Lean Strategies
Used to Optimize Automation

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Why LEAN Six Sigma?
Laboratory Goals
- Decreased TAT
- Accurate Results
- LEAN Goals
- Increase Process Speed
- Reduce Waste
- Six Sigma Goals
- Eliminate Errors
- Reduce Variation

Why Lean Six Sigma?

LABORATORY GOALS
- Increased accuracy
- Decreased turnaround time

LEAN STRATEGIES: Collect and Use Your Own Data

Study overall workflow:
- Specimen arrival patterns and volumes
- Specimen activities
- Activity timing
- Specimen wait times
- Specimen transportation
- Lab layout / staffing

Collect data by:
- Direct observation and measurement
- Talking with people in the process
- LIS database
Optimizing Pre-Analytic Processes

LEAN Strategy: Continuous Flow

Automation:
- Is single piece continuous flow
- Has a consistent throughput, capacity, and rate
- Requires a bar code labeled specimen

Specimens often:
- Arrive in large batches
- Require significant data entry
- Must be re-labeled with bar code label

Utilize workload leveling and pull vs. push to continuously load small batches of specimens

How Do Specimens Arrive?
- Specimen types and volumes
- STAT / routine
- Pneumatic Tube Station / Courier
- IP / OP
- Labeled / Unlabeled (barcode)
- Un-Spun vs Pre-spun
- Registered / Ordered
- Batch sizes

Examples of Accessions by Hour of Day

Volume of Accessions by Hour of Day

How Do Specimens Arrive?
**Optimizing Pre-Analytic Processes**

**LEAN Strategy: Workload Leveling**

**Workload Leveling** (based on leveled production concept)
- Smooth out peaks in volume
- Prevent an unbalanced amount of work being given to a worker, team or equipment or specific time, while others are idle
- Maximize capacity utilization and level staffing

**Upstream Analysis - Start at the beginning!**
- Phlebotomy schedules and process
- Courier drop-off schedules and volumes

*(Large batches slow processes – including automated processes!)*

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**Optimizing Pre-Analytic Processes**

**LEAN Strategy: Process and Value Stream Mapping**

**Example Outreach Specimens Activities**
- Patient registration
- Order entry
- Re-label tubes with bar code labels
- Centrifugation

**Build Current State Value Stream Map and Process Map**
- Identify waste
- Identify bottlenecks

**Design Future State Value Stream Map and Process Map**
- Eliminate bottlenecks and waste
- Reduce batch size

*(Reduces cycle time Eliminates opportunities for error)*

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**Current Example Process Map**

*Total Time = 87:10*

*Batch size: 25 requisitions 73 tubes*
Future State Example Process Map

Optimizing Pre-Analytic Processes

LEAN Strategy: Work Cell Design

Work Cell Design Goals:

- Locate pre-analytic work cells near automation input
- Include all necessary equipment and supplies in each work cell
- Standardize work cells in the order of the process activities
- Adjust number of work cells to accommodate demand

Centrifuge, register, order, receive, and barcode label each patient in one continuous process

Assay and Reagent Management Planning
Assay and Reagent Management Planning

Goals:
- Distribute tube and test volume across all analyzers
- One reagent management intervention per day
- Minimal unplanned reagent depletions
- Minimize reagent waste

**LEAN Strategies:**
- Just in time inventory
- Standardization
- Workload leveling

Assay and Reagent Management Planning

**LEAN Strategy: Workload Leveling**
Goal: Distribute tube and test volume across all analyzers.
- Group profiles and assays commonly ordered together on the same analyzer
- Load high volume assays and assays with patient STAT requirements on multiple analyzers
- Load low volume assays on single analyzer
- Group assays on analyzers by control material

**Benefits:**
- Increased assay efficiency
- Increased analyzer efficiency
- Maximized automation throughput
- Optimized TAT

### Assay and Reagent Management Planning

**LEAN Strategy: Workload Leveling**

<table>
<thead>
<tr>
<th>Average Daily Volume</th>
<th>Analyzer #1</th>
<th>Analyzer #2</th>
<th>Analyzer #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>Creatinine</td>
<td>Creatinine</td>
<td>Creatinine</td>
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<tr>
<td>Glucose</td>
<td>Glucose</td>
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<tr>
<td>ICT All-in-One</td>
<td>ICT All-in-One</td>
<td>ICT All-in-One</td>
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<tr>
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<tr>
<td>Calcium</td>
<td>Calcium</td>
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<tr>
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<tr>
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<td>Triglyceride</td>
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</tr>
<tr>
<td>Direct LX</td>
<td>Direct LX</td>
<td>Direct LX</td>
<td>Direct LX</td>
</tr>
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</table>
Assay and Reagent Management Planning

LEAN Strategy: Workload Leveling

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<tr>
<td>Average Daily = Analyzer #1</td>
<td>Analyzer #2</td>
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<tr>
<td>79</td>
<td>Cephalin</td>
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<tr>
<td>79</td>
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<tr>
<td>13</td>
<td>Sodium</td>
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<td>7</td>
<td>Ammonia</td>
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<td>5</td>
<td>Vagron Act</td>
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</table>

Assay and Reagent Management Planning

LEAN Strategy: Workload Leveling

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<tbody>
<tr>
<td>Goal: One reagent management intervention per day.</td>
<td></td>
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<tr>
<td>Data Required by Assay:</td>
<td></td>
</tr>
<tr>
<td>Average weekday volume.</td>
<td></td>
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<tr>
<td>Weekday volume percent variation.</td>
<td></td>
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<tr>
<td>Kit sizes available.</td>
<td></td>
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<tr>
<td>Onboard stability.</td>
<td></td>
</tr>
<tr>
<td>Number of analyzers.</td>
<td></td>
</tr>
<tr>
<td>Calculate:</td>
<td></td>
</tr>
<tr>
<td>Safety daily volume = average weekday X (1 + percent variation)</td>
<td></td>
</tr>
<tr>
<td>Days on board = kit size(s) X number of analyzers</td>
<td></td>
</tr>
<tr>
<td>Average daily volume</td>
<td></td>
</tr>
<tr>
<td>Compare to onboard stability to determine appropriate kit size.</td>
<td></td>
</tr>
<tr>
<td>Kits on board = safety daily volume / number of analyzers</td>
<td></td>
</tr>
<tr>
<td>Restock level = safety daily volume minus kit size X (kits onboard – 1) / number of analyzers</td>
<td></td>
</tr>
</tbody>
</table>
Assay and Reagent Management Planning
LEAN Strategy: Just In Time Inventory Example

Data Required by Assay:
- Average weekday volume = 800
- Weekday volume percent variation = 10%
- Kit sizes available = 300 and 1,200
- Onboard stability = 8 days
- Number of analyzers = 2

Calculate:
- Safety daily volume = 800 X 1.10 = 880
- Days on board = 300 X 2 = 0.75

\[
\frac{1,200 \times 2}{800} = 3.0
\]

- Kits on board = 880 / 1,200 = 0.733 = 1
- Restock level = 880 / 2 minus 1,200 X (1 – 1) = 440

Assay and Reagent Management Planning
LEAN Strategy: Just In Time Inventory Example

Data Required by Assay:
- Average weekday volume = 5,000
- Weekday volume percent variation = 15
- Kit sizes available = 1,000
- Onboard stability = 30 days
- Number of analyzers = 2

Calculate:
- Safety daily volume = 5,000 X 1.15 = 5,750
- Days on board = 1,000 X 2 = 0.4

\[
\frac{5,750}{5,000} = 1.15
\]

- Kits on board = 5,750 / 1,000 = 5.75 = 3
- Restock level = 5,750 minus 1,000 X (3 – 1) = 875

Assay and Reagent Management Planning
LEAN Strategy: Standardize

Goal: Minimize unplanned reagent depletions and reagent waste
- Post reagent load data and instructions for each analyzer
- Load additional kit when partial kit on board is less than restock level

<table>
<thead>
<tr>
<th>Assay</th>
<th>Safety Daily Volume</th>
<th>Kit Size</th>
<th>Kits on Board</th>
<th>Number of Analyzers</th>
<th>Restock Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>880</td>
<td>1,200</td>
<td>1</td>
<td>2</td>
<td>440</td>
</tr>
<tr>
<td>Orange</td>
<td>5,750</td>
<td>1,000</td>
<td>3</td>
<td>2</td>
<td>875</td>
</tr>
</tbody>
</table>

Benefits:
Reagent does not expire on board
Kits remain on board until empty
All analyzers and assays are available during peak volume
Goal: Maximum throughput capacity during peak volume hours
- Perform analyzer maintenance and reagent management during low volume times one analyzer at a time

Benefits:
- Maximize throughput capacity
- Optimize TATs

EXAMPLE GRAPH
Perform maintenance between 9pm and 3am

THANK YOU!
ANY QUESTIONS?