What was the problem to be solved?

Turn-around-times (TATs) for emergency department troponin results were not meeting physician expectations for both consistency and speed. Although, internally, it appeared we were meeting our goals, we failed to illicit input from our caregivers on what the goal should actually be! We had set goals that were easily achievable and didn’t drive for process improvement.

How was it identified?

The Laboratory launched a Value Stream Analysis (VSA) in July of 2014. In addition to Laboratory Leadership, team members included physicians from both the Emergency Department (ED) and inpatient hospitalist services. The timeliness of Emergency Department results was chosen as a VSA level metric to gauge the level of improvement of services. To further focus our efforts, we asked our physician partners to choose a test that was typically ordered in the ED that was causing frustration. Troponin was selected because it has high-impact on patient care and was a data point for Chest Pain Center accreditation.

What base line data existed?

TATs for ED Troponin results have been measured by the Laboratory for many years. The goal (set by the Laboratory!) was to have ≥90% of the Troponins reported within 60 minutes after receipt in the laboratory. The average TAT was to be ≤ 60 minutes. Metrics based on the criteria are shown in Chart 1.
What were the goals – how would you know if you were successful?

It was important for us to let our customers determine how success looked and felt. In our future state, ED physicians wanted troponin results completed within 30 minutes of receipt in the Laboratory (>90% of the time).

With this new goal came new baseline data (Chart 2). The results were horrifying.

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**Chart 1**

<table>
<thead>
<tr>
<th>Month</th>
<th>Average TAT (mins)</th>
<th>% of Troponins reported within 60 mins</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Goal = ≤60 mins</td>
<td>Goal = &gt;90%</td>
</tr>
<tr>
<td>May 2014</td>
<td>49</td>
<td>93.2</td>
</tr>
<tr>
<td>June 2014</td>
<td>49</td>
<td>94.0</td>
</tr>
<tr>
<td>July 2014</td>
<td>49</td>
<td>94.0</td>
</tr>
</tbody>
</table>

**Chart 2**

<table>
<thead>
<tr>
<th>Month</th>
<th>Average TAT (mins)</th>
<th>% of Troponins reported within 30 mins</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Goal = ≤30 mins</td>
<td>Goal = &gt;90%</td>
</tr>
<tr>
<td>May 2014</td>
<td>49</td>
<td>1.3</td>
</tr>
<tr>
<td>June 2014</td>
<td>49</td>
<td>1.4</td>
</tr>
<tr>
<td>July 2014</td>
<td>49</td>
<td>2.9</td>
</tr>
</tbody>
</table>

We identified several ways in which we would determine the success of this process:

- Speed - Troponin average TAT ≤ 30 minutes
• Consistency - ≥ 90% of Troponins completed within 30 minutes
• Physician satisfaction

Process:

What methodology or process was used to develop the Solution?

The Laboratory used Lean methodology to develop solutions that would drive the department towards this goal. An interdisciplinary team of physicians, nurses, patient care techs, and laboratory staff met to determine gaps, using an Ishikawa diagram, which prevented us from reaching our target state. We also brain-stormed multiple solutions and used a PICK Chart (Image 1) to prioritize ideas with the greatest potential impact. At the heart of this process was the use of metrics to measure success and drive for continual process improvement.

Solution:

What Solution was developed? How was it implemented?

Solutions included both education and process changes. All were successful to some degree but not necessarily a magical cure individually.

• Staff education – Both nursing and laboratory staff received education about the importance of timeliness when sending, receiving, and reporting of troponin tests. This resulted in an “awareness” bump that moved the consistency metric from 2.9% to 45.5% (% of troponins reported in ≤30 minutes). As with most education, the information is transitory and keeping it “top of mind” requires constant reinforcement.
Sequester troponin specimens – Blood tubes that included troponin requests were highlighted by ED nursing staff prior to sending them to the lab. This visual cue was used by the laboratory staff to pull them out of the current standard processing work flow and expedite them through the testing process. This included spinning the samples on a small “stat” centrifuge and by-passing the clinical automation line that transports specimens to the analyzers. The positive impact on the metrics was tangible but the process was not sustainable. After an initial improvement in the metrics (87.5% reported in ≤30 minutes), we soon noticed that the specimens were not being marked in the ED and were then getting missed for special-handling in the Laboratory. As a result the metric fell. We worked with our nursing partners and discovered that process was not sustainable for a variety of reasons (ex. didn’t fit into the natural workflow, unable to find highlighters, etc.). This process of highlighting tubes was abandoned since it introduced a level of variability that could potentially delay results even further. We continued to have our Lab Assistants try to sequester troponin requests upon receipt in the Laboratory.

Daily huddles – Laboratory staff were introduced to the revised metrics during daily huddles. In order to avoid angst and desperation, the manager incrementally stepped the staff into the new goal. A run chart was used to monitor daily performance. Staff was initially told that the goal was to have troponins reported within 45 minutes 80% of the time. As the goal was met, the target was moved closer to our ideal state. The run chart (Image 2) provided visual reinforcement to staff that targets were being achieved and stimulated discussion (and counter measures) when the goal was not met.
• Instrument reconfiguration – The blood tube collected for troponin testing included requests for additional chemistry analytes. The tube would be directed to the analyzer that performs troponin testing (Siemens Advia® Centaur XP) AFTER stopping at the analyzer that performed general chemistry testing. Troponin testing requires twice as much time as chemistry testing so it would be more efficient to initiate the troponin testing process first. Our vendor was able to reconfigure the path that the tube takes so it is directed to the Centaur first.

• Auto verification – While observing the testing process, we noticed that valuable time was wasted during the result verification stage. Results would transmit from the instrument to our LIS via a middleware interface. Often, the result would sit in queue awaiting the review of a technologist before being verified and transmitted to the electronic medical record (EMR). In most cases, the reviewing of the result did not result in any change of the data. We worked with our instrument vendor (Siemens WorkCell® w/Advia® 1800 & Advia® Centaur XP) to streamline this process by implementing auto-verification of results. Now, each result is assessed by the computer using a series of rules. Results that pass established criteria are automatically verified and made available in the EMR. Currently ~94.6% of results are being auto-validated.

Measurable Outcomes:

What are the results of implementing the Solution? Provide qualitative and/or quantitative results to data.

An immediate improvement was seen between July 2014 and August 2014 with simply making the staff aware of the new metric. Daily metrics, including Run and Pareto charts, allowed for more immediate investigation into outliers and also gave staff the opportunity to change process and see more timely feedback of its effectiveness (Chart 3).
What measures are being taken to ensure that results can be sustained and spread?

Troponin TAT is a daily metric that is shared during departmental daily huddles (Image 3 and 4). Outliers are investigated and countermeasures are developed for trends.

Sustainability:

Troponin TAT is a daily metric that is shared during departmental daily huddles (Image 3 and 4). Outliers are investigated and countermeasures are developed for trends.
Our goal is to continually push for process improvement. Our chemistry analyzers are scheduled for replacement in fiscal year 2016. While assessing the current market, the machine-time (the time it takes the analyzer to produce a result) was used as one of the evaluation criteria. Our current machine-time is 18 minutes. Our replacement analyzer (Siemens Dimension Vista® 1500) has a machine-time of 9 minutes. As we continue to move towards improvement, it would be mind-blowing if we could actually adopt a more ambitious goal than what our physicians expect!

### Role of Collaboration and Leadership:

**What role did teamwork and collaboration play in the Solution? What partners and participants were involved?**

The project has benefited from a multi-disciplinary approach. The active participation of physician and nursing during the VSA gave us key insights into the needs of our stakeholders. This also gave our stakeholders key insights into the operations of a department that supports the care that is provided to our patients.

Lean management is supported at Anne Arundel Medical Center through an active performance improvement team. The Laboratory’s VSA is guided by a facilitator and on-site sensei as well as sponsored by a member of the Executive Leadership Team.

**Was the organization’s leadership engaged and did they share the vision for success?**

This work was highlighted during the organization’s Chest Pain Center w/PCI Accreditation process. Results are also discussed at bimonthly VSA steering committee huddles which include members of the medical staff, executive leadership, lab leadership, and process improvement teams.

**How was leadership support demonstrated?**

A testament to the impact that this project has had on operations: Several months into this process, a vendor approached our ED leadership team offering a solution to improve the TAT of troponins by implementing a point-of-care testing device. The vendor’s solution would have cost our organization approximately $214,000/year to operate. Our team (Lab, ED physicians, ED nurses) reviewed our latest metrics and decided that our current progress (and future projects) to continue improvement would preclude the need to add this additional expense to our budget.
This show of support for the process was tremendous and was shared with all levels of our organization.

**Innovation:**

**What makes this Solution innovative? What are the unique attributes?**

The voice of the customer is a key tenant of Lean methodology. At the start of this process, the Laboratory and the ED physicians were clearly not aligned in how success looked. The Laboratory thought it was doing a fabulous job meeting physician expectation because the goal, albeit an artificial one, was clearly being met. While in fact, we were perpetuating their stereotype that the Laboratory was slow and unresponsive to their needs as well as the needs of our patients. By engaging our customer (ED physicians) in establishing our service goal we were able to build a collaborative vision of success that improved patient care.

The concept of setting challenging goals was a paradigm shift for us. Without it though, we would not have kept working towards solutions as doggedly as we have. In the past, we would have met the goal, said good-enough, and moved on. We would have missed the opportunity for some ground-breaking changes that have positively impacted other processes within the Laboratory. As yet, we have not consistently met our goal so we continue to push towards it. When we reach it, we’ll reset the bar even higher, with the input of our customers!

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