1D – Improvement Measures and Data

Attributes of Useful Improvement Measures

- Responsive
- Valid
- Comprehensible
- Timely
- Feasible
- Relevant
Attributes of Useful Improvement Measures

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsive</td>
<td>The measure is sensitive to changes in the system state. When the system improves, the measure says so.</td>
</tr>
<tr>
<td>Valid</td>
<td>The measure aligns with the theory of changes (driver diagram). Improvement in the measure means improvement in the system.</td>
</tr>
<tr>
<td>Comprehensible</td>
<td>The intended audience understands the meaning of the measure for system improvement.</td>
</tr>
<tr>
<td>Timely</td>
<td>The data are available soon enough to inform improvement decisions (project planning, PDSA testing).</td>
</tr>
<tr>
<td>Feasible</td>
<td>The data can be collected with minimum effort and cost, and in a timely fashion.</td>
</tr>
<tr>
<td>Relevant</td>
<td>The measure supports problem identification and testing at the appropriate level of management.</td>
</tr>
<tr>
<td>Consistent</td>
<td>The measure has a clear definition: it yields consistent results when applied in different places and at different times.</td>
</tr>
<tr>
<td>Ownership</td>
<td>Someone is explicitly assigned to monitor the measure on a regular basis, detect problems, and initiate change.</td>
</tr>
</tbody>
</table>

Discussion: What are the Trade-Offs?

Concept = ‘Catheter insertion compliance’

1. Percent of catheter insertions with hand hygiene compliance last year.
2. Percent of catheter insertions in the measurement month with all insertion bundle elements in compliance.
3. Average time from catheter order to insertion in the current week.
4. Number of catheters inserted this week within 2 hours or order?
5. Descriptive notes on 5 catheter insertions last week.
Why Time Is Important for Measuring Improvement

- “Improvement is temporal!” – Lloyd Provost
- Displaying data over time (using run charts or control charts) allows us to make informed predictions, and thus manage effectively

![Graph showing number of bed turns per 100 patients over time]

“Managing a company by means of the quarterly reports is like trying to drive a car by watching the yellow line in the rearview mirror.”

Myron Tribus
The Manager’s Dilemma

In order to improve a system, we are required to make predictions about its future performance.

“Management is prediction!”
- W. Edwards Deming

Did We Improve?

Percent of ER patients with Chest Pain Seen by a Cardiologist 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>88%</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>81%</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>93%</td>
</tr>
<tr>
<td>14</td>
<td>10-Jan</td>
<td>70%</td>
</tr>
<tr>
<td>15</td>
<td>17-Jan</td>
<td>73%</td>
</tr>
<tr>
<td>16</td>
<td>24-Jan</td>
<td>76%</td>
</tr>
<tr>
<td>17</td>
<td>31-Jan</td>
<td>78%</td>
</tr>
<tr>
<td>18</td>
<td>7-Feb</td>
<td>79%</td>
</tr>
<tr>
<td>19</td>
<td>14-Feb</td>
<td>84%</td>
</tr>
<tr>
<td>20</td>
<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>
</tr>
<tr>
<td>23</td>
<td>13-Mar</td>
<td>91%</td>
</tr>
<tr>
<td>24</td>
<td>20-Mar</td>
<td>96%</td>
</tr>
</tbody>
</table>

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

Source: R. Lloyd
How Many Different Processes?

<table>
<thead>
<tr>
<th>Cycle Time results for units 1, 2 and 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle Time (min.)</td>
</tr>
<tr>
<td>Avg Before Change: 70</td>
</tr>
<tr>
<td>Avg After Change: 35</td>
</tr>
</tbody>
</table>

Importance of Timely Data
The Pace of Change

- **Driver 1:** Reduce catheter associated urinary tract infections by 50% in one year
  - **Primary:** Leadership and aligned policy for catheter use
  - **Secondary:** Eliminate unnecessary catheter insertions
  - **Changes/Interventions:**
    - M1: Clear policies for infection control
    - M2: Transparent reporting of process failures
    - M3: Staff training, with feedback on observed protocol compliance
    - M4: Insert catheters only for appropriate indications
    - M5: Consider alternative methods
    - M6: Minimize use of catheters for patients at risk for infections
    - M7: Remove when no longer required
    - M8: Insertion only by trained staff
    - M9: Standard insertion procedure
    - M10: Daily assessment of need, removal at earliest opportunity
    - M11: Standard cleaning and maintenance protocol

- **Driver 2:** Reduce catheter use
  - **Primary:** Unobstructed flow
  - **Secondary:** Disposal & clean container
  - **Changes/Interventions:**
    - M1: Hand hygiene
    - M2: Sterile gloves, materials
    - M3: Aseptic insertion
    - M4: Unobstructed flow

- **Driver 3:** Maintain unobstructed flow
  - **Primary:** Measure
  - **Secondary:** Change
  - **Changes/Interventions:**
    - M1: Hand hygiene
    - M2: Sterile gloves, materials
    - M3: Aseptic insertion
    - M4: Unobstructed flow

- **Driver 4:** Maintain unobstructed flow
  - **Primary:** Measure
  - **Secondary:** Change
  - **Changes/Interventions:**
    - M1: Hand hygiene
    - M2: Sterile gloves, materials
    - M3: Aseptic insertion
    - M4: Unobstructed flow

- **Driver 5:** Maintain unobstructed flow
  - **Primary:** Measure
  - **Secondary:** Change
  - **Changes/Interventions:**
    - M1: Hand hygiene
    - M2: Sterile gloves, materials
    - M3: Aseptic insertion
    - M4: Unobstructed flow

**Validity: Aligned with Improvement Theory**

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Primary Drivers</th>
<th>Secondary Drivers</th>
<th>Changes / Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce catheter associated urinary tract infections by 50% in one year</td>
<td>Leadership and aligned policy for catheter use</td>
<td>Eliminate unnecessary catheter insertions</td>
<td>Clear policies for infection control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Transparent reporting of process failures</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Standard insertion procedure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Daily assessment of need, removal at earliest opportunity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Standard cleaning and maintenance procedure</td>
</tr>
</tbody>
</table>

**Insertion Bundle:**
- A: Hand hygiene
- B: Sterile gloves, materials
- C: Aseptic insertion
- D: Unobstructed flow

**Maintenance Bundle:**
- A: Tamper seal intact
- B: Secured in place
- C: Hand hygiene
- D: Sterile hygiene
- E: Disposal & clean container
- F: Maintain unobstructed flow
Validity: Alignment with Improvement Work

- Improvement in a pilot population (1 practice, 1 unit, etc.) will not be evident in measures based on the total population (city, hospital system).

Validity: Alignment with Improvement Work

- To track improvement, we must measure in the same target population where we are working to improve.
Comprehensible?

- Percentage of patients discharged in the measurement month that suffered a CAUTI
- Number of CAUTIs per 1000 Foley catheter days during measurement month
- Number of CAUTIs per 1000 inpatient days during the measurement month
- Count of CAUTIs in the measurement month
- Number of catheter days since the last CAUTI event

Responsive

- Percent of catheters removed during the measurement month within 2 days of insertion
- Average catheter duration by month
  
  - Which measure better reflects the improvement work of improvement teams?
  - Which measure better reflects protocol compliance?
**Consistency: How Do You Define…?**

- Surgery start time
- A medication error
- A complete H&P
- A patient fall
- Good patient education
- A readmission
- A missed diagnosis
- A short A&E visit
- Reliable data abstraction
- Staff productivity
- Transformational change
- Timely technical assistance
- Patient & family satisfaction
- Breakthrough Priorities
- A culture of safety
- A patient complaint

Source: R. Lloyd
Consistency: Operational Definitions

A procedural description of what to measure and the steps to follow to measure it consistently…

✓ Gives communicable meaning to a concept
✓ Tells what you need to count or measure, and how to do it
✓ Specifies measurement methods and equipment
✓ Provides guidance on sampling
✓ Identifies detailed criteria for inclusion and exclusion

… is the basis for reliable measurement

Source: R. Lloyd

Exercise: Operational Definitions

- Create a step-by-step operational definition to capture the concept of “banana size”
- Measure your banana using the definition, and write down the result and keep it secret!
- Pass your definition and banana to another table. They will use your definition to measure.
- Compare results.
Operational Definition Example

**Measure:** Percentage of patients undergoing hip and knee replacement surgery during the measurement period who have had preoperative nasal swabs to screen for *Staphylococcus aureus* carriage

**Goal:** 95%

**Measurement Period Length:** Monthly

**Numerator Definition:** Number of patients undergoing hip or knee replacement surgery who have had a nasal swab specimen processed to screen for *Staphylococcus aureus* carriage prior to surgery

**Denominator Definition:** Number of patients undergoing elective hip or knee replacement surgery

**Numerator and Denominator Exclusions:**
- Patients who are less than 18 years of age
- Patients who had a principal or admission diagnosis suggestive of preoperative infectious diseases
- Patients with physician-documented infection prior to surgical procedures
- Patients undergoing non-elective hip or knee replacement surgery

**Definition of Terms:**
Hip or knee replacement surgery includes operations involving placement of a nonhuman-derived device into the hip or knee joint space. ICD-9 Codes include 00.70-00.73, 00.85-00.87, 81.51-81.53, 00.80-00.84, 81.54, and 81.55.

**Calculate as:** (numerator/denominator*100)

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Developing Operational Definitions

- Small team: key content expert(s); improvement specialist; project lead; data support
- Iterative process
  - Start with outcomes, key drivers as concepts
  - Clinical protocol is background for percent compliance indicators
  - Identify denominators: what are the OPPORTUNITIES for protocol compliance?
  - Identify numerators: what counts as successful compliance?
- All terms are defined (glossary)
  - Consistent terminology
  - Eliminate ambiguities
- ‘Your programmer will decide if you do not!’
### Developing Operational Definitions

**Glossary of Key Terms**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>EDR Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active dental patient</td>
<td>Patients 0 to 72 months (i.e. &lt;2160 days) old with at least 1 dental exam in the past 18 months, and carried on the center’s EDR.</td>
<td>D0602: Moderate caries risk D0606: High caries risk D0601: Low caries risk</td>
</tr>
<tr>
<td>Caries risk assessment (CRA)</td>
<td>Patients are assessed for risk of caries lesions using a standard caries risk assessment form. The presence of a risk status code for a visit indicates that risk has been assessed.</td>
<td>D0603: High caries risk D0601: Low caries risk</td>
</tr>
<tr>
<td>Dental exam</td>
<td>Oral examination conducted by a dental provider</td>
<td>D01150/D0145: comprehensive exam D01120: Periodic exam</td>
</tr>
<tr>
<td>Measurement month</td>
<td>The month over which measures are calculated. For example, patient visits in the measurement month of April are summarized and reported in May. In general a patient will have only one dental exam or other visit in a measurement month. If a patient had more than one exam (or other designated visit) in the measurement month, assess only the most recent visit. The visit assessed for process or outcome measures during the measurement month is referred to as the “current visit.”</td>
<td></td>
</tr>
<tr>
<td>Well child visit</td>
<td>Regular visit with pediatrician</td>
<td>[identify CDT codes]</td>
</tr>
</tbody>
</table>
**Current Care Measures**

- Throughput...
- Admissions
- Discharges
- ...daily care...
- ...aggregated over a month...
- ...yields a measure of process reliability ("% conformance")...
- ...viewed over time.

**Algorithm** provides criteria for process quality

**Typical Current Care Questions**

- Did we do the right thing for patients last month (week, quarter)? How reliable is care?
- When we failed to do the right thing, why? What are the sources of process failure?
- What can we expect next month? What can we tell our patients? Leadership? Payers?
- Are our ongoing efforts to improve care processes having the desired impact? Should we change course or push ahead?
Population Measures

Throughput = visits...

...with reliable care process...

Population: who’s health are we responsible for?

...have an incremental impact on population.

Typical Population Questions

- What is the current state of the population for whom we are responsible (even those we haven’t seen for awhile?) re: Health status? Pt. Experience? Cost of care?
- How do our population’s risk factors and outcomes compare with those of other provider organizations?
- How should we plan for the long term?
- What has the impact of our improvement work been on the population? Are there other factors effecting changes in outcomes?
Outpatient ‘Look-Back’ Measures

Percent of population with current self-management plan as of most recent visit within the past 12 months.

- Current test
- No current test

67%

73%

Each measurement contains mostly the same patients as the previous month. These measures are slow to show improvement, but reflect the state of care for the population!

“Current Care” Measures

Percent of patients seen last month who lacked an up-to-date A1C and who got the test during the visit or were referred.

- Current test
- No current test

100%

80%

100%

Etc...

Each subgroup contains different patients & represents current work. These measures are great for tracking process changes!
Outpatient Populations

Patients enter a population by birth or immigration, or because they age-in.
- They exit by death, emigration, or because they age-out.
- That means that different patients are measured at different points in time.
- This can interfere with measures of improvement.
- This is a severe issue when measuring outcomes in pediatric populations with narrow age limits.

The faster the turnover, the more severe the problem.
Did We Improve?

- New patients entering the population dilute the population measure with 'unimproved' patients.
- These patients have had NO exposure to improvement interventions.
- These patients have had FULL exposure to our improvement interventions.

Cohorts

- A cohort measures a group of patients as they move through the population. The impact of the intervention is clearer.
- These patients have had NO exposure to improvement interventions.
- These patients have had FULL exposure to our improvement interventions.
Exercise

- Own Project
  - Choose one outcome and one process measure. Draft an operational definition for each.
  - How do your measures relate to the attributes of useful improvement measures?
  - Discuss at your table
- Share your insights

Measuring Process Reliability
Measuring Reliability

Reliability =

\[
\text{Number of Actions That Achieve The Intended Result} \div \text{Total Number of Opportunities for Action} = \text{‘Percent Conforming’}
\]

Many standard healthcare process measures are percent conforming. Process goals are ‘baked into’ the measures.

**Catheter Insertion Process**

- Proposal that patient requires urinary catheter
- Indications are appropriate?
  - Yes
  - Alternative methods available?
    - No
    - Check pt. for past problems, allergies, etc.
    - Stop
  - Yes
- Put on personal protection equipment (PPE) and sterile gloves
- Explain procedure to pt. and/or caregivers
- Decontaminate hands
- Clean and prepare the work area, assemble materials
- Put on personal protection equipment (PPE) and sterile gloves
- Prepare patient
- Is the patient male?
  - Yes
  - Follow male procedures for urinary catheter insertion
  - Dispose of equipment and materials in designated bag. Remove PPE and wash hands
  - Record patient experience, document technical specifications and time of completion into the chart
  - A
  - B
  - % of males with proper insertion procedure
- No
  - Follow female procedures for urinary catheter insertion
- % of females with proper insertion procedure
Examples of % Conforming Measures

- Percent of diabetic patients with foot exams at previous visit
- Percent of surgeries with checklist completed
- Percent of sepsis patients with antibiotics administered within 1 hour of recognition of sepsis.
- Percent of bundle CLBSI bundle elements completed for lines inserted last week
- Percent of patients who received all VAP bundle elements

Getting Reliable One Step at a Time

What Can Go Wrong in a Process?

Problems in hand-off between steps

Problems in execution within steps

Source: Peter Margolis, CCHMC; Moira Inkelas, UCLA
Every Step Counts

How many people get what they need from a process that has multiple steps – if there is 90% reliability in each step?

Example

What proportion of parents with a young child leave a dental visit with a written idea about how they can improve their child’s oral health?

Source: Peter Margolis, CCHMC; Moira Inkelas, UCLA

Source: Moira Inkelas, UCLA
### How Reliable Does Each Step Need To Be?

**What if we have a one step process?**

<table>
<thead>
<tr>
<th># of Steps</th>
<th>Probability of Success, Each Step</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.95</td>
</tr>
<tr>
<td>1</td>
<td>95%</td>
</tr>
<tr>
<td>10</td>
<td>60%</td>
</tr>
<tr>
<td>25</td>
<td>28%</td>
</tr>
<tr>
<td>50</td>
<td>8%</td>
</tr>
</tbody>
</table>

Cells within the table show how often people will receive the care, in the overall system, under different levels of reliability. Multi-step processes, which are typical in complex systems, require very high consistency in each step.

### How Reliable Does Each Step Need To Be?

**What if we have a ten step process?**

<table>
<thead>
<tr>
<th># of Steps</th>
<th>Probability of Success, Each Step</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.95</td>
</tr>
<tr>
<td>1</td>
<td>95%</td>
</tr>
<tr>
<td>10</td>
<td>60%</td>
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</tr>
</tbody>
</table>

Cells within the table show how often people will receive the care, in the overall system, under different levels of reliability. Multi-step processes, which are typical in complex systems, require very high consistency in each step.
### How Reliable Does Each Step Need To Be?

What if we want >95% reliability in a process with 25 steps?

<table>
<thead>
<tr>
<th># of Steps</th>
<th>Probability of Success, Each Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.95 0.99 0.999 0.999999</td>
</tr>
<tr>
<td>10</td>
<td>0.95 0.99 0.999 0.999999</td>
</tr>
<tr>
<td>25</td>
<td>0.95 0.99 0.999 0.999999</td>
</tr>
<tr>
<td>50</td>
<td>0.95 0.99 0.999 0.999999</td>
</tr>
</tbody>
</table>

#### Staph aureus (SA) Screening and Decolonization Process Example

1-4 weeks pre-procedure

- Schedule procedure
- TK or TH?: Yes or No

2-3 weeks pre-procedure

- “What lab result for SA culture?”
- “Inform patient of SA screening”

Day of surgery

- “Pt presents for nasal swab”
- “Positive for SA?”
- “Process specimen”
- “Results to surgeon & hospital”

- “Contact patient”
- “Prescribe 5-day mupirocin”
- “Confirm Rx complete”

- “Document in record”
- “Surgery”

**KEY RELIABILITY MEASURE**

- % of colonized patients with completed Rx

Source: IHI Project Joints
**Staph aureus (SA) Screening and Decolonization Process Example**

1-4 weeks pre-procedure

**Scheduling**
- Schedule procedure
  - Yes
    - Insert lab request for SA culture
    - % of cases with missing lab order
  - No
  - Patient presents for nasal wash
- TKA or THA?
  - Yes
    - Inform patient of SA screening
    - % of no-shows for nasal wash
  - No
  - Notify hospital

2-3 weeks pre-procedure

**Lab**
- Time to receive lab results
  - Yes
    - Process specimen
    - Results to surgeon & hospital
    - % of positive results not acted on
    - Time to notify patient
    - % completing Rx
  - No
    - Notify hospital

Day of surgery

**Hospital/Support**
- Confirm Rx complete
- Document in record
- Prescribe 5-day mupirocin
- Process 5-day mupirocin
- Notify hospital
- % of cases with missing lab order
- Time to receive lab results
- Time to notify patient
- % completing Rx
- % positive results not acted on
- % of colonized patients with completed Rx

Front line staff responsible for identifying process failures and REASONS!

Source: IHI Project Joints
Combining Measures

- Assessing care quality may require a combination of several measures (aka a ‘bundle’).
- Needed when optimal care requires reliable provision of multiple services
- Examples
  - **Diabetes**: medications, assessment, counseling
  - **VAP**: Elevation, “Sedation vacations,” Extubation on time, Peptic ulcer prophylaxis, DVT prophylaxis, Chlorhexidine oral care
  - **Central line infections**: Hand hygiene, Barrier precautions at insertion, Chlorhexidine skin antisepsis, Catheter site selection, Prompt Removal
  - **SSI**: Antibiotic selection & timing, normothermia, glycemic control, clippers, etc.
**Example: Diabetes Care Measures**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of patients with A1c &lt; 7</td>
<td></td>
</tr>
<tr>
<td>% of patients with BP &lt;= 130/80</td>
<td></td>
</tr>
<tr>
<td>% of patients with LDL &lt; 100</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of patients with &gt;= 1 LDL</td>
<td></td>
</tr>
<tr>
<td>% of patients with &gt;= 2 A1c</td>
<td></td>
</tr>
<tr>
<td>% of patients with foot exam</td>
<td></td>
</tr>
<tr>
<td>% of patients with eye exam</td>
<td></td>
</tr>
<tr>
<td>% of patients with microalbumin screen</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Balancing</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual cost / patient</td>
<td></td>
</tr>
<tr>
<td>Cycle time</td>
<td></td>
</tr>
<tr>
<td>Staff satisfaction</td>
<td></td>
</tr>
</tbody>
</table>

**Measuring Process Reliability**

<table>
<thead>
<tr>
<th>Single measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of patients with &gt;= 1 A1c</td>
<td></td>
</tr>
<tr>
<td>Etc.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>All or nothing measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of patients with all of the following care components:</td>
<td></td>
</tr>
<tr>
<td>• LDL test</td>
<td>• Foot exam</td>
</tr>
<tr>
<td>• A1c test</td>
<td>• Eye exam</td>
</tr>
<tr>
<td>• Microalbumin screen</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Composite ('opportunities') measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of successful opportunities for appropriate care across all patients</td>
<td></td>
</tr>
<tr>
<td>Total opportunities (i.e. # measures * # patients)</td>
<td></td>
</tr>
</tbody>
</table>
Calculating Reliability Bundle Measures

<table>
<thead>
<tr>
<th>Pt</th>
<th>A1c test</th>
<th>LDL screen</th>
<th>Eye exam</th>
<th>Foot exam</th>
<th>Microalb</th>
<th># Successful opportunities</th>
<th>All components?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>5</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>3</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>3</td>
<td>No</td>
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<tr>
<td>7</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>3</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>5</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
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<td>No</td>
<td>No</td>
<td>Yes</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>10</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>5</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Performance: 36/50 (72%) 3/10 (30%) 7/10 (70%) 5/10 (50%) 6/10 (60%) 8/10 (80%) 9/10 (90%)

Composite measure = (# successes) / (# opportunities) = (5+4+3+3+5+2+5) / (10x5) = 72%
All-or-nothing measure = 3/10 = 30%

Integrated Use of Measures

- Single measures are useful for monitoring process testing
- All-or-nothing (‘bundle’) measures are the ultimate goal (patient receives all components of appropriate care)
- Composite measures are useful for measuring improvement across processes: they are sensitive to process changes.
- General approach:
  - ✔ Composite measure to track and verify progress
  - ✔ Bundle and outcome measures as ultimate goals
Data Collection

- Data for PDSA testing
- Concurrent data collection
- Segmentation
- Sampling

Project Data Collection

- Existing EMR system
  - PRO: data collected as component of routine care
  - CON: needed process measures may not be included; data may lag by weeks or months; process failures lack context; usually requires custom reports
- Paper chart review
  - PRO: notes may provide useful context; may be necessary if no electronic system
  - CON: labor intensive (but sampling helps); data may lag by days or weeks
- Concurrent log or registry
  - PRO: ad hoc data can target PDSAs, project measures; no lag; context available;
  - CON: extra work for caregivers; special data process necessary
Sampling

... when you can't measure the entire population, you can estimate its characteristics by sampling

- Systematic sampling
- Random sampling
- Stratified sampling
- Convenience sampling
- Judgment sampling

Sampling Methods

Convenience Sample

"Gosh I'm in a hurry. Why don't I just review these?"

Source: R. Lloyd
**Sampling Methods**

**Simple Random Sample**

Every element has an equal chance of being selected.

**Sampling Methods**

**Systematic Sample**

First element selected at random...

...then select every r\textsuperscript{th} element

You might survey every 10\textsuperscript{th} patient who arrives at a clinic beginning at a randomly selected time.

Possible bias if there are patterns in the sequence of elements.
**Sampling Methods**

**Judgment Sample**

Especially for PDSA testing, someone expert with the process selects items to test & measure:

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

**What Sample Size?**

To be useful, samples should be large enough to reveal improvement shifts and trends.

- This also depends on magnitude of the change, and the inherent variability of the measure.
- 30 is a good rule of thumb for current care measures
- You can approach this issue empirically
- Don’t sample unless you need to
- Small samples ok for PDSA testing
What Sample Size is Adequate?

Length of Stay for ED Discharged Patients
(sample of 1 patient per week)

Avg=135, SD=35

Avg=180, SD=50

What Sample Size is Adequate?

Median Length of Stay for ED Discharged Patients
(sample of 14 patient per week)

Avg=180, SD=13.4

Avg=135, SD=9.4
What Sample Size is Adequate?

Median Length of Stay for ED Discharged Patients
(sample of 28 patient per week)

Avg = 180, SD = 9.4

Avg = 135, SD = 6.6

Tracking Change– Segment by Segment

Jan 10 — Mar 11

Segment 1 - Pilot

Segment 2

Segment 3

Chart showing improvement in median length of stay over time, with a decrease from an average of 180 minutes (SD = 9.4) to 135 minutes (SD = 6.6) over the course of 29 weeks.
Segmentation

By
- Organization
- Site
- Provider
- Region
- Diagnosis
- Patient process ‘trajectory’

Exercise

- How did the CAUTI team approach their data collection task?
- Own Project
  - What data are available to support your improvement measurement plan? Is it possible to gather concurrent data?
  - What are some of the change ideas that you will test? What data will be needed to assess their impact? How will you gather those data?