of a set of observations about their mean is equal to zero.</td>
<td>(\Sigma (x_i - \bar{x}) = 0)</td>
</tr>
<tr>
<td>The <strong>average deviation (AD)</strong> is obtained by adding the absolute values of the deviations of the individual values from their mean and dividing by (n).</td>
<td>(AD = \frac{\Sigma</td>
</tr>
<tr>
<td>The <strong>sample variance</strong> ((s^2)) is the average of the squares of the deviations of the individual values from their mean.</td>
<td>(s^2 = \frac{\Sigma (x_i - \bar{x})^2}{n - 1})</td>
</tr>
<tr>
<td>Which finally leads us to our good old friend, the <strong>standard deviation</strong>, which is the positive square root of the variance.</td>
<td>See the next page for this fun formula!</td>
</tr>
</tbody>
</table>

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**Building Cascading Systems of Learning**

*Institute for Healthcare Improvement Faculty*

*Michael Posencheg, M.D.*

*Rebecca Steinfield, MA*
Definition of a System

“A group of items, people, or processes working together toward a common purpose.”


Role of the System

The discipline of seeing interrelationships gradually undermines older attitudes of blame and guilt. We begin to see that all of us are trapped in structures, structures embedded both in our ways of thinking and in the interpersonal and social milieus in which we live. Our knee-jerk tendencies to find fault with one another gradually fade, leaving a much deeper appreciation of the forces within which we all operate.

This does not imply that people are simply victims of systems that dictate their behavior. Often, the structures are of our own creation. But this has little meaning until those structures are seen. For most of us, the structures within which we operate are invisible. We are neither victims nor culprits but human beings controlled by forces we have not yet learned how to perceive.

Peter Senge, The 5th Discipline
Characteristics of a System

- A system has an aim or purpose
- The network of factors that lead to outcomes of value to stakeholders
- Factors comprise structures, processes, culture, personnel, geography, and much more.
- Dynamic: The “thing in motion”
- The system is perfectly designed to achieve the results it gets!
- Improving outcomes requires understanding the dynamics of the system

Atlanta’s infamous “Spaghetti Junction”

Courtesy of Richard Scoville
Improving medical care requires system redesign…

“Every system is perfectly designed to get the results it gets.” – Paul Batalden

The definition of insanity is doing the same thing over and over and expecting to get a different result.

Does the system determine the outcome?

Step 1: Pick a number from 3 to 9
Step 2: Multiply your number by 9
Step 3: Add 12 to the number from step 2
Step 4: Add your 2 digits together
Step 5: Divide # from step 4 by 3 to get a 1 digit number
Step 6: Convert your Number to a letter:
1=A  2=B  3=C  4=D  5=E  6=F  7=G  8=H  9= I
Step 7: Write down the name of a country that begins with your letter
Step 8: Go to the next Letter: A to B, B to C, C to D, etc.
Step 9: Write down the name of an animal (not bird, fish, or insect) that begins with your letter from Step 8
Step 10: Write down the color of your animal

Do you have a 2-digit Number?

Result:
Color__________
Animal________
Country________
Components of a System

Inputs
Processes
Outcomes

Inputs
(Material, Participants, Equipment)

Processes
(Voice of the Process)

Outcomes
(Voice of the Customer)

Process = a sequence of decisions and actions that delivers value to stakeholders

© Richard Scoville & I.H.I.
What principle characterizes a system?

Purpose of the Healthcare System

“The quality of patients’ experience is the ‘north star’ for systems of care.”

Don Berwick
The Voice of the Customer
(patient, family, care givers, staff)

How would your customers (e.g., patients) describe the purpose of your system of care?

“I want your pharmacy to provide me with the right medications at the right time, in the correct dosages, to help me heal.”

“While I am in your care, I want you to provide me with compassionate, respectful care. I want to be free from pain and have a good plan for going home.”

Levels of the System

Nursing Services

Macro-systems
(e.g. a hospital, multiple hospitals, a state, a region)

Nursing Divisions

Meso-systems
(e.g. a division, a clinical department, pathology, IT)

Frontline Nursing Units

Microsystems
(e.g. a ward or unit, a clinic, home care nurses)
Micro System Of Care

- Reliable evidence-based care
- Patient-centered
- Timely
- Safe
- Efficient
- Equitable

Meso System Of Care

- Staying fit
- Getting better
- Managing chronic disease
- Healthy mom & baby
- Coping with end-of-life
Macro System Of Care

Population health and well-being
- Percent of patients who suffered harm
- Percent with current preventive care
- Percent of patients who would recommend

Drivers of the System

\[ S + P + C^* = O \]

Structure + Process + Culture* = Outcomes


*Added to Donabedian’s original formulation by R. Lloyd and R. Scoville
Exercise
What is your system?

- Take a few minutes to think about what you want to improve.
- Would you say that what you are thinking about is a Macro, Meso or Micro level issue?
- How would your customers (e.g., patients) describe the purpose of your system of care?
- Do you know the 3 or 4 key factors that produce the outcomes of this system?
- Do those you work with agree that these are the factors that drive the results?

Defining your system!

The **Driver Diagram** is a tool to help us understand the system you wish to improve, its outcomes and the processes and related factors that drive the outcomes.
A Theory of How to Improve a System

Aim: Expresses stakeholder value!

Primary Drivers
- P. Driver

Secondary Drivers
- S. Driver 1
- S. Driver 2
- S. Driver 3

Outcome

System Factors

A Theory for A New Me!

Aim: A New ME!

Primary Drivers
- Calories In
- Calories Out

Secondary Drivers
- Limit daily intake
- Substitute low calorie foods
- Avoid alcohol
- Exercise
- Fidgiting

Ideas for Process Changes
- Track Calories
- Plan Meals
- Drink H2O Not Soda
- Work out 5 days
- Bike to work
- Hacky Sack in office

“Every system is perfectly designed to achieve the results that it gets”

“Every system is perfectly designed to achieve the results that it gets”
Two Main Categories of Drivers

**Primary Drivers**
System components which will contribute to moving the outcome(s); the “big buckets.”

**Secondary Drivers**
- Elements of the associated Primary Drivers
- They can be used to create projects or a change package that will affect the Primary Drivers and ultimately the Outcome(s).

About Drivers

**Primary Drivers**
- Groups of secondary drivers with common resources, manager, equipment, patients, etc.
- Could be assigned to a team to improve

**Secondary Drivers**
- Structures, processes, or cultural norms that contribute to the desired outcomes
- Necessary and sufficient for improvement
- Identified by subject matter experts (i.e., staff)
A Theory for A New Me!

“Every system is perfectly designed to achieve the results that it gets”

Types of Drivers

- **Values and Operating Rules** — A concept, regulation, or norm governing individual conduct
- **Organizational Structures** - The way that the components of a system are connected or interact.
- **Processes** — A sequence of steps that repeatedly interact to make inputs into outcomes
At OHC over 16 months, we will
1) increase the % of pts completing
caries control within 2 month by X% and
2) decrease the % of “risk
management” pts who need
treatment for new caries by Y%
(active pt = 18+ w/ >=1 visit in past 2
years, not withdrawn)

Source: Richard Scoville, Ph.D. IHI Improvement Advisor

Improving Care for Colon Cancer Patients

The primary effect "What?"
- You begin the adequate treatment within four weeks
- You are well informed/involved in the entire healthcare chain
- The diagnosis and treatment with 'best method' is offered
- Equally good palliative care is provided no matter of the place of residence
- The best possible health promotion measures and efficient screening program is offered
- Regional cancer center should prioritize patient-oriented research in oncology

Secondary effect "How?"
- Early detection
- Investigation/Treatment
- Patient's involvement
- Multi-disciplinary Collaboration
- Palliation
- Prevention
- Interactive research approach in several parts of the project

Our promise to patients with colon cancer
Good health care

Goal/objectives
Improving quality of care on an inpatient female psychiatric ward

AIM

To improve the inpatient experience for adult female inpatients on a mental health unit in order to increase satisfaction by 25% in 10 months

PRIMARY DRIVERS

- Ward Environment
- Multidisciplinary Ward Team Process
- Patient Choice
- Ward Activities

SECONDARY DRIVERS

- Bed occupancy
- Nurse input
- Pharmacy input
- Family support
- Ward round
- Complaints

CHANGE IDEAS

- Review of delays at weekly bed meetings
- Rewrite protocol
- Ensure daily 1:1 time with named nurse
- Offer pharmacy advice to every patient during stay
- Train one staff member on each ward to use support skills
- Change concept of large MDT ward round meetings
- Add senior OT to project team

Ward Environment

- Stop sleep outs

Multidisciplinary Ward Team Process

- Nursing input
- Pharmacy input
- Family support

Patient Choice

- Ward round

Ward Activities

- OT programme

Improving physical health collaborative

AIM:
Reduce cardiovascular risk for all adults and children for whom we initiate or change psychotropic medication

Outcome measure:
- QRISK2

Equipment

- Care, Careline, Priscilla

Measuring and reporting

- Lucja, Toby, Simon, Tom

Assessment & monitoring

- Shameem, Kate, Susham

Intervention

- Kate, Delphi, Gerard, Sian, Shameem, Hannah

Service user & staff engagement

- Paul, Andy, Duncan

Minimum standards & checks

- Pods for community settings

Define scope, data, spec

- Reports & dashboards

Antipsychotic monitoring

- Access to diagnostics

Reliable monitoring of physical health indicators

- Smoking cessation
- Prescribing
- Health promotion (exercise, diet, education)

Inpatient primary care access

- Community GP liaison

Workforce development

- Information provision
- Involvement in all QI areas

EXISTING WORK

- C&H CMHTs

- Bevan, forensic, community LD

- C&H and TH clozapine clinics

- C&H AOS, EQUIP, rehab Joshua, Lodges, Community CAMHS & adolescent team

- Forensic, Millharbour

- Weight (NOVEM, forensic), Connolly, Wolfson Hse, Community LD, Newham CMHTs, forensic

- Early warning system training
Diabetes Driver Diagram

Outcomes

Primary Drivers

Secondary Drivers

Change Concepts

Improved outcomes for patients with Diabetes

Information Systems

Identify DM patients at time of visit

Recall patients for follow up

Identify needed services for DM patients

Planned Care

Team work dedicated to patient centered care

Guideline-driven Care

Reliable care delivery processes

DM protocol

Patient Self Management

Care conforms to individual patient plan

Patient is knowledgeable about DM & control

Patient is able to participate in self management

See change ideas in the METRIC Interventions document

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Driver diagram informs testing, testing refines theory

Bennet, B, Provost, L. *What’s Your Theory Quality*
Progress. July 2015
Driver Diagram Tip #1
Drivers and Processes are Linked!

Improving the reliability, consistency, usability or efficiency of processes is central to improving system outcomes.

Source: Richard Scoville & I.H.I.

Driver Diagram Tip #2
Don’t forget about the timing of change!

Outcomes

Outcome measures change more slowly

Processes

Process measures change more quickly

Source: Richard Scoville & I.H.I.
Exercise
Driver Diagram

Draft a Driver Diagram for your project

• Make a list of potential improvement drivers for your system of care
• Create a driver diagram for your project
  — Aim/Outcome
  — Key drivers of improvement in the outcome(s)

Driver Diagram Tip #3

Look at your system of care as a cascade!
Most cascades start at the top!

And, trickle downward…

A typical top-down cascade

- Microsystems
  - Departments/Staff/Patients
  - Departments/Units/Wards/Service Lines
  - Sr VPS & VPs
  - Board & CEO

- Mesosystem

- Macrosystem

The Big Dots
Which way does (should) your cascade flow?

Top Down?

Spread from the Middle?

Bottom Up?

IOM Chasm Report Chain of Effect (it all starts with the patient)

1. Patient (start here)
2. Physician
3. Clinical Unit/Microsystem
4. Clinical Service Line/Mesosystem
5. Health System/Macrosystem

Information System Design Principle: Capture data at **lowest** level and aggregate up to higher levels for **cascading** metrics throughout system.
Think about reversing the cascade!

Traditional Pyramids

Inverted Pyramids


So, think about building an inverted pyramid

Start with the Little Dots

Level 1
Micro: Patient & the provider of care

Level 2
Meso: Clinical Units, Departments and Service Lines

Level 3
Macro

Adapted from R. Lloyd & G. Nelson, 2007
What system are you trying to improve?

The key question, however, is do you fully understand the complexity of these systems and which aspects of the system you want to improve?

You need to start drilling down from the...

Macro

Meso

That then percolates back up

Micro levels and build a cascade

Jönköping’s System Level Cascade

Source: G. Henriks & Bojestig, Jönköping County Council, Sweden, 2008
Improving Care for Colon Cancer Patients

**Goal/ objectives**

Our promise to patients with colon cancer

**Good health care**

You begin the adequate treatment within four weeks

The diagnosis and treatment with 'best method' is offered

Equally good palliative care is provided no matter of the place of residence

The best possible health promotion measures and efficient screening program is offered

Regional cancer center should Prioritise patient-oriented research in oncology

**Primary effect**

"What?"

**Secondary effect**

"How?"

**Early detection**

**Investigation/Treatment**

**Patient’s involvement**

**Multi-disciplinary Collaboration**

**Palliation**

**Prevention**

**Interactive research approach in several parts of the project**

Patient Involvement

**Goal/ objectives**

**Interactive research approach in several parts of the project**

**Early detection**

**Investigation/Treatment**

**Patient’s involvement**

**Multi-disciplinary Collaboration**

**Palliation**

**Prevention**

**Interactive research approach in several parts of the project**
Exercise
Driver Diagram

- Use the Driver Diagram you just reviewed.
- Review the Secondary Drivers you identified on this initial Driver Diagram.
- Select one of the Secondary Drivers and make it the Outcome of your new Driver Diagram.
- Identify the Primary and Secondary Drivers of this new outcome.
- Do you need to cascade down another level?