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Lean Healthcare Applications

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Focus on partnership with hospitals and healthcare providers to provide training/facilitation through implementation to create self-sustaining programs

- 35 projects completed, 9 on-going, 22 hospitals, 8 hospital systems
- 83% implementation rate
- 81% of implemented sustained at 9-12 months
- 65% of implemented projects showed good spread
Purdue Statewide/Regional Campus Model

Research in:
- Clinical Implementation
- Modeling and Simulation
- Supply Chain Management

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Designing reliable processes...

VAP Compliance Rate for Unit A

Standardized Protocols, education Order sets in place
Designing reliable processes...

- Scales changed to make Bed Angle easier to determine
- Weaning protocol with RT driven algorithm implemented
- Grand rounds with daily feedback to staff
Sustainability

What happened?

What does this process look like 3 months later?

Average Daily % of ED stat orders (Order to Verify) returned within 60 minutes through April, 2006
What is Sustainability?

- The persistence of Performance Improvements over time.

How is Sustainability assessed?

- **Excellent:** Fully implemented, Sustained to goal for greater than 12 months
- **Good:** Significant or partial implementation, sustained to goal for greater than 6 months
- **Fair:** Some implementation occurred, but did not sustain to goal for greater than 3 months
- **Poor:** No Implementation, and/or did not meet goal for at least 3 months following implementation or other sustainability issues
What factors impact Sustainability?

- **Bottom up vs Top Down Initiatives:** Change should be driven from the lowest level possible within the organization.

- **Small Incremental Tests of Change:** Change should be gradual, beginning with the lowest levels of implementation complexity and migrating to higher levels over 4-6 weeks.

- **Regular (Daily) Data Feedback to front line staff:** Process performance data should be presented to the front line staff members on a regular basis (daily is preferred, reducing frequency as process stability is achieved).

- **Accountability infrastructure:** Performance metrics should be monitored and supervisors, front line staff members held accountable to low performance and recognized/rewarded for high performance.
What is Spread?

- The application of tools and techniques outside of the original project focus area.

How is Spread assessed?

- **Excellent:** Principles spread to other unit or project area with no outside assistance
- **Good:** Principles spread to other unit or project area with limited outside assistance
- **Fair:** Some evidence of application of principles beyond initial project area
- **Poor:** No evidence of application of principles beyond initial project area
What factors impact Spread? [1]

1. **Perceived Benefit** - organizational and personal

2. **Compatibility** with existing systems, values, beliefs, current needs

3. **Simplicity** — Simple innovations spread faster than complicated ones due to the role of adaptation in spread of innovation.

4. **Trialability** — Changes should be tested and verified prior to full implementation.

5. **Observability** — Tests of change should be conducted in such a way so as to be readily observable by other ‘early adopters’.

100 Day Lean Healthcare Projects
Key Lean Concepts

- **Value**
  - Determined by the “customer” (patients; ordering provider; traveler)

- **Waste**
  - Anything that does not add value from the customer’s perspective
  - *(or, is not necessary for compliance)*

- **Value stream**
  - The actions (and waste) taken to create value

Information used courtesy of Peter Woodbridge
Lean Process Design…

HEALTHCARE PATIENT TREATMENT FLOW

Step 1 → Step 2 → Step 3 → Patient Outcome

Identifying and Eliminating Operational Barriers within Patient Treatment Processes

Methods | Materials | Environment

People | Equipment | Information

Output of Treatment Step
Reducing sources of variation...

Every step in the patient treatment process contributes to the:

- Patient Outcome
- Patient Satisfaction
- Cost of Treatment

HEALTHCARE PATIENT PROCESS VARIATION

\[
\text{Var(Process)} = \text{Var(Step 1)} + \text{Var(Step 2)} + \text{Var(Step 3)} + \ldots
\]

\[
\text{Var(Treatment Step)} = \text{Var(Methods)} + \text{Var(Materials)} + \text{Var(Environment)} + \text{Var(People)} + \text{Var(Equipment)} + \text{Var(Information)}
\]

Every caregiver and staff member must be active in reducing variation.
Goal: Provide Lean Healthcare training and facilitation over 100 day project cycle to build basic knowledge and proficiency in Lean methods and tools:

- Drive Improvements to the Front Line Staff Level
- Begin Adaptation Cycle
  - Simplicity
  - Compatibility
100 Day Lean Healthcare Training

Steps:

1. Define the Problem
2. Baseline current processes
3. Identify operational barriers and failure modes in the current process
4. Create the ‘future state process’ by applying Lean techniques to eliminate operational barriers and failure modes.
5. Create a ‘process control strategy’ – a strategy for insuring long term sustainability and spread adoption
**Expected Outcomes:**

- Participants will learn how to define the problem under investigation.
- Participants will learn how to collect data to baseline process performance.
- Participants will learn how to observe processes to identify operational barriers within their processes.
- Participants will learn how to apply basic and advanced Lean techniques, such as 5S and visual controls to create robust ‘future state processes’.
- Participants will learn how to design and implement long term control strategies to insure sustainability and spread adoption.
Where is PDSA used within the 100 Day Lean Cycle?

- Define the Problem
- Baseline Current Processes
- Identify Operational Barriers
- Develop Future State Process
- Process Control Strategy

PDSA PDSA PDSA
100 Day Lean Healthcare Training Agenda

- Week #1: Define the Problem
- Week #2: Baseline Current Processes
- Week #3: Identify Operational Barriers
- Week #4: Future State Process: Basic Lean Tools
- Week #5: Future State Process: Advanced Lean Tools
- Week #6: Healthcare Financial Concepts
- Week #7: Pilot Implementation
- Week #8: Process Control Strategy
- Week #9-12: Pilot Plan Implementation
Key Factors for Lean Tool Application to Healthcare

- Focus on enabling the cultural transformation, rather than building technical skills
  - Simplify, Simplify, Simplify
  - Require immediate application
  - Use readily accessible materials
  - Use Healthcare terms and examples rather than those from Lean Manufacturing
- Facilitate through repeated applications of tools for at least 2 additional cycles
Workflow Analysis

Workflow analysis is used to:

1. Baseline existing clinical processes prior to the improvement cycle
2. Validate process outputs following improvement

- Workflow analysis includes qualitative and quantitative assessments of work processes.
Baseline Current Processes

- What is a baseline?
  - Measurement of output metrics in the current process

- Why?
  - Identify the ‘BIG’ hitters – primary operational barriers
  - Provides reference once improvements are made
Tools for performing workflow analysis...

- Current State Process Maps
- Checksheets
- Process Observation Worksheets
- Spaghetti Diagrams
- Value Stream Map
Current State Process Map

- A diagram that uses graphical symbols to depict the nature and flow of the steps in a process

- Process Maps (a.k.a Flowcharts) provide a visual tool for:
  - Understanding the Process
  - Identifying problem areas that can be targeted for improvement
Current State Process Map

Steps to creating a process map:

1. Review the process under investigation and establish boundaries as outlined in the project charter.
2. Using brainstorming techniques, identify steps in the process.
3. Arrange the processing steps in order.
4. Validate the process flow either by showing the process map to a non-team member involved in the process, or by physically observing the process.
Outpatient Registration
Current State Process Map

Patient Arrives at Registration Desk

Clerk Requests ID and Medical Card

Patient Pre-registered?

Yes

Patient escorted to outpatient radiology

No

Clerk Assigns Patient to Registrar

Registrar Enters patient information into system

Not Enough Escorts

Patient Wait Times

Not Enough Registrars

Patient Arrives At Radiology
Process Mapping
Daily/Terminal Cleans
Checksheets

- A worksheet used to collect qualitative process output data, such as compliance and adherence data.

- Standardizing forms ensures that data is collected in a reliable, repeatable way.
Checksheets

- Steps to creating/using a checksheet:
  1. Select the output variable(s) to be measured.
  2. Add columns to collect additional information, such as dates, times and shifts.
  3. Add columns that may be used to indicate categories or reasons for non-compliance/adherence.
  4. Pilot test the form design and make changes as required.
# Checksheet Example #1

## Example #1: Audit Checksheet

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Output metric:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Unit</th>
<th>Room #</th>
<th>Compliance against Hand Hygiene protocol (Y/N)</th>
<th>Reason if non-compliant:</th>
<th>Comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/1/2007 10:00AM</td>
<td>ICU</td>
<td>405</td>
<td>Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/1/2007 10:05AM</td>
<td>ICU</td>
<td>405</td>
<td>N</td>
<td>Alcohol dispenser empty</td>
<td></td>
</tr>
<tr>
<td>1/1/2007 10:10AM</td>
<td>ICU</td>
<td>405</td>
<td>N</td>
<td>Nurse carrying items</td>
<td></td>
</tr>
</tbody>
</table>
# Checksheet Example #2

## Example #2: Operational Barrier Checksheet

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Patient Delay?</th>
<th>Delay Type</th>
<th>Patient Pre-reg'd?</th>
<th>Reason for delay</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/1/2007 10:00AM</td>
<td>N</td>
<td></td>
<td>Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/1/2007 10:05AM</td>
<td>Y</td>
<td>DATA</td>
<td>N</td>
<td>Wrong billing info</td>
<td></td>
</tr>
<tr>
<td>1/1/2007 10:10AM</td>
<td>Y</td>
<td>ES</td>
<td>N</td>
<td>Call-off, low staffing</td>
<td></td>
</tr>
</tbody>
</table>

**Reason codes:**
- **DATA**: Data Error
- **REG**: Waiting on Registrar
- **ES**: Waiting on Escort

**Reason or defect code key**
Process Observation Worksheet

- A data collection tool used during process observation to collect times and durations for individual process steps.

- Using a standardization process observation worksheet allows for reliable, repeatable data collection.
Process Observation Worksheet

- Steps to creating/using a process observation worksheet:

  1. List the steps from the process map in sequential order.
  2. Observe the process and collect information on process step durations, wait times, and travel distances.
  3. Multiple observations should be done in order to determine range of variation in processing steps/times.

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Outpatient Registration
Current State Process Map

Step #1: Patient Arrives at Registration Desk

Step #2: Clerk Requests ID and Medical Card

Step #3: Patient Pre-registered?
- Yes: Patient escorted to outpatient radiology
- No: Clerk Assigns Patient to Registrar

Step #3A: Registrar Enters patient information into system

Step #3B: Patient Arrives At Radiology

Step #4: Patient escorted to outpatient radiology

Step #5: Patient Arrives At Radiology
# Process Observation Worksheet

<table>
<thead>
<tr>
<th>Step #</th>
<th>Description</th>
<th>Distance</th>
<th>Clock Time</th>
<th>Task Time</th>
<th>Wait Time</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Patient Arrives at the Registration Desk</td>
<td></td>
<td>0:10</td>
<td>0:10</td>
<td></td>
<td>Long line at desk</td>
</tr>
<tr>
<td>2</td>
<td>Clerk Requests ID + Medical Card</td>
<td>0:13</td>
<td>0:03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Patient Pre-registered? (Y/N)</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3A</td>
<td>Clerk Assigns patient to Registrar</td>
<td></td>
<td>0:15</td>
<td>0:02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3B</td>
<td>Registrar enters patient information into system</td>
<td>100</td>
<td>0:25</td>
<td>0:10</td>
<td>0:03</td>
<td>wait for registrar</td>
</tr>
<tr>
<td>4</td>
<td>Patient escorted to Outpatient Radiology</td>
<td>200</td>
<td>0:33</td>
<td>0:08</td>
<td>0:05</td>
<td>wait for escort</td>
</tr>
<tr>
<td>5</td>
<td>Patient Arrives at Outpatient Radiology</td>
<td>0:45</td>
<td>0:12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Process Observation Worksheet

**Process:** Outpatient Registration  
**Name:** Jane

<table>
<thead>
<tr>
<th>Step #</th>
<th>Description</th>
<th>Distance</th>
<th>Clock Time</th>
<th>Task Time</th>
<th>Wait Time</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Patient Arrives at the Registration Desk</td>
<td></td>
<td>0:10</td>
<td>0:10</td>
<td></td>
<td>Long line at desk</td>
</tr>
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<td></td>
<td>0:13</td>
<td>0:03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Patient Pre-registered? (Y/N)</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3A</td>
<td>- Clerk Assigns patient to Registrar</td>
<td></td>
<td>0:15</td>
<td>0:02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3B</td>
<td>- Registrar enters patient information into system</td>
<td>100</td>
<td>0:25</td>
<td>0:10</td>
<td>0:03</td>
<td>wait for registrar</td>
</tr>
<tr>
<td>4</td>
<td>Patient escorted to Outpatient Radiology</td>
<td>200</td>
<td>0:33</td>
<td>0:08</td>
<td>0:05</td>
<td>wait for escort</td>
</tr>
<tr>
<td>5</td>
<td>Patient Arrives at Outpatient Radiology</td>
<td></td>
<td>0:45</td>
<td>0:12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Distance traveled In steps**

**Enter time that step was completed.**

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## Waste Worksheet Example

### Process Observation Worksheet

**Process:**

<table>
<thead>
<tr>
<th>Types of Waste</th>
<th>Observations During Process Walk-through</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Processing</strong></td>
<td>Unnecessary processes and activities traditionally accepted as necessary. More steps than necessary. Unnecessary effort (“friction”).</td>
</tr>
<tr>
<td><strong>Motion (Search Time)</strong></td>
<td>Unnecessary movement that does not add value. Movement that is too slow or too fast. Time spent looking for information, people, supplies and equipment.</td>
</tr>
<tr>
<td><strong>Defects</strong></td>
<td>Cost of inspection for defects; customer complaints; passing on defects to others rather than fixing the problem when detected; work-arounds</td>
</tr>
<tr>
<td><strong>Transportation</strong></td>
<td>Conveying, transferring, picking-up/setting down, piling up, and otherwise moving unnecessary items.</td>
</tr>
<tr>
<td><strong>Inventory</strong></td>
<td>Anything – materials, parts, implants, supplies – that are retained for any length of time that could be ordered just-in-time. Work in progress waiting for action</td>
</tr>
<tr>
<td><strong>Overproduction</strong></td>
<td>Producing what is unnecessary, when it is unnecessary, and in unnecessary amounts; “just-in-case” work</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>Waiting for people or services to proceed; idle time rather than “just-in-time” or “pull production.” Delays and queues.</td>
</tr>
<tr>
<td><strong>Complexity</strong></td>
<td>Complex process flows. Product choices that confuse customers. Organizational boundaries that introduce inefficiency and frustrate customers.</td>
</tr>
</tbody>
</table>

Courtesy of Peter Woodbridge
Spaghetti Diagram

- Spaghetti Diagrams:
  - Also known as a transportation or workforce diagram
  - Is used to visually represent the physical flow of work for a process
Spaghetti Diagram

Steps for creating a spaghetti diagram:
1. Find or create a diagram of the workspace.
2. Observe the process:
   - Note the physical location of the worker at the beginning of the process.
3. Draw lines that follow the path that the worker takes as they complete the process.
   - Lines may be numbered to reflect the steps on the process map.
Spaghetti Diagram

Registration Waiting Area

Step #3A (wait)

Patient #1, no pre-reg.

Step #4 (wait)

Information Desk

Patient #2, pre-reg'd

Reg Desk

Step #1/#2/#3A

Registrar

Registrar

Step #3B

Radiology Waiting Area

Outpatient Radiology

Step #5

Registrar

Registrar

Registrar
A Value Stream Map is used to summarize the information collected by the other process observation tools.

Information and material flow may be added to provide a complete snapshot of the process.
Value Stream Symbols

- **Process Box**
- **Data Box**
- **Physician**
- **Hospital**
- **Information /Computer System**
- **Pull System Flow**
- **Information Flow**
- **Physical Flow**
- **Electronic Information Flow**
- **Queue/Inventory**

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Steps to creating a Value Stream Map:

1. Flow Chart the Process from the Perspective of the Patient
2. Add Suppliers and Customers
3. Map the Information flow
4. Map the Material Flow
5. Collect/Add information about process times, wait times and queues
Value Stream Map Step #1/#2

- Scheduling
  - Verify Information
  - Assign to Registrar
  - Enter information
  - Escort to Radiology

- Radiology
  - Referring Physician

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Value Stream Map Step #2/#3

1. Referring Physician
2. Registration System
3. Verify Information
4. Assign to Registrar
5. Enter Information
6. Escort to Radiology
Value Stream Map Step #5

Scheduling

1. Verify Information
   - PT = 3 min

2. Assign to Registrar
   - PT = 2 min

3. Enter Information
   - PT = 10 min

4. Escort to Radiology
   - PT = 8 min

Referring Physician

Registration System

Radiology

Total Process Time = 23 minutes
Total Lead Time = 48 minutes
Apply Lean Tools

- Apply Lean Tools to reduce or eliminate waste
- 5S
- Visual Controls
- Visual Workplace rules
- Workstation Design
- Setup Reduction
5S Workplace Organization

S1: Sort

S2: Set in Order

S3: Shine

S4: Simplify and Standardize

S5: Sustain

A place for everything and everything in its place
Before 5S
S1: Sort

• Remove and Red Tag Items not used or excess supplies
S2: Set in Order
S3: Shine
S4: Simplify/Standardize
S5: Sustain

Right Side
- Gloves
- NACL 10ML
- NACL 250ML
- B/C Bottles
- Tape
- Sterile Towels
- Betadine
- Glasses
- Green Soap
- Peroxide

Drawer 1
- Angio Cath 18/20/22
- CottonTip Applicator
- Razors
- .25/.23 Needles
- .22/.18 Needles
- Iodine/Betadine SEPPS
- Purple/Red Tubes
- Mint Green/Blue Tubes
- Purple/Green Tubes
- Surgilube Bacitracin
- Vacutainers Tourniquet
- Alcohol Swabs
- Suture 2-0, 3-0
Visual Controls

- Key Principle: Make It Visible
  - Everyone, including outsiders, can see and understand the status of the process at all times

- See
  - Flow
  - Performance
  - Problems
  - Opportunities for improvement
Visual Workplace Rules

- Tools, supplies, and equipment must be:
  - Easy to see
  - Easy to use
  - Easy to return

- 30-second rule:
  - Items accessed at least once a month should be located within 30-seconds
    - Supplies
    - Tools, equipment
    - Information
5S Examples
Visual Controls + 5S
Visual Control Examples....
Contact Isolation
Visual Controls
MRSA Project
Visual Controls
Lean Healthcare

Project Example

courtesy of Joe Swartz
Lean Simulation Exercises

Lean Simulation Exercise

- What is a Lean Simulation Exercise?

- Hands-on Activity or Event that provides:
  - Opportunity for immediate application of Lean tools
  - Greater understanding of the processes under investigation
  - Ability to test change in no-risk environment
Developing Effective Healthcare Based Lean Exercises

1. Consider your audience
2. Introduce basic Lean tools first
3. Baseline current processes
4. Require immediate application
5. Quantify improvements
6. Recognize the team(s) accomplishments.
Basic Lean Exercise

- Goals:
  - Provide Hands-On application of basic Lean Tools:
    - Process Mapping
    - Checksheets
    - Process Observation Worksheets
    - Spaghetti Diagrams
    - 5S
    - Visual Controls
Basic Lean Exercise

1. Participants are divided into teams of 5-6.
   - One team member → ‘doctor’.
   - Other team members → observe the process and collect process data using Lean Tools.

2. The ‘doctor’:
   1. Examines the patient
   2. Determines the supplies necessary to treat the patient.
   3. Goes to the supply area to find supplies
Basic Lean Exercise
### Basic Lean Exercise

3. The Team goes through multiple iterations of collecting data, identifying waste in the process and applying Lean tools to reduce the time to obtain supplies.

<table>
<thead>
<tr>
<th>Round</th>
<th>Time</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>9 min</td>
<td>Disorganized supply area, far from patient rooms</td>
</tr>
<tr>
<td>#2</td>
<td>4 min</td>
<td>More organized supply area, closer to patient rooms</td>
</tr>
<tr>
<td>#3</td>
<td>2 min</td>
<td>‘Leaned’ supply area, easy access to both units</td>
</tr>
</tbody>
</table>
Basic Lean Exercise
Advanced Lean Exercise

Goals:
- Provide Hands-On application of advanced Lean Tools:
  - Value Stream Mapping
  - Flow
  - Constraint Identification
  - Constraint Management

- Based on Patient Flow through an ER
Advanced Lean Exercise

1. Participants are assigned roles (Triage Nurse, ED nurse, Registrar, Transporter, ED Physician, Lab Tech, Radiology Tech)

2. Roles are defined to perform a specific service for the ‘patient’ and send the patient onto the next provider.
   - ‘Patients’ are colored coded to receive specific services

3. The ‘patient’ is evaluated upon ‘discharge’ to insure that they have received the required services.
**STATION: ER Doctor**

1. ER Doctor rolls die and counts to the average # of seconds to simulate treatment time.

2. Patients must see ancillary services and/or specialist as outlined in the table below prior to moving patient to next unit.
   a. **NOTE:** Patient Bed must be held during any ancillary or specialist services.
   b. **NOTE:** Purple Patients must be held over in the ER for the duration of the exercise.

3. After ancillary services requirements are met, the ER Doctor must contact the ER Nurse and arrange for patient move as outlined below.

4. ER Doctor may only communicate with an ER Nurse or Charge Nurse.
## Patient Requirements Example

<table>
<thead>
<tr>
<th>Gingerbread Color</th>
<th>Ancillary Services/Specialist Requirements</th>
<th>Move to:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lab</td>
<td>Radiology</td>
</tr>
<tr>
<td>Brown</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Light Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tan</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Pink</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Blue</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Green</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Advanced Lean Exercise

1. Participants:
   - Receive the patient into their unit/area
   - Roll dice and count to number displayed on die.
   - Call the transporter (or otherwise coordinate) to transport the patient to the next provider.

2. Multiple iterations are used to:
   - Create a current and future state value stream map
   - Identify constraint areas in the process
   - Streamline processes to remove waste and/or add value
Lean Simulation Exercises can be customized for specific projects:

- **5S Exercise:**
  - Nursing Station Design
  - Central Line Insertion

- **ED Flow Exercise**
  - Outpatient Registration
  - Cath Lab Processes
  - Outpatient Hypertension Assessment
Questions?