Thank you for enrolling in our upcoming Forum Minicourse on *Better Quality Through Better Measurement*.

We are looking forward to this exciting opportunity to work with you in a new way this year. IHI’s ‘Flipped Classroom’ format promises to accelerate and reinforce learning with a combination of pre-workshop preparation and additional hands-on activities during the Minicourse in Orlando.

This document will help you prepare for the session and make the most of our time together. Note: Although the case study is based on several actual improvement initiatives and draws upon the infection control literature and government sources, it is fictitious and does not reflect care at any specific institution or facility.

**THE ‘FLIP’**

Our aim for this course is to maximize your learning about the practical application of improvement measurement principles. In the spirit of continuous improvement, we are testing this approach, based on proven adult learning methods. In place of the lengthy lecture and Q&A format, we will ‘flip’ the classroom. We are asking you to spend a couple of hours prior to the session to become familiar with the basics of quality improvement measurement. This involves:

- Reviewing the case study presented below
- Reading the supplementary materials provided
- Viewing IHI videos related to measurement topics.

Completing these pre-work assignments will allow us to apply and practice the various milestones in the quality measurement journey. As you review this background material, we encourage you to relate the concepts and principles to a topic or project that is relevant to your own personal situation; when we gather in Orlando, we will supplement PowerPoint presentations with exercises and plenty of Q&A and discussion. Your ‘prework’ prior to the session will prepare you to learn more effectively and to apply the principles to your own work situation more quickly.
THE ASSIGNMENT

Please complete the three steps outlined below:

1. The following materials will provide background for your quality measurement journey:
   
   - You should also explore the IHI Whiteboard videos by Dr. Lloyd (3-6 minutes each) that cover a variety of topics from the Model for Improvement, PDSA cycles, driver diagram, building measures, static and dynamic displays of data, flowcharting, as to run and control charts. The Whiteboard videos can be found at http://www.ihi.org/education/IHIOpenSchool/resources/Pages/BobLloydWhiteboard.aspx
   
   - For further background on quality measurement concepts and tools, review the following publications:
     
     
     

2. Review the CAUTI case study (below), which outlines the basic principles and tools of devising measures for a QI initiative.

3. Select a topic or problem in your own work experience for which you need to measure improvement.

DURING THE WORKSHOP, we will call for volunteers to share their own aims, measures, driver diagrams, measure trees, and other work with the rest of the participants. In the spirit of ‘all teach, all learn’ we encourage you to be prepared to share your work!

CHOOSING AN ‘OWN’ PROJECT

Adults learn best when they are able to connect new information to familiar situations. As you review these prework materials, think of a problem or goal that your organization is currently seeking to improve. In the callout boxes below, we will prompt you relate the ideas in the case study to your own project.

During our workshop in Orlando, we will give you an opportunity to elaborate some of the tools and methods outlined in the case for your own project. Discussion with your peers and the workshop faculty will provide fresh insights and feedback to enable you to apply the methods when you return to work.
THE CAUTI CASE STUDY

1. Background: Reducing Catheter Associated Urinary Tract Infections (CAUTIs)

A medium sized acute care hospital has noticed that there has been an increasing occurrence of catheter associated urinary tract infections (CAUTIs) over the past year. Not only has the occurrence of CAUTIs been gradually going up but also the severity of the infections has been increasing.

Indwelling urinary catheters are commonly used medical devices within acute and non-acute settings. But their use does increase the risk of CAUTIs by:

- Enabling organisms to gain entry to the bladder via external surface or opened connections
- Reducing the body’s defense of flushing out organisms during urination
- Facilitating biofilm formation

Reducing CAUTIs would contribute to:

- Improving the patient experience
- Reducing the cost of antibiotic prescribing
- Reducing inpatient length of stay
- Reducing readmissions
- Improving patient outcomes

2. Organizing the Initiative

A core improvement team was identified, which included an Executive Sponsor, a Project Manager, an Improvement Advisor, a staff urologist with a keen interest in CAUTI reduction, a Staff Development representative, clinical nurses from an ICU and a general med/surg unit, an Infection Control nurse and a member of the Patient and Family Engagement team.

The team reviewed infection data for the past 17 months, and created a control chart to assess the current state of the system. The chart below is a u-chart which is used for rate based measures such as the CAUTI rate per 1000 Foley days.

For Your Own Project

- What are you trying to accomplish (your aim?)
- What is the outcome measure that best captures the aim of your project?
- What is the baseline level of performance on the outcome? How much does the outcome need to improve?
The graph shows the number of CAUTI infections per 1000 catheter days. Since the risk of a UTI is roughly proportional to the time that the catheter is in place, this measure adjusts for patients with longer or shorter catheter durations. The graph is a U-type control chart, which is appropriate for rates. The chart exhibits a strong special cause – 8 sequential points below the mean from Dec-12 through Jul-13 – which is consistent with a rising rate of infections since that time.

The team also reviewed benchmark data from comparable institutions that revealed a median of 2.31 and a 10th percentile of 1.60 CAUTIs per 1000 Foley days.

After considerable discussion of the current state of their system and the potential for successfully completing an improvement initiative to reduce CAUTIs, the team formulated the following aim statement:

**AIM: Reduce CAUTI infections in all units below 1.6 (10th percentile) within 12 months and to zero within 24 months.**

3. Developing an Improvement Theory

Led by the infection control nurse with the assistance of the team Improvement Advisor (IA), the team reviewed literature from the CDC and other sources, and constructed a *driver diagram* to capture their best thinking about what factors would be important for achieving their aim.

For Your Own Project

- What are the factors that will drive improvement in your system?
- What changes will need to occur to achieve your aim?
4. Identifying Outcome Measures

The outcome measure for the CAUTI initiative is based on standard industry practice. As noted above, it is the infection rate: the number of infections per 1000 Foley catheter days.

In addition to the rate, the team felt that it was important to track the number of infections. Since this is the count of actual patients who suffered avoidable harm, it more directly engages staff in adhering to prevention procedures.

5. Identifying needed process measures

In discussion with their infection control specialists, the team identified secondary drivers that would have the highest impact on infection rates. (Note: The letter/number references below – e.g. S4, S7 – refer to the Secondary Drivers in the driver diagram on the previous page.)

- **S4**: Insert catheters only for appropriate indications. The most effective way to eliminate the possibility of a CAUTI is to eliminate an unneeded catheter.

- **S7**: Remove when no longer required. Since the risk of infection is roughly proportional to the time the catheter is in place, removing catheters as soon as possible will reduce the risk.
• **S9: Standard insertion procedure.** If trained staff follow strict protocols for aseptic insertion of catheters, the risk of bacterial infection will be minimized.

• **S11: Standard cleaning and maintenance procedure.** Similarly, careful adherence to the components of the maintenance bundle will reduce risk.

These drivers involve care processes that are critical to reducing CAUTI risk. The improvement initiative will concentrate on increasing the reliability of these processes. To track the progress of their work, the team will measure these processes for change over time as well as the number of CAUTIs and the CAUTI rate.

6. Defining the measures

The Improvement Advisor led a session to acquaint the team with the principles of good improvement measure design. She stressed that to be useful for guiding improvement, measures must have certain attributes. The IA used the following slide as a guide for the discussion.

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

After considerable discussion about the attributes of various alternatives, the team settled on a set of 6 measures for their project.

For Your Own Project

• What are the key processes or other drivers that will need to be improved to achieve your aim?

• What measures might you use to track improvement in those processes?
They then created a *measure tree* diagram (below) in order to further clarify their measures and to support a discussion with their infection control staff and clinicians.

A measure tree shows the relationship between measure’s numerator and denominator. In this case measures will be reported once per month. Note that item D3,N2 is both the denominator for M4 and the numerator for M2. Similarly, item N3,M3 is the numerator for M4 and a measure in its own right: ‘Count of CAUTIs in the measurement month’.

**Process Measures**

D1 is the count of patients with catheters; N1 is the subset of those patients who met criteria for a catheter. These two counts yield the percentage of patients for whom catheters were appropriate. Increasing this number indicates progress on Secondary Driver S4.

The table below shows the relationship between measures and drivers.

**For Your Own Project**

- Consider the numerators and denominators you will need to calculate the key process measures for your system.
<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
<th>Process/Outcome</th>
<th>Subprocess</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>Percent of patients with appropriate catheter placements</td>
<td>Process</td>
<td>S4 Insert catheters only for appropriate indications</td>
<td>Increase</td>
</tr>
<tr>
<td>M2</td>
<td>Average catheter duration</td>
<td>Process</td>
<td>S7 Remove when no longer required</td>
<td>Decrease</td>
</tr>
<tr>
<td>M4</td>
<td>CAUTIs per 1000 patient days</td>
<td>Outcome</td>
<td>N/A</td>
<td>Decrease</td>
</tr>
<tr>
<td>M3</td>
<td>Count of CAUTIs</td>
<td>Outcome</td>
<td>N/A</td>
<td>Decrease</td>
</tr>
<tr>
<td>M4 (alternate)</td>
<td>Catheter days between CAUTI events</td>
<td>Outcome</td>
<td>N/A</td>
<td>Increase</td>
</tr>
<tr>
<td>M5</td>
<td>Percent of catheter insertions with all insertion bundle elements in compliance</td>
<td>Process</td>
<td>S9 Standard insertion procedure</td>
<td>Increase</td>
</tr>
<tr>
<td>M6</td>
<td>Percent of catheter placements with all maintenance bundle elements in compliance</td>
<td>Process</td>
<td>S11 Standard cleaning and maintenance procedure</td>
<td>Increase</td>
</tr>
</tbody>
</table>

**Notes on the Measures**

**M4** (alternate): Should the infection rate (number of CAUTIs per 1000 catheter days) become very low, months can go by with no CAUTIs at all, and graphs of the measure become difficult to interpret. Hence the team specified an additional measure, *Catheter days between CAUTI events*. This measure can reveal increasing intervals between infections, thus tracking improvement even when CAUTIs are rare.

**M5, M6**: The measures of insertion procedure and maintenance procedure are both *all-none* reliability measures (aka 'bundle measures'). Because effective infection control requires adherence to multiple steps in the insertion and maintenance protocols, these measures require that all of the protocol elements be successfully enacted in order to be counted in the numerator of the measures. In addition, M6 requires that the maintenance protocol be enacted perfectly for every day that the catheter is in situ.

### 7. Operational Definitions and the Measurement Plan

The specifics of measurement are captured in operational definitions, which describe step-by-step procedures for calculating a measure, along with the data elements, criteria for inclusion and exclusion, and other details needed to ensure that measures are consistent over time and comparable across settings.

For Your Own Project

- Identify key terms that appear in your measures: can you define them in specific detail to enable someone else to calculate the value?

Note that the details of clinical operational definitions can be quite complicated, including specific diagnostic codes, risk factors, treatment types, or lab results. For example, CDC guidance on identifying catheter-associated urinary tract infections includes the following:
NOTE: The details of operational definitions are often subject to much discussion or disagreement by clinical staff. Even measures approved by national professional groups or accreditation organizations may not be readily accepted by all clinical faculty. Thus it is important that an organization embarking on an initiative like the one described here work with staff to develop standard definitions of key clinical concepts that can form the basis for consistent operational definitions.

8. Process Map

Based on their driver diagram and the informed opinion of the nursing staff, the team decided to focus their initial work on the catheter insertion process on Floor 7 in the South Wing of the hospital (a critical care unit) in order to begin testing process changes to increase the reliability of insertion bundle compliance. In preparation for the meeting, the team drafted the following process map, which served to organize discussion about process problems that needed attention.
9. Logging Data, Diagnosing Process Failures and Testing Changes

In order to track the impact of their process changes, and to gather useful information about bundle failures, the team created a 'Foley Log' for Floor 7; the nurse supervisor (a member of the QI team) was tasked with logging each catheter insertion, including patient number, compliance with each of the bundle elements, reasons for non-compliance, and any contextual issues that might affect reliability. During the first month of the project, they organized their data into the following Pareto Chart, which revealed multiple lapses in documentation and technique.
In order to improve CAUTI bundle compliance, the team began a series of PDSA cycles to address problems revealed in their Pareto analysis. The team tested detailed process changes involving the following ideas:

- Provide a daily review of catheter documentation in connection with Foley Log
- A checklist of required indications for catheterization, with suggested alternatives
- Standardize catheter manufacturer
- Assemble standard ‘Foley kits’ that include catheters of various lengths, visual aid for insertion procedures, and a checklist
- Spot observations of aseptic technique including hand hygiene
- Maintain a sterile, continuously closed drainage system
- Keep collection bag below the level of the bladder at all times
- Empty collection bag regularly, using a separate collecting container for each patient, and avoid allowing the draining spigot to touch the collecting container

During PDSA testing the team used a number of ‘PDSA measures’ to assess the impact of the changes. For example, they tracked the contents of the catheter kits, and when items were initially missing they tested a stocking process to ensure that the kits were complete. They

For Your Own Project

- What changes have you identified that can improve the drivers of your aim? How can you test them on a small scale?
- How will you measure and communicate the impact of your changes?
kept close track, via direct observation, of hand washing technique, and gave feedback on proper procedures. They used a ‘mini checklist’ on index cards to measure the reliability of the bag emptying process. These items were reviewed with project staff each day during shift changes.

10. Results

The team recorded bundle compliance on a weekly basis. The following run charts show results for measures M5 and M6 over the course of the succeeding four months. These graphs were posted in the break room on Floor 7, and updated weekly. Results were reviewed in staff huddles at shift changes on Mondays.

In addition to the positive trends in the bundle measures, staff report that checklist and documentation compliance is high, and that the situational awareness of staff during insertion and maintenance procedures has been good.

The key outcome measure, CAUTI rate, is shown in the following U-Chart. While it is too soon to say that the project has prompted a drop in infections, the team is encouraged by the last three months’ data, which correspond well with the increases in CAUTI bundle compliance.

For Your Own Project

- How can you provide feedback to your team about progress? What opportunities will you have to discuss changes, testing, and data? Who needs to be involved in those discussions?