Using Laboratory Automation as a Catalyst for Performance Improvement

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Baptist Health

2010 EXECUTIVE WAR COLLEGE

Goals and Objectives

Briefly review the evolution and benefits of automation in laboratory medicine.

Understand how automation can be the catalyst for process changes.

Review examples of how automation has impacted change at Baptist Medical Center.
Why Automate?

Three reasons

1. Efficiency
2. Safety
3. Error reduction

Chemistry Outpatient Test Volume and FTEs 2002-2009

[Graph showing increasing OP Test Volume and constant Total Paid FTEs]
Medical Technologists are a dwindling resource

- Third largest group of health care professionals behind physicians and nurses
- Of 9300 positions needed annually MT schools graduate only 4800 leaving a shortfall of 4500
Preanalytic

Analytic

Postanalytic

1955

Much Effort!

Much Time!
The AutoAnalyzer platform allowed laboratories to construct their own menus and methods.
Preanalytic Analytic Postanalytic

Effort / Activity

1955

Much Effort!

Much Time!
Preanalytic  Analytic  Postanalytic

<table>
<thead>
<tr>
<th>Effort / Activity</th>
<th>1955</th>
<th>Much less Effort !</th>
<th>Much Less Time !</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td></td>
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</table>
“In the past 40 years, quality has improved greatly, largely because of automation.”

Jan S. Krouwer, Ph.D.

"Automating a bad process only serves to speed-up problems."

Ana Stankovic, MD, PhD, MSPH
Elizabeth DiLauri, MBA
Human / Automation Integration

- There is significant preanalytical manual activity prior to samples entering automation.
- Automation success depends heavily on the success of preanalytical human processes.
- Successful automation has an integrated link with human tasks.

Pre Automation Questions

1. How do samples arrive in the laboratory?
2. Do samples have to be relabeled?
3. How often are samples aliquoted?
4. To how many different workstations are samples routed?
5. Where are samples stored?
6. How often and how difficult is it to retrieve samples from storage for add-on testing?
Pre Automation Advice

1. **Know your laboratory!** Flow chart processes to determine areas for improvement.
2. Look for repetitive tasks and redundant processes.
3. Focus on the front end (preanalytical). This is the area where automation can have the biggest gains.
4. Eliminate as many inefficiencies as possible before automating (LEAN).
5. Outline goals for automation.

Clinical Chemistry Laboratory Automation
Baptist Medical Center

**Goals for Automation - Established 2007**
- Improve efficiency (LEAN)
- Consistency in quality and turn around time ($6\delta$)
- Patient and technologist safety
- Reduction in medical errors
- Ability to continue expansion of outreach
- Ability to offset technologist shortage
OPI Project

Laboratory/ED

TAT

Dec 2008 - March 2009

Kim Torres

Problem Statement

- In September 2008, 35% of the CBCs of the Adult ED Laboratory tests were not resulted within 32 minutes.

- In September 2008, 39% of the Chem 7 and PT of the Adult ED Laboratory tests were not resulted within 44 minutes.

- In September 2008, 34% of the CK, CKMB, Troponin, Liver Profile, and Lipase of the Adult ED Laboratory tests were not resulted within 60 minutes.

Time is referenced from ORDER to VERIFY.
**Goal Statement**

- By March 17, 2009 80% of the CBCs of the Adult ED Laboratory tests will be resulted within 32 minutes.

- By March 17, 2009 80% of the Chem 7 and PT of the Adult ED Laboratory tests will be resulted within 44 minutes.

- By March 17, 2009 80% of the CK, CKMB, Troponin, Liver Profile, and Lipase of the Adult ED Laboratory tests will be resulted within 60 minutes.

**Business Case**

- To improve physician and ED Patient Satisfaction by contributing to improved ED throughput.

- Reduction of Laboratory Turnaround time will support reduction of ED length of stay and LWBS (Left Without Being Seen) in the Adult Emergency Department.

- By reducing LWBS rate from 5.2% to 2%, assuming a historical admission rate of 20%, then we will see an additional contribution margin of $950,675.
Critical Factors Identified

- Lab orders and recollects not communicated to MLA in ED Triage
- Inadequate assistance for HUCC or other RN
- MLA in Triage batching specimens to tube to laboratory
- Triage MLA under-utilized
Rapid Cycle Process Improvements

1. Established a dedicated line for the ED staff to call the Laboratory.

2. Lab Automation in Chemistry went live the week of December 12th.

3. Indices automatically performed by Instrumentation.

4. Triage MLA flagging charts with RED tag so nurses know which patients have had blood drawn.

5. No batching of specimens from Triage (Tube station to be added)

6. Added Printer in Chemistry for Add-on Orders; changed process for ED nurses.

Revised Flowchart – Deliver to Chemistry
Major Outcomes

- ER processing bench located next to automation inlet.
- Add on procedure simplified to sync with automation.
- Pneumatic tube station installed in ER Triage area linked to pneumatic tube at ER processing bench.
- Dedicated phone line for ER calls.
- Identified second OPI project for improving specimen quality.
Revised Flowchart – Deliver to Chemistry

Symbols for Flow Charting

- Requires Human Handling
- Potential Time Delay
- Biohazard Potential
- Medical Error Potential
<table>
<thead>
<tr>
<th>Task</th>
<th>Tech</th>
<th>Time</th>
<th>Safety</th>
<th>Error</th>
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<tbody>
<tr>
<td>Physical Specimen Arrives</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Received in LIS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Racked for Centrifugation</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centrifuge Loaded</td>
<td>X</td>
<td></td>
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<tr>
<td>Centrifugation</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Centrifuge Unloaded</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove Cap</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Aliquot Necessary</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Print Labels</td>
<td>X</td>
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<td>Label Aliquot Tubes</td>
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<tr>
<td>Aliquot</td>
<td>X</td>
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<td>X</td>
</tr>
<tr>
<td>Rack for transport</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport to Chemistry</td>
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<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Transfer of Instrument Rack</td>
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<td>X</td>
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<tr>
<td>Load Instrument</td>
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<td>X</td>
<td>X</td>
<td></td>
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<td>Analyze</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unload Instrument</td>
<td>X</td>
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<td></td>
<td></td>
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<tr>
<td>Scan specimen for storage</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place in storage rack</td>
<td>X</td>
<td>X</td>
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Preanalytical Processing with Automation
Sample Introduced at INLET

Barcode scanned and sample auto-received at INLET
Samples queued for Centrifugation

CENTRIFUGE automatically loaded, balanced, and unloaded.
Caps removed and dropped into biohazard waste in DECAPPER.

Samples queried at instrument loading for routing instructions.
One sample routed to DXI for testing, the second sample routed down the automation track for the next instrument.

Specimen Arrives (Barcoded)
Specimen Received in LIS
Specimen Racked for Centrifugation
Centrifuge Loaded
Centrifugation
Centrifuge Unloaded

Specimen Arrives (Barcoded)
Specimen Loaded onto Automation Line
Potential Steps, Delays, or Hazards

<table>
<thead>
<tr>
<th>Manual</th>
<th>Automated</th>
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<tr>
<td>16</td>
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<td>13</td>
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</tr>
<tr>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
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</tbody>
</table>

Potential Steps, Delays, or Hazards

OPI Project
ED Blood Specimen
Quality Improvement
April 2009 - July 2009

Betsy Schifanella
**Problem Statement**

- Less than optimal quality specimens from the ED result in decreased quality results and increased TAT due to special handling or rework.

- From March '09 baseline data in the ED, the hemolysis rate was 14%, the short sample rate was 23%, the fibrin interference rate was 2.5%, the rework rate was 1%, and the blood culture contamination rate was 4%.

**Goal Statement**

By July 22, 2009 our team’s goal is to:

- Reduce hemolysis to 2%
- Reduce short samples by 50%
- Reduce fibrin interference by 75%
- Reduce rework (clotted, gross hemolysis, QNS, mislabeled) by 50%
- Reduce blood culture contamination rate to 2%
Business Case

- Eliminating the gold tube from the collection requirements will save Downtown $4,987 annually
- Reducing rework costs will save $5,883 per year in Laboratory supplies and labor
- Decreasing rework will improve Laboratory turnaround time and will increase ED revenue $29,952 per year by increasing ED throughput and decreasing LWBS
- Chlorascrub Swabstick supply will save Downtown $15,222 per year and $17,363 system-wide

Improvements

- Eliminated Gold Tube from collection requirements which results in Downtown savings of $4,987/yr. and reduction of short samples (low volume) by 72%.
- ED Skills Fair provided education on collection requirements based on best practice flowcharts.
  - Standardized extension assembly
  - Standardized IV blood collection (eliminated syringe/supplies for safety & proper tube filling)
  - Standardized blood culture collection
  - Reduced supply choices
**Improvements**

- Pre-packing IV Start (6 items) and Blood Culture (4 items) collection supplies which supported best practice flowcharts and education.
  - Provided only the best practice supplies
  - Facilitated gathering of supplies
  - Improved compliance with safety goals
  - Increased nurses' satisfaction in the ED

- Replace Chloraprep Frepp Applicator with Chlorascrub Swabstick as a more effective blood culture site preparation solution for a system savings of $17,363.

IV start with blood collection supplies consolidated to best practice items.
Supplies bagged to minimize searching and assembling items.

Grab and Go!

Laboratory tests  Blood culture
Latest Results

Occurrence of Less than Optimal Quality ED Specimens in DPMO

- Pre-Trial
- Trial
- Total defects

% Decrease: 28% 72% 100% -17%

Sigma: 1.63 2.33 2.34

Operational Performance Improvement Presents

DOWNSIZING ED BLOOD SPECIMEN QUALITY IMPROVEMENT

The Roland Garcia Award “Most Innovative Improvement”
July 22, 2009

Amy Landey, Director of Operational Performance Improvement
Operational Performance Improvement

Presents

The Beth Mehaffey Award
“Biggest Staff Satisfier”
July 22, 2009

Amy Mishot, Director, Operational Performance Improvement

Automation Performance
Distribution of Chemistry Tests by Priority - 5 Days (N=8274)

- **AM**: 14%
- **EX**: 11%
- **RT**: 20%
- **ST**: 40%
- **TS**: 15%

Automation Turn Around Time by Priority

- AM: 29.7
- EX: 30.4
- RT: 27.1
- ST: 30.6
- EST: 26.8
- TS: 30.9
Automation reduces variation by elimination of manual steps and reproducibly handling specimens.
Impact of Automation

- Automation TAT is consistent and independent of priority.
- Variation in TAT is less than non-automated results
- Automation performance is on par with other facilities with similar configuration.
- Good samples = good results = good TAT
Problem & Goal

Process Capability - Laboratory tests Order to Receive
Calculations Based on Logistic Distribution Model
ED Triage - CBC & Chem 7

- Sample Mean: 55.7213
- Sample N: 4212
- Location: 3.78767
- Scale: 0.38445

PPM < LSL: 0.00
PPM > USL: 886099.89
PPM Total: 886099.89

89% > than 20 minutes
89% Opportunity

Sigma Level: 0.3
Problem & Goal

July 2009 - Triage ED
(Cbc & Chem 7) - Order to Receive

Meeting Lab turnaround time of 20 minutes - 11% of the time

Business Case

- Project could contribute to reduce Left without Being Seen patients in the Emergency Department. If LWBS is reduced to 2 percent (the benchmark), the Hospital Contribution Margin would be between $1.5 and $2.5 million dollars.
**Improvements**

- Create Triage RN-MLA phlebotomist teams; one MLA assigned to each nurse; laboratory specimens drawn while nurse is triaging patient.
- Dedicate Processing Station in laboratory to Emergency Department specimens only.
- Triage rooms modified to a multi-functional standard.
- Patient taken to triage room and Triage Teams move between rooms.
- Rescue Patients triaged by Triage RN-MLA team; labs ordered and drawn before patient sent to Main ED bed.

**Latest Results**

![Control Chart - ED Triage Lab Tests (Chem 7 & CBC)](chart.png)

Order to Receive time in minutes (GOAL = 20 minutes)

- **AVG=65 min**
- **AVG=11 min**

**July Baseline** - meeting 20 minute goal 11% of the time
**9-8-09** - meeting 20 minute goal 92% of the time
**9-30-09 & 10-1-09** meeting 20 minute goal 80% of the time
Latest Results

Control Chart - Rescue Patients - Arrival to First Order
(CHEM 7 & CBC)

Baseline 9-21 meeting 20 min. goal 31% of the time
Meeting 20 min. goal 100% of the time
Meeting 10 min. goal 91.4% of the time

20 minutes

Patients

Minutes

X=5.5
UCL=13.0
LCL=-2.0

Awards

• Greatest staff satisfier
  – Team Concept
• Greatest patient satisfier
  – Expedited patient care
• Most innovative improvement
  – Team comes to the patient
• Most successful project
  - Arrival to first order 40 to 5.5 min. (100%)
  - Order to received in Lab 65 to 11 min. (92%)
Post-analytical Data Review and Monitoring Station

Clinical Laboratory Automation
Baptist Medical Center - Downtown
Goals for Automation - Established 2007

- Improve efficiency (LEAN)
- Consistency in quality and turn around time (6σ)
- Patient and technologist safety
- Reduction in medical errors
- Ability to continue expansion of outreach
- Ability to offset technologist shortage

Goals for Automation - Accomplished 2009
Lessons Learned (OPI Team Perspective)

• Little changes can make a big difference!

• Well designed changes improve outcomes for patients and staff.

• Education alone had minimal impact on changing a process. When pre-packed supplies were provided the new process was enforced and positive change resulted.

• The power and momentum of a dedicated team is awesome!

Lessons Learned (OPI Team Perspective)

• Different perspectives from multiple departments give better insight into improving how processes in one department affect another department.

• Improved relationships between departments contributes to improved processes and better outcomes for patients.

• Appreciated their ideas being heard and incorporated into possible solutions.

• We are contributing to better patient care!
Successful LEAN processes = Successful Automation

MLA / RN Triage Team
Prepackaged Collection Sets for ER
Pneumatic tube station in Triage
ER processing bench next to automation inlet
Add-on procedures utilize automated storage
ER Tracker board in Chemistry

Summary
Automated laboratories today are a reflection and continuation of clinical laboratory automation that begun with the invention of the AutoAnalyzer.

Automation is efficient, safe, and accurate . . .

but only when successfully integrated with well implemented LEAN human processes.