Health Care Accreditation Council
Quality Health Care Conference & Exhibition 2010

Applying a Reliable Design Framework to Improve Quality of Care for Your Patients

CASE STUDY: IMPLEMENTING THE VENTILATOR-ASSOCIATED PNEUMONIA (VAP) PREVENTION BUNDLE
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DISCLAIMER
The views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government. The data presented in this case study are from a facility assisted by Scottish Patient Safety Programme (SPSP) and the Scottish Intensive Care Society (SCIS). Names and locations have been changed for confidentiality purposes.
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Applying a Reliable Design Framework to Improve Quality of Care for Your Patients

**Introduction:** The Scottish Patient Safety Programme (SPSP) and the Ventilator Associated Pneumonia (VAP) Prevention Bundle

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*Nolan Model Diagram; Associates in Process Improvement (API)*
Introduction: The Scottish Patient Safety Programme (SPSP) and the Ventilator Associated Pneumonia (VAP) Prevention Bundle
Applying a Reliable Design Framework to Improve Quality of Care for Your Patients

Workshop Agenda and Goal

- Mini Plenary
- Case Study
- Planning Sheet

Each participant should come away from this workshop with a plan to implement a quality improvement project in their facility using a reliable design framework.

High-Reliability
Reliability

“Reliability is failure free operation over time”
David Garvin
Harvard Business School

“When applied to clinical processes consider the viewpoint of the patient by invoking the all or nothing measure”
IHI Innovation Team

Why Reliable Design?

A Reliable Design Framework will allow you to ensure that the critical processes at your facility are implemented consistently and successfully.

“Average number of ventilated days per month has fallen from a median of 6.7 days to 5.5 days. This has been sustained. Currently the last episode of VAP was > 400 calendar days ago.”
Malcolm Daniel,
Glasgow Royal Infirmary

Premises – IHI Innovation Team

For healthcare processes where failure does not cause immediate catastrophic consequences:

• 80% performance lacks consistent clear understanding of the process (5 front line process users can not easily articulate the process)

• 95% performance has some variation but 5 front line users can easily articulate the process
What does it mean to be 80% reliable?
Which processes do we want to be at 95% or better?

Non Catastrophic Processes

- Definition: Failure of the process does not lead to death or severe injury within hours of the failure
- Less than 95% performance or worse is most commonly seen in these processes (hand-washing as an example)
- Poor outcomes do not occur with each defect due to either to biologic or system resilience

The Scottish Patient Safety Programme (SPSP) and the Ventilator Associated Pneumonia (VAP) Prevention Bundle
The Ventilator Associated Pneumonia (VAP) Prevention Bundle

1. Sedation to be reviewed and, if appropriate, stopped each day;
2. All patients will be assessed for weaning and extubation each day;
3. Avoid the supine position, aiming to have the patient at least 30 degrees head up;
4. Use chlorhexidine as part of daily mouth care; and
5. Use subglottic secretion drainage in patients likely to be ventilated for more than 48 h.

Implementation of the VAP Bundle

GRI VAP Prevention Bundle
Sampled one day per week - varied day
Aim >95% Reliability by May 2009
All 4 components of bundle
30° head up
Chlorhexidine used as part of daily mouth care
DG sheet -
Wi ti
hd
Re-testing at daily goals: handing script, using script,
AIM - how much by when

How was this achieved?

...through Quality Improvement
QI Overview

“Crossing the Quality Chasm” IOM 2001: “Between the health care we have and the care we can have lies not only a gap, but a chasm” … “the problems come from poor systems – not bad people”

Fundamental Concept of Improvement: “Every system is perfectly designed to achieve exactly the results it achieves”

Principles of Improvement:
- Understanding work in terms of processes and systems
- Solutions by teams of health care providers
- Focusing on patient needs
- Testing changes and measuring results

*Nolan Model Diagram, Associates in Process Improvement (API)*
Section 1: Identify Your Improvement Aim and Targets
Section 1: Identify Your Improvement Aim and Targets

Where do Topics for Aim Statements come from?

Depending on the scale, topics can come from:
- Existing NHS/MOH/MOPH priorities
- Data (ex: existing reports, baseline assessment studies) that show were need is greatest
- Priorities recognized by donors and funders
- Patients, staff, practitioners, communities, other stakeholders
A Good Aim Statement Has

- A defined **boundary** that specifies the scope of the improvement goal
- Specific **numerical goals** for **outcomes** that are ambitious but achievable
- A **timeframe** (how much improvement by when?)
- **Guidance** on how the aim will be achieved

Lloyd & Associates, 2008

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**Escalating Scale of Reliability**

**Chaotic processes:**
- Failure in 2 or more out of 10 times
- 80% or lower success rate

**Stable processes:**
- Less than 2 failures out of 10 times
- Better than 80 or 90% success rate

**Reliably Designed Processes:**
- Less than 5 failures out of 100 times
- Better than 90% success rate

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**Case Study: Example of an Aim Statement**

Identifies the:
- Outcome
- Core Process
- Methods
- Reliability Goal
- Timeframe

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Exercise 1: Develop your own Aim Statement

In your *workbook*, develop your own aim statement

In *group discussions* at your table, share and discuss your aim statements
Case Study Part 1: Reducing VAP Incidence

The NHS in Scotland has adopted a national approach to improving the quality of health care and has enlisted the technical support of the institute for Healthcare Improvement (IHI) through the Scottish Patient Safety Programme (SPSP).

The goal of the SPSP is to improve the safety and reliability of hospital care across the country and they have identified prevention of Ventilator Associated Pneumonia (VAP) as a high priority for their hospitals to address. All hospitals in the country participated in the national effort to reduce VAP through the application of five interventions known as the VAP prevention bundle.

The five interventions of the VAP prevention bundle, which can prevent most cases of VAP if done consistently for every patient on ventilation are:

1. Sedation to be reviewed and, if appropriate, stopped each day;
2. All patients will be assessed for weaning and extubation each day;
3. Avoid the supine position, aiming to have the patient at least 30 degrees head up;
4. Use chlorhexidine as part of daily mouth care; and
5. Use subglottic secretion drainage in patients likely to be ventilated for more than 48 h.

The Director of one participating hospital, Dr. Khaled knows the five interventions that can prevent VAP in most cases and that his staff have the necessary resources to complete them for all patients. The problem is that, while most of the interventions are made for most patients, many patients are not receiving all of them and VAP is occurring regularly in the hospital. They have no way to ensure that all patients are receiving all five interventions of the bundle every time.

Dr. Khaled wants to reduce the incidence of VAP and knows that they will be able to if they can consistently deliver the entire bundle. Ensuring that this will happen requires creating a system to ensure that each patient receives the same treatment by the same process. Staff may need additional training or reminders, and a checklist should be developed. If they take these steps over the next few months, he believes that his hospital should be able to consistently deliver the bundle to at least 8 out of 10 patients within one year.

Once they have a system in place and are consistently completing all five interventions of the bundle that regularly, Dr. Khaled thinks it will take a few more months to fine-tune their systems so that they are able to work even more efficiently and consistently. Within one year of achieving a consistent system, he would like to see no fewer than 95% of patients on ventilators receive all five elements of the VAP prevention bundle.

Dr. Khaled crafted the following aim statement for his hospital:

“In our hospital, we will eradicate ventilator associated pneumonia by stabilizing our process for care for patients on ventilators to provide consistent care for at least 80% of patients within 12 months through implementation of the VAP prevention bundle.

We will then improve the success rate of that process to 95% within 12 months by incorporating contingencies, failure prevention, and other process improvement measures.”
Example 1: Establish Your Quality Improvement Aim

When answering these questions, you should remember that your goals should be ambitious, but achievable. An ambitious goal that is not realistic will demotivate you and your colleagues while a realistic goal that is not ambitious will fail to motivate you to make as much of a change as you are capable of making.

Where will your change be implemented:  Our hospital _______________________ (A)  
- A location such as a town, clinic, or office

What outcome are you trying to increase/decrease:  eradicate ____________________________ (B)  
- Should be a tangible result, such as a decrease or increase in some factor

What core process must you improve to achieve this outcome:  care for patients on ventilators ____________ (C)

When do you expect to see this process consistently implemented:  12 months _____ (E)  
- An amount of time or by a certain date

What will you do/use to achieve this result:  implementation of the VAP prevention bundle ____________ (F)  
- What tool, method, or resource will you employ to make the change?

After becoming consistent, how long do you think it will take to see your process improved to high reliability:  12 months ______________ (G)

Put together your responses to complete the aim statement for your improvement project:

In (A) our hospital _______________, we will (B) decrease the incidence of ventilator associated pneumonia ____________________________

by stabilizing our process for (C) care for patients on ventilators __________________ to provide consistent care for at least 80% of patients within (D) 12 months __________________ through (E) implementation of the VAP prevention bundle ______. We will then improve the success rate of that process to 95% within (F) 12 months ______________ by incorporating contingencies, failure prevention, and other process improvement measures.
Exercise 1: Establish Your Quality Improvement Aim

When answering these questions, you should remember that your goals should be ambitious, but achievable. An ambitious goal that is not realistic will demotivate you and your colleagues while a realistic goal that is not ambitious will fail to motivate you to make as much of a change as you are capable of making.

Where will your change be implemented: ____________________________________________ (A)
- A location such as a town, clinic, or office

What outcome are you trying to increase/decrease: __________________________________________ (B)
- Should be a tangible result, such as a decrease or increase in some factor

What core process must you improve to achieve this outcome: ____________________________ (C)

When do you expect to see this process consistently implemented: ___________________ (E)
- An amount of time or by a certain date

What will you do/use to achieve this result: __________________________________________ (F)
- What tool, method, or resource will you employ to make the change?

After becoming consistent, how long do you think it will take to see your process improved to high reliability: _________________________________________________________ (G)

Put together your responses to complete the aim statement for your improvement project:

In (A) ________________________________, we will (B) ________________________________ by stabilizing our process for (C) ________________________________ to provide consistent care for at least 80% of patients within (D) ________________________________ through (E) ________________________________. We will then improve the success rate of that process to 95% within (F) ________________________________ by incorporating contingencies, failure prevention, and other process improvement measures.
Section 2: The Quality Improvement Team
Section 2: The Quality Improvement Team

Why is teamwork important for improvement?

- Healthcare processes consist of inter-dependent steps that are executed by different people.
- Quality faults often occur in the hand-over between people.
- Given the opportunity, staff can often identify problems and generate ideas to resolve them.
- Participation improves ideas, increases buy-in, and reduces resistance to change.
- Accomplishing things together increases the confidence of each team member, which empowers organizations.
Teamwork
Steps and participants in a patient visit to the clinic

<table>
<thead>
<tr>
<th>Patient Arrives</th>
<th>Registration</th>
<th>Take Temperature</th>
<th>Doctor's Exam</th>
<th>Collect Tests</th>
<th>Specialists Exam</th>
<th>Patient Leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td>Receptionist</td>
<td>Nurse</td>
<td>Physician</td>
<td>Lab technician</td>
<td>Specialist</td>
<td>Patient</td>
</tr>
</tbody>
</table>

Case Study: An Improvement Team

Exercise 2:
Develop your own Improvement Team

In your workbook:

1) Referring back to your aim statement, consider the process that you want to improve.
2) Think of those responsible for each step in that process. A representative of each function should be on your improvement team.
3) Think about who else would be important to include on your improvement team, such as: management, practitioners, patients or groups representing patients, or other people involved in the system of care.

In group discussions at your table, discuss your teams.
Case Study Part 2: The NHS Greater Glasgow & Clyde

Dr. KHALED assembled his senior staff to discuss the VAP bundle. In their discussion, they looked at the entire process involved in putting patients on ventilators and providing care for them while they are on ventilators. There are quite a few steps in the process and these steps are completed by various doctors, nurses, and other staff at the hospital.

The only way to truly ensure that all elements of the VAP bundle are being consistently delivered is to involve everyone who contributes to the process in improving that process. By engaging employees in the process, Dr. KHALED hopes to achieve better results and develop more efficient ways to work. Also, by having each type of care provider represented in decision-making, he will bring a diverse and more complete understanding of the process of delivering care and how that operates in his hospital.

A core quality improvement team is needed because there are far too many employees in the hospital for everyone to feasibly attend meetings and guide improvements. To form this team, Dr. KHALED made a list of those involved in caring for patients on ventilators and tried to narrow down the team to include as many representatives as possible without making the team too large. He has many people to draw upon, but decided that more than 10 would be too many for him to gather and manage in a team.

The team began to meet every three months to discuss their progress in providing the VAP prevention bundle elements and reducing the incidence of VAP in the hospital.
Example 2: Form Your Improvement Team

Referring back to your aim statement, consider the process that you want to improve. Think of those responsible for each step in that process. A representative of each function should be on your improvement team.

Think about whom else would be important to include on your improvement team, such as: management, practitioners, patients or groups representing patients, or other people involved in the system of care.

Who is involved in the process you are changing that needs to be part of the team?

<table>
<thead>
<tr>
<th>What part of the process, what role?</th>
<th>Who?</th>
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</thead>
<tbody>
<tr>
<td>- Intubation of a patient</td>
<td>- Doctors (we have 20)</td>
</tr>
<tr>
<td>- Sedation reviewed and, if</td>
<td>- Supervising Nurses (we have 12)</td>
</tr>
<tr>
<td>appropriate, stopped</td>
<td>- Staff Nurses (we have 34)</td>
</tr>
<tr>
<td>- Patient assessed for weaning</td>
<td></td>
</tr>
<tr>
<td>and extubation</td>
<td></td>
</tr>
<tr>
<td>- Daily mouth care with chlorhexidine</td>
<td></td>
</tr>
<tr>
<td>- Subglottic secretion drainage</td>
<td></td>
</tr>
<tr>
<td>- Extubation</td>
<td></td>
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</table>

Are there other stakeholders or contributors that you have forgotten?

<table>
<thead>
<tr>
<th>How are others affected by or integral to this process?</th>
<th>Who?</th>
</tr>
</thead>
<tbody>
<tr>
<td>- ensure that the patient is sitting up at least a 30 degree angle</td>
<td>- Staff Nurses (we have 34)</td>
</tr>
<tr>
<td>- compile data on patient conditions and patient numbers</td>
<td>- Support staff (we have 28)</td>
</tr>
<tr>
<td></td>
<td>- Data Clerk (we have 3)</td>
</tr>
</tbody>
</table>

When you have filled in all of the individuals above, narrow down the group by circling those who are necessary to be involved. Of those remaining, will the team be able to function well and produce real effective change without them? Make sure all of the necessary people are included but that the team is not too large or to small to be able to function well. In many cases, the ideal team size is 7 to 9 people.
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Referring back to your aim statement, consider the process that you want to improve. Think of those responsible for each step in that process. A representative of each function should be on your improvement team.

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Section 3: Indicators and Measurement
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Why measure?

- If you don’t measure, what you are doing, how will you know if it is an improvement?
- If you don’t measure, how will you know what led to the improvement?

Ask: What is the minimum amount of measurement that you need in order to answer these questions?
How measurement should work:

• Should be linked to aims
• Should be used to guide improvement and test changes
• Should be integrated into the team’s daily routine.
• Will allow QI teams to learn
• Should concentrate on *key* measures—don’t overwhelm teams with endless data collection and analysis!

Types of Indicators

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<th>Input Indicators</th>
<th>Process Indicators</th>
<th>Output Indicators</th>
<th>Outcome Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient arrives</td>
<td>Patient moves through system</td>
<td>Short-Term Result</td>
<td>Long-Term Result</td>
</tr>
<tr>
<td># of staff trained in AMTSL</td>
<td>% compliance with AMTSL bundle</td>
<td>PPH Incidence Rate</td>
<td>Reduction in Maternal Deaths</td>
</tr>
<tr>
<td># of doses of Oxytocin supplied</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Qualities of a good indicator

- **Clear and unambiguous** (teams will not confuse what is meant by the indicator)
- **Quantifiable**
- Identifies the *source* of the data and the *person* responsible for collecting it
- Identifies a clear *numerator* and *denominator*
- Identifies the *frequency* with which the data should be collected
Percentages vs. Numbers Vs. Days Between

- Common and frequent events are usually measured in terms of percentages
- Less common events can be measured as a simple number of occurrences
- Very infrequent events can be measured in terms of the number of days in between occurrences

Implementation of the VAP Bundle

GRI VAP Prevention Bundle
Sampled one day per week - varied day
Aim >95% Reliability by May 2009

All 4 components of bundle
30° head up
Chlorhexidine used as part of daily mouth care

Daily Goals Sheet
Script of questions
Re-testing at daily goals: handing script, using script.

Case Study: The VAP Bundle

Indicator: VAP Bundle Implementation
Numerator: # of patients receiving 4 elements of the VAP bundle
Denominator: # of patients on ventilators
Source: Patient records
Person Responsible: Data clerk
Frequency: Patient records be reviewed for counts every Friday
Exercise 4: Develop indicators for your process

In your workbook, reflecting on your flowchart, propose:
• 1 process indicator
• 1 outcome indicator

Working in groups, discuss your proposed indicators.
Case Study Part 3: The Four Elements and All-Or-Nothing

As discussed, the bundle of recommended interventions that Dr. KHALED and his team want to see implemented consistently at their hospital has five elements:

1. Sedation to be reviewed and, if appropriate, stopped each day;
2. All patients will be assessed for weaning and extubation each day;
3. Avoid the supine position, aiming to have the patient at least 30 degrees head up;
4. Use chlorhexidine as part of daily mouth care; and
5. Use subglottic secretion drainage in patients likely to be ventilated for more than 48 h.

In January of 2008, the team started working on individual components of the bundle separately because they had no clear way of measuring whether or not each one is delivered successfully.

Number five was particularly challenging in that it is difficult to predict how long a patient will need to be on a ventilator for, particularly when a fair proportion of patients are intubated in A&E or the operating theatre. In addition, it turned out the hospital did not have subglottic secretion drainage endotracheal tubes in stock.

Despite this difficulty, the team still wanted to work on applying a consistent process to deliver the other interventions and agreed to focus on bundle elements 1 to 4. They agreed that if their rate of VAP did not improve with consistent application of the first four elements, they would add in the fifth one.

While they decided to drop the fifth element, they agreed that their process must include all four elements every time so that the true mark of their success will be the number of patients who receive the entire bundle. Any patient receiving less than all four remaining elements will be considered not to have received complete treatment.

Collecting data on this was still a challenge. Patient files do not reflect all of these steps in the process, certainly not what angle at which the patient is propped-up. A new checklist or form would have to be created to capture this data, using regular rounds as the timing for information to be recorded and assisting nurses and doctors caring for the patients to complete necessary actions. The interventions stated in the bundle cannot always be checked off as a simple “yes this was performed” or “no it was not” and frequently require more details or some form of ongoing activity. As a result, the team wanted to avoid simple “tick boxes” and will instead ask people to write out what was performed in each case.

The team drafted a Daily Goals Sheet to record all of this. Data would be compiled by the supervising nurses once a week on a rotating basis and the team agreed to continue modifying the sheet over time as time goes on. The data the nurses will assemble each week is simply the number of patients who receive all four elements of the bundle.

For this number to be useful, it has to be converted to a percent of total patients. The team realized that most of the information on numbers of patients on ventilators and indeed on incidence of VAP is readily available through patient files that are kept by the hospital’s data clerks.

To keep track of this indicator, the hospital’s senior Data Clerk was assigned to review the files of patients each week at the same time that the nurses review the Daily Goals sheets and report the total number of patients on ventilators and the total number of cases of VAP.

By calculating the percent of patients on ventilators who receive the four elements of the VAP bundle from the above data, the team defined their process indicator. This is the value that they want to see approach 100% as their process becomes more consistent.

While keeping an eye on whether or not they are delivering services, the team will also monitor the outcome of the process; whether or not their patients are acquiring VAP. The percent of patients acquiring VAP thus becomes their outcome indicator.
Example 3: Define Your Indicators

As you fill out the form below identifying your indicators, ask yourself whether or not they fulfill all of the following qualities:

- **Clear and unambiguous** (teams will not confuse what is meant by the indicator)
- **Quantifiable**
- Identifies the **source** of the data and the **person responsible** for collecting it
- Identifies a clear **numerator** and **denominator**
- Identifies the **frequency** with which the data should be collected

**Process Indicator:** This tells you whether or not your change is being implemented (what led to the improvement)

| **Indicator:** Describe what you are measuring | The percentage of patients on ventilators who receive all four elements of the VAP prevention bundle |
| **Numerator:** The number of times your process succeeded (or failed) | # of patients on ventilators who receive all four elements of the VAP prevention bundle |
| **Denominator:** The total number of times you ran your process | # patients on ventilators |
| **Source:** Where you are getting your data from | Daily goals sheets and patient files |
| **Responsible person:** Individual who will ensure that the data is collected and maintained. | The supervising nurses will compile patients who receive the bundle and the data clerks will count total patients |
| **Frequency:** How often it will be collected | Data will be compiled once a week on a rotating day |

**Output Indicator:** This tells you whether or not your change is making a real improvement (what is the improvement)

| **Indicator:** Describe what you are measuring. | % of patients on ventilators who acquire VAP |
| **Numerator:** The number of times your process was completed properly? | # of who acquire VAP |
| **Denominator:** The total number of times you ran your process | # of patients on ventilators |
| **Source:** Where you are getting your data from? | Patient files |
| **Responsible person:** Individual who will ensure that the data is collected and maintained. | the data clerks will count total cases of VAP and the number of patients on ventilators |
| **Frequency:** How often it will be collected | Data will be compiled once a week on a rotating day |
Exercise 3: Define Your Indicators

As you fill out the form below identifying your indicators, ask yourself whether or not they fulfill all of the following qualities:
- **Clear and unambiguous** (teams will not confuse what is meant by the indicator)
- **Quantifiable**
- Identifies the **source** of the data and the **person responsible** for collecting it
- Identifies a clear **numerator** and **denominator**
- Identifies the **frequency** with which the data should be collected

**Process Indicator**: This tells you whether or not your change is being implemented (what led to the improvement)

<table>
<thead>
<tr>
<th>Indicator:</th>
<th>Describe what you are measuring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numerator:</td>
<td>The number of times your process succeeded (or failed)</td>
</tr>
<tr>
<td>Denominator:</td>
<td>The total number of times you ran your process</td>
</tr>
<tr>
<td>Source:</td>
<td>Where you are getting your data from</td>
</tr>
<tr>
<td>Responsible person:</td>
<td>Individual who will ensure that the data is collected and maintained</td>
</tr>
<tr>
<td>Frequency:</td>
<td>How often it will be collected</td>
</tr>
</tbody>
</table>

**Output Indicator**: This tells you whether or not your change is making a real improvement (what is the improvement)

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<thead>
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<th>Describe what you are measuring</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Denominator:</td>
<td>The total number of times you ran your process</td>
</tr>
<tr>
<td>Source:</td>
<td>Where you are getting your data from?</td>
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<td>Responsible person:</td>
<td>Individual who will ensure that the data is collected and maintained</td>
</tr>
<tr>
<td>Frequency:</td>
<td>How often it will be collected</td>
</tr>
</tbody>
</table>
Section 4: The Time Series Plot
Section 4: The Time Series Plot

Elements of a Time-Series Chart

- Clear and well-defined title that includes what and when
- X and Y axes have clear scale and include indicator label
- Numerator and denominator values shown for each month
- Tested changes are annotated
- Numerator defined, including data source and sampling strategy
- Denominator defined, including data source and sampling strategy

Model for Improvement

What are we trying to accomplish?

How will we know that a change is an improvement?

What changes can we make that will result in improvement?

*Nolan Model Diagram, Associates in Process Improvement (API)
Case Study:
First Time-Series Chart

VAP Bundle Compliance
Selected one day a week - varied day

- All 4 components of bundle
- 30° head up
- Chlorhexidine used as part of daily mouth care
- Responsive to command; had sedation hold; or described exclusion
- Described weaning target or described exclusion

Exercise 4:
Plotting Your Own Time-Series Chart

In your workbook, fill out your time-series chart using the indicators you developed.

Working in groups, discuss your time-series charts.

Exercise 4:
Plotting Your Own Time-Series Chart

<table>
<thead>
<tr>
<th>Process indicator</th>
<th>Numerator: # of patients on ventilators who receive the full VAP prevention bundle</th>
<th>Denominator: # of patients on ventilators</th>
<th>Indicator: % of patients on ventilators who receive the full VAP prevention bundle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 0 1 2 2 3 3 3</td>
<td>5 6 3 5 6 4 6</td>
<td>20 0 33 40 64 50 50 50</td>
</tr>
</tbody>
</table>

Outcome

<table>
<thead>
<tr>
<th>Numerator: # of who acquire VAP</th>
<th>Denominator: # of patients on ventilators</th>
<th>Indicator: # of patients on ventilators who acquire VAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 1 2 1 1 0 1</td>
<td>5 6 3 5 6 4 6</td>
<td>45 17 67 20 33 17 0 17</td>
</tr>
</tbody>
</table>
Case Study Part 4: Collecting and Plotting the Data

In June 2008 overall reliability of the four recorded elements of the bundle (all-or-none) was only 35%.

Looking at their data, the team discussed their experience with providing each element of the bundle and trying to record data on it. While all four of the elements were being provided to the majority of patients, it was very surprising how few patients were actually receiving all four elements of the bundle.

Head of bed elevation and oral chlorhexidine were easier to complete while sedation holds, vacation, titration, and weaning plans were harder. Some changes needed to be made to the Daily Goals sheet. However, the data was complete enough to begin plotting a time series chart.

One member of the improvement team, was nominated to plot the data on time series charts for display in one of the hospital meeting rooms. The supervising nurses and the data clerk email him the patient numbers they collect each week and he adds it to their spreadsheet and prints an updated copy to post on the bulletin board.

The resulting charts and changes to the daily goal sheet are discussed in each team meeting.
**Example 4: Create a Sample Time Series Chart**

Complete the blanks below to create the run chart for your improvement project.

**Compliance with VAP Prevention Bundle and % of Ventilated Patients Acquiring VAP**

<table>
<thead>
<tr>
<th>Week</th>
<th>% patients receiving VAP bundle</th>
<th>% patients acquiring VAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>5</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>8</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process indicator</th>
<th>Numerator: # of patients on ventilators who receive the full VAP prevention bundle</th>
<th>Denominator: # patients on ventilators</th>
<th>Indicator: % of patients on ventilators who receive the full VAP prevention bundle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 0 1 2 2 3 3 3</td>
<td>5 6 3 5 3 6 4 6</td>
<td>20 0 33 40 67 50 75 50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome indicator</th>
<th>Numerator: # of who acquire VAP</th>
<th>Denominator: # of patients on ventilators</th>
<th>Indicator: % of patients on ventilators who acquire VAP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 1 2 1 1 1 0 1</td>
<td>5 6 3 5 3 6 4 6</td>
<td>40 17 67 20 33 17 0 17</td>
</tr>
</tbody>
</table>

**Notes:**
Exercise 4: Create a Sample Time Series Chart

Complete the blanks below to create the run chart for your improvement project.

(Title: Refer to your aim statement)

<table>
<thead>
<tr>
<th>Process indicator</th>
<th>Numerator:</th>
<th>Denominator:</th>
<th>Indicator:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome indicator</td>
<td>Numerator:</td>
<td>Denominator:</td>
<td>Indicator:</td>
</tr>
</tbody>
</table>

Notes:
Section 5: Standardise the System
Section 5: Standardize the System

Improvement Concepts Associated with less than 95% Performance

(Primarily can be described as intent, vigilance, and hard work)

- Common equipment, standard order sheets, multiple choice protocols, and written policies/procedures
- Personal check lists
- Feedback of information on compliance
- Suggestions of working harder next time
- Awareness and training

Institute for Healthcare Improvement
Tools used to standardize processes:

- Written standards
- Norms and protocols
- Posting of job aids / reminders
- Checklists or other forms
- Feedback forums
- Supervision
- Training

Developing and Implementing Changes:

- Choose big changes to implement on a small scale
- Changes must be feasible
- Changes must be within your control to implement
- Changes should not have negative consequences

Case Study Part 5: The Daily Goals Sheet
Exercise 5: Developing Changes to Standardize your Process

• What change will you make?

• How will it work?

• What improvement do you expect to see as a result of this change?
Case Study Part 5: Development of the Daily Goals Sheet

The Daily Goals Sheet quickly became critical in achieving consistent delivery of the VAP prevention bundle elements. Improvements to it were a vital outcome of each team meeting. The original Daily Goals sheet was based closely upon one provided by IHI. It served its purpose of collecting data on the VAP bundle, however it needed to be better adapted to their situation and even the data collection itself was unclear.

The team quickly set about making changes to the DG sheet. Possible changes were brainstormed by the team and they decided as a group which changes to implement. In addition to changes to the DG sheet, additional job aids were suggested.

The team decided to also write a script of questions for nurses to ask the doctors on the morning ward round. The five questions in the script covered daily goals setting and completion of the four components of the ventilator associated pneumonia prevention bundle. The team hoped that this would increase communication between doctors and nurses and ensure that everyone receives all of the regular information that they need in order to play their part in the process.

All of these suggestions, whether changes to the DG sheet or other interventions were still aimed at establishing a system for the hospital to achieve consistency in their care to patients on ventilators. They were still mainly grappling with basic issues of establishing the right job aids to help staff remember all necessary steps and providing the supervision and feedback to ensure proper completion of those steps.

After the meeting, the hospital began regularly using the new script and updated DG sheet.
Example 5: Intervene to Standardise Your System

Fill in the table below with some change concepts. A change concept is an idea for a change that you think may lead to an improvement in your process.

<table>
<thead>
<tr>
<th>Change: What change will you make?</th>
<th>Why will this change result in an improvement?</th>
<th>Prediction: What improvement will we expect to see as a result of this change?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct a training on the VAP bundle</td>
<td>It will educate staff on the need for the bundle and techniques</td>
<td>Everyone will be more aware of the need to implement the bundle and how to do it</td>
</tr>
<tr>
<td>Add more questions to the DG sheet</td>
<td>It will record more data each time the sheet is filled out</td>
<td>More vital information, such as expected release time, will be shared</td>
</tr>
<tr>
<td>Create a script of questions for Nurses to ask Doctors each morning</td>
<td>It will encourage and guide more complete conversations</td>
<td>The Nurses will have all of the information they need to do their jobs</td>
</tr>
</tbody>
</table>

Is the change you've selected feasible? Do you have the resources you need or can you get them?
Exercise 5: Intervene to Standardise Your System

Fill in the table below with some change concepts. A change concept is an idea for a change that you think may lead to an improvement in your process.

<table>
<thead>
<tr>
<th>Change: What change will you make?</th>
<th>Why will this change result in an improvement? How will it work to establish a stable, consistent system in your hospital?</th>
<th>Prediction: What improvement will we expect to see as a result of this change? What do you think the result will be?</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

Is the change you’ve selected feasible? Do you have the resources you need or can you get them?
Section 6: Test and Implement Changes with PDSA Cycles
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Why test?

The PDSA Cycle

USAID HEALTH CARE IMPROVEMENT PROJECT

*Nolan Model Diagram: Associates in Process Improvement (API)
QI methodology

Test and Implement Changes
Analysis - Collect and analyze data to answer the questions:

- Did the changes lead to improvement?
- Is the change significant?

- Develop Other Changes
- Adapt the change and conduct another test
- Keep the changes - Develop new changes

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Testing a change

1. Test BIG changes on an initially small scale, then ramp up
2. Test individual changes separately when possible
3. Negative results are an opportunity to learn
4. Think about how conditions change over time (monthly, seasonal patterns, external variables)

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Case Study Part 6: Discussing Experiences and More Changes

- Things to ask the doctors on the ward round:
  - What are our daily goals for this patient?
  - Is there a reason why we cannot stop this patient’s sedation – to assess their neurological status – when should we do this?
  - What are our goals for weaning this patient – what level do you want to get to – and what would you like me to change this?
  - Is there any reason for the patient not to be head up?
  - Is the patient intubated (on steroids) get prescribed for healthcare?
Exercise 6: Prepare your PDSA journal

In your workbook, fill in the details that will help you establish a complete and useful PDSA journal for your improvement project.

Working in groups, discuss your proposed changes.
Case Study Part 6: Discussing our Experiences

At this point, the improvement team’s discussions were becoming very rich with feedback and suggestions from everyone based upon their experiences. The time series charts prepared and posted on the meeting room wall also fueled the conversations. Each team meeting, all of the doctors, nurses, and other staff gathered around the charts to see what they could learn from the data.

Notes were being kept on the changes that the team introduced and the times at which they were implemented. One nurse on the team was nominated to record these notes at each meeting. By adding this notation to the time series charts, further changes as well as more fine tuning to previously implemented changes were identified.

By participating in the process of identifying changes to their process and designing the interventions, the team members were full owners of their evolving process. The solutions they generated were all based upon complete working knowledge of their facility and the specific successes and failures of each preceding change.

In addition to directly improving their ability to provide complete care for patients on ventilators, this engaged individual employees overall in the design of their daily work and decision making in their workplace. This type of workplace employee engagement typically leads to higher quality services, improved productivity of health workers, and greater retention of staff, which could benefit the hospital in many other ways.

The team meetings continued as a forum to study the experience of the latest round of changes, plan new changes, and do what needs to be done to act out those changes before the next meeting.
Example 6: Prepare Your PDSA Journal

For the PDSA journal to be useful, it must be regularly maintained by team members familiar with the changes being implemented. How will your journal be maintained?

<table>
<thead>
<tr>
<th>Who will write it?</th>
<th>How will it be written?</th>
<th>How often will it be updated?</th>
<th>What resources are needed to write it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>The supervising nurse</td>
<td>In a notebook to be kept in central files</td>
<td>Every improvement team meeting</td>
<td>A notebook and 30 minutes time for the nurse after team meetings</td>
</tr>
</tbody>
</table>

For a PDSA journal to be worthwhile, it must be reviewed and used in a regular fashion by the team. How will your PDSA journal be used?

<table>
<thead>
<tr>
<th>How/where will it be shared with staff?</th>
<th>Who will be responsible for sharing it?</th>
<th>How often will it be shared/discussed?</th>
<th>What is the agenda/purpose of sharing it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous entries will be read during improvement team meetings</td>
<td>The team leader</td>
<td>Improvement team meetings will happen once every three months</td>
<td>Discuss previous changes in relation to new data and use to suggest new changes</td>
</tr>
</tbody>
</table>

For a PDSA journal to be complete, it must contain certain qualitative details about what is going on in the clinic. The following format illustrates a typical PDSA journal:

<table>
<thead>
<tr>
<th>What change was implemented</th>
<th>When was it implemented</th>
<th>How was it implemented</th>
<th>What results or other important lessons were learned in the process</th>
<th>What do you plan to do next?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revised DG sheet and added script of 5 questions</td>
<td>July</td>
<td>The updated DG sheet and script provided to all nurses</td>
<td>Getting sedation hold to happen is still a barrier</td>
<td>the sedation protocol is still too wordy and complex - Simplify it</td>
</tr>
</tbody>
</table>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section 7: Contingencies and Failure Prevention
Section 7: Contingencies and Failure Prevention

**Improvement Concepts Associated with better than 95% Performance**
(Designing sophisticated failure prevention, basic failure identification, and mitigation)

- Decision aids and reminders built into the system
- Desired action the default (based on evidence)
- Redundancy
- Scheduling
- Takes advantage of habits and patterns

*I Institute for Healthcare Improvement*
Examples of strategies to improve reliability of processes:

- Updates to standards, norms, and protocols
- Clarification or simplification of job aids and posted reminders
- Improvements to checklists or other forms
- Other changes to improve efficiency of supervision and training
- Engagement of front-line workers in decision making and ownership of processes

How to Engage a Workforce

- Clear Expectations
- Future Possibilities
- Worker Engagement
- Capacity Development
- Reward & Recognition
- Feedback
- Evaluation

Engaged Health Workers Produce Results

- Believe in their job and organization
- Believe in their ability to succeed
- Have good relations with supervisor and/or team
- Have a future in health care
- Feel recognized and rewarded
- Have influence in decisions about their work

1. Higher quality services
2. Improved productivity of health workers
3. Greater retention of staff

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Example of 3 Step Design in Implementing the Ventilator Bundle

- Integrate daily goals with MDR to identify defects as a feedback concept (step 1).
- Redundancy in the form of a check by RT built into 1-hour scheduled vent checks as a robust change concept (step 2).

Example of using 10^1 and 10^2 change concepts to initially reach a reliability of 10^1, then additionally using a robust 10^2 change concept (redundancy) to reach 10^2 reliability in the four elements of the ventilator bundle (Baptist Memorial, Memphis).

Case Study Part 7: Further Improvements to the System

Exercise 7: Developing Changes to Improve Reliability

- What new challenges will you face and what changes will you make?
- How will it work to avoid failures or make the process more efficient and effective?
- What improvement do you expect to see as a result of this change?
Case Study Part 7: An Evolved Daily Goals Sheet

As the team continued to meet, the changes they came up with evolved in nature. The first changes to the DG sheet were simple adaptations, adding logos and changing some terminology to match what they use in their hospital versus what was used on the version provided by IHI.

Once those were in place, staff identified underlying concepts and actions that were not clear, such as the delivery of patient information in the mornings or the way in which certain questions on the DG sheet were asked.

As they began using the DG sheet and other developed tools more consistently, their process began to stabilize. At the same time as they began to see fewer and fewer human errors and general lapses of their system, more specific and infrequent causes of failure to meet all four elements of the bundle were directly addressed by newly suggested changes.

Having achieved stability in their process allowed the team to focus on the reliability of their system to overcome ever more specific barriers and design new changes to avert new potential causes instead of being only reactive to the wide range of problems faced when the process was less clear and less consistently implemented.

Further modifications were again designed for the DG sheet, including developing a more specific target list for weaning patients off of ventilators. Team members noted that they were having difficulty always getting the sedation hold to happen. The principal barrier was clarity on what to do if one needed to restart sedation. Initially they had a one-page sedation hold protocol printout for staff to refer to. No one was reading it because it was too wordy, so they then simplified it to a mere 15 words: “Stop, if need to start again – start at 1/2 previous rate and titrate to effect”

The team even stepped back to the beginning of their process and looked at how they refer to the bundle elements. Initially the ventilation goals were numbered 1., 2., 3. – allowing everyone to state it in whatever order or format they wanted. However, this left too much variability and eventually caused some confusion. The team then agreed upon one set of abbreviations to use to consistently refer to each of the four elements they are tracking: “Mode; Support level; PEEP; FiO2”

All of these more recent changes improved clarity and make the jobs of all of the staff as well as managers much easier in both providing complete services and assessing the success of changes.
Example 7: Plan Future interventions

This type of activity should be done each time data and experiences are reviewed to plan new changes to implement. Think forward to a point at which your process is operating smoothly using the changes you developed earlier. What new obstacles might you face. What type of less frequent problems might you be able to address if you and your colleagues are not seeing most of the earlier system errors?

<table>
<thead>
<tr>
<th>New Challenges and Changes:</th>
<th>Why will the new changes result in an improvement?</th>
<th>Prediction: What will be different as a result?</th>
</tr>
</thead>
<tbody>
<tr>
<td>What new challenges might you face once your process is operating consistently?</td>
<td>How will it work to overcome a barrier or prevent a type of system failure?</td>
<td>What do you think the result will be?</td>
</tr>
<tr>
<td>What further changes might you make?</td>
<td>How will it make your process operate more smoothly?</td>
<td>A simple phrase or two that will jog people’s memories will be more effective than a long detailed narrative</td>
</tr>
</tbody>
</table>

| Getting sedation hold to happen is still a barrier | the sedation protocol is still too wordy and complex, if we have something easier to read and remember, people will be more likely to follow it | Reducing false responses due to bad wording or missing details will avoid potential errors caused by false recording |
| Questions on the DG sheet still need more specific details | Questions continue to be revised to eliminate the possibilities of false responses to questions due to bad wording or missing details | |
| The terminology used for the four elements of the bundle is not consistently used | Having common terminology for all conversations and documents will make the whole process more clear | Clear communication will improve efficiency and reduce miscommunication errors |
**Exercise 7: Plan Future interventions**

This type of activity should be done each time data and experiences are reviewed to plan new changes to implement. Think forward to a point at which your process is operating smoothly using the changes you developed earlier. What new obstacles might you face. What type of less frequent problems might you be able to address if you and your colleagues are not seeing most of the earlier system errors?

<table>
<thead>
<tr>
<th>New Challenges and Changes:</th>
<th>Why will the new changes result in an improvement?</th>
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<th>Prediction: What will be different as a result?</th>
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</tr>
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</tr>
</tbody>
</table>
Section 8: Monitoring Results and Continuing to Act
Section 8: Monitoring Results and Continuing to Act

Implementation of the VAP Bundle

GRI VAP Prevention Bundle
Sampled one day per week - varied day
Aim >95% Reliability by May 2009
All 4 components of bundle
30° head up
Chlorhexidine used as part of daily mouth care
DG sheet
Re-testing at daily goals: handling script, using script,
Weaning section - changed from list (1,2,3) to specific
AIM - how much by when

Daily Goals Sheet
Script of questions

USAID HEALTH CARE IMPROVEMENT PROJECT
**VAP Bundle Outcomes:**

**USAID HEALTH CARE IMPROVEMENT PROJECT**

**GRI Average ICU Length of Stay (days)**

Median till May 2008

**GRI Average Number of Ventilated Days per Month**

Median to May 2008
The Outcome of Reliable Design

“Average number of ventilated days per month has fallen from a median of 6.7 days to 5.5 days. This has been sustained. Currently the last episode of VAP was > 400 calendar days ago.”

Malcolm Daniel,
Glasgow Royal Infirmary

Reliability in Niger AMTSL Results 2006-2007

Next Steps

• Implement your quality improvement project
• Learn more about Reliable Design and other Quality Improvement methods
• Join communities of practice in quality improvement
• Connect with the HCI Knowledge Management Website and online community of practice:  www.hciproject.org
Case Study Part 8: 400 Days Without VAP Infections

In June 2008 overall reliability of the bundle (all-or-none) was only 35%. Now, bundle reliability has improved to greater than 90%.

Average number of ventilated days per month has fallen from a median of 6.7 days to 5.5 days. This has been sustained. Currently the last episode of VAP as defined in the hospital was more than 400 calendar days ago.

The definition used for ventilator-associated pneumonia was that of the Hospital In Europe Link for Infection Control through Surveillance (HELICS) dataset. The definition is a high bar to cross, is a European standard, and was recorded in NHS Scotland’s database. This definition was used consistently before and during the activities described in the case study.

The team in the case study was based upon the actual experience of a hospital in NHS Scotland. The small sample data presented as part of the case study is not actual and the changes implemented have been summarized. The actual success of the changes has been documented and presented in the mini plenary sessions.

The actual data as seen in the time series charts on the next few pages documents their real interventions and experience improving the reliability of their process for consistently applying the VAP prevention bundle for patients on ventilators in their hospital.
Example 8: Long Term Run Charts

In your facility, you should build your ability to efficiently collect and monitor your indicator data. Being able to do so without causing too much additional work for staff will be key in order to easily analyze your experiences and learn from them. The following time series charts not only document their experiences for you to learn from, but they were also an effective tool in reaching their results.