HFMA: Lone Star Major League Institute
Using Lean and Six Sigma to Optimize Performance

May 20, 2013
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Overview
Session Objectives

The objective of this session is to understand how Lean and Six Sigma can provide the necessary framework to rethink care delivery processes.

By the end of this discussion, all participants should be able to:

• Appreciate how the simultaneous necessities to lower cost and improve quality are not contradictory.
• Understand the basic tenets of Lean and Six Sigma.
• Recognize how healthcare organizations are applying these tool sets.
• Identify opportunities to incorporate Lean and Six Sigma tools and understand how to get started.

NOTE: In this document, “Lean and Six Sigma” language is used in its technical context. A glossary of key terms is included in APPENDIX A for reference.
Agenda

I. Laying the Groundwork
II. Toolbox
III. Case Study

Appendix A – Glossary

I. Laying the Groundwork
I. Laying the Groundwork
The Relationship Between Cost and Quality

Many programs being put into place today are fundamentally based on the assumption that higher quality ultimately leads to lower costs.

- **Accountable Care Organizations** – Based on the premise that better quality can reduce long-term costs.
- **Preventable Harms** – Eliminating falls, pressure ulcers, and adverse drug events improves care quality and simultaneously reduces costs.
- **Access** – Improving access (one aspect of quality) through the use of advanced practice clinicians (APCs) reduces the direct expense for a patient visit.
- **Proactive Care Management** – Certain types of proactive care management (e.g., cancer screenings, yearly physicals) will improve quality of life and save dollars at the same time.

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In September 2012, the Institute of Medicine (IOM) published its findings on waste in the healthcare system, much of which could be addressed through the effective deployment of Lean and/or Six Sigma as a way of doing business.

Conduct analysis of variance between providers in order to identify best practices.

Streamline processes to minimize unnecessary expenditures.

Optimize processes and establish a Lean culture that focuses on continuous improvement.

Develop and implement standard work and care protocols.

These areas will be the target of continued governmental and payor pressures. Organizations with strong continuous improvement programs will be the best prepared.

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I. Laying the Groundwork

More Demanding Consumers Are the Norm

New demands from patients and payors are forcing the redesign of the way care is delivered in physician practices.

New Demand for Care

Access

Comprehensive Care

Coordinated Care

Patient Engagement and Communication

Practice Responses

- Schedules with same-day open access and/or extended hours.
- New delivery model (patient-centered medical home [PCMH] or team model).
- New patient encounter types (e-visits, e-mail).
- Stratification of patient panel at the start of the visit to off-load physician schedule.

- Dedicated care managers or disease management PCMHs.
- Coordination with dentists, pharmacists, and nutritionists for preventive care.
- Provision of services at schools, employers, so forth.
- Evidence-based practices.

- Primary care physician (PCP) collaboration with specialists to set expectations for referral coordination.
- Standards for information sharing (e.g., patient discharge notes, medication reconciliation).
- Organization-wide standard protocols for patient follow-up.

- Patient portals, chat rooms, e-visits.
- Group visits.
- Education champions in each practice.
- Online scheduling.
- In-office resource centers.
- Telephone calls for patient follow-up.
- Public disclosure.

I. Laying the Groundwork

Evolution to Population Management

Payment systems are being designed with an end-state vision of evolving from isolated episodes of care delivered by independent physicians to a more collaborative approach with greater accountability.

Physician engagement.

Peer-to-Peer Counseling

Collaboration

- Patient engagement and involvement.
- Evidence-based medicine.
- Care coordination.

- Cost monitoring.
- Encouraging improved performance.

Performance Measures

- Data sharing.
- Quality monitoring.
  - Individual level.
  - Group level.
  - Entire organization.

Financial Incentives

The requirements for care delivery transformation will vary for PCPs and specialists, but they will likely result in the need to rethink processes within the clinical environment.
I. Laying the Groundwork

By Definition

Many organizations are turning to Lean and Six Sigma as tools to address cost and quality simultaneously. They are complementary and often overlapping philosophies that make the patients’ needs the top priority.

Lean
• Considers any activity that does not directly create value for the customer to be a target for improvement or elimination.
• Often known for the principle of “waste reduction.”
• Valued as a tool for cultural change as well as cost reductions.

Six Sigma
• Targets perfection by identifying the causes of errors and reducing process variation.
• Focused on quality improvement, with cost reduction as a benefit of reaching that goal.
• Establishes a threshold of acceptable performance at the “six sigma” level (i.e., 3.4 defects per million opportunities).

“Americans would be better served by a more nimble health care system that is consistently reliable and that constantly, systematically, and seamlessly improves.”
– IOM, September 2012

I. Laying the Groundwork

Readiness Assessment

As Lean and Six Sigma are deployed, organizations are having mixed results. There is great potential, but organizations are frequently unprepared, lacking the infrastructure necessary for success.

Leadership Commitment
Project Management
Physician Alignment

Project Prioritization
Easy Access to Reliable Data

Before embarking on a process improvement program, it is critical to ensure that the necessary infrastructure is in place so that you can make the most of limited resources.
I. Laying the Groundwork

Change Continuum

Once an improvement program is in place, an organization slowly shifts its culture along the change continuum during the transition to a culture of continuous improvement.

Action
- Launch program.
- Train limited resources.
- Tackle “quick win” projects and begin to see results.
- Have success stories and work on a sustainment program.
- Have developed into a learning organization with bottom-line results.

Culture
- “What are Lean and Six Sigma?”
- “We are in this together and are making positive changes.”
- “Maybe this could actually be useful.”
- “This is just the flavor of the month.”
- “Why didn’t we do this sooner?”

The culture must be regularly assessed in order to ensure that it is continuing to move up the continuum.

I. Laying the Groundwork

Measurement

Meaningful goals must be defined at the outset of any process improvement initiative to drive performance expectations with monitored, objective data.

<table>
<thead>
<tr>
<th>Area</th>
<th>Outcome Metrics</th>
<th>Improvement Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational</td>
<td>Patient visits per day.</td>
<td>Provider time that is value-added.</td>
</tr>
<tr>
<td>Throughput</td>
<td>Length of visit (cycle time).</td>
<td>Average patient queuing time.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ratio of cycle time to “takt” time.¹</td>
</tr>
<tr>
<td>Scheduling</td>
<td>Appointment lead time.</td>
<td>Amount of rescheduling.</td>
</tr>
<tr>
<td></td>
<td>Portion of provider time not</td>
<td>Schedule accuracy (actual vs. scheduled visit duration).</td>
</tr>
<tr>
<td></td>
<td>utilized.</td>
<td>Cancellation/no-show rate.</td>
</tr>
<tr>
<td>Revenue Cycle</td>
<td>Collections rate.</td>
<td>Portion and value of denials that are controllable.</td>
</tr>
<tr>
<td></td>
<td>Charge lead time.</td>
<td>Portion of pre-authorizations done correctly the first time.</td>
</tr>
<tr>
<td>EMR Optimization</td>
<td>Achievement of meaningful use.</td>
<td>Improved processes and work flows.</td>
</tr>
<tr>
<td></td>
<td>Disease registries.</td>
<td>Provider time that is value-added.</td>
</tr>
<tr>
<td></td>
<td>Completed health risk assessments.</td>
<td>Participation in new payor models.</td>
</tr>
<tr>
<td>Quality</td>
<td>Patient satisfaction.</td>
<td>Adherence to protocols.</td>
</tr>
<tr>
<td></td>
<td>Physician satisfaction.</td>
<td>Referral sources.</td>
</tr>
<tr>
<td></td>
<td>National measures (HEDIS,</td>
<td>Subsets of satisfaction surveys.</td>
</tr>
<tr>
<td></td>
<td>core measures).</td>
<td></td>
</tr>
</tbody>
</table>

¹ Takt time is demand divided by capacity.
## II. Laying the Groundwork
### Sample Findings

*By effectively managing these areas of opportunity, organizations can realize measurable improvements within the physician enterprise.*

### Operational Processes
- Improve scheduling accuracy/ownership.
- Balance clinic/staffing schedules to better utilize resources.
- Evaluate clinic building space allocations.
- Reduce duplicative processes.

### Care Model
- Identify appropriate staffing models.
- Evaluate staffing levels and licensure mix.
- Clarify expectation of nursing roles in clinic.
- Promote team-based accountability for patient experience.

### Systems
- Develop robust dashboards with clear targets.
- Optimize EHR to enable daily task management.
- Create ongoing in-clinic training program.
- Streamline documentation.

### Revenue Cycle
- Stabilize front-end revenue cycle expectations.
- Optimize charge capture performance.
- Develop manager training to enhance understanding of practice drivers.

### Organizational Enhancement
- Clarify roles and responsibilities.
- Create decision-making forum with physician input.
- Develop infrastructure for process improvement.
- Evaluate support functions for centralization.

**Lean and Six Sigma offer additional analytical rigor and provide tools to achieve desired results.**

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## II. Toolbox
II. Toolbox
Six Sigma Process (DMAIC)

Define
- Determine scope, goals, and key stakeholders.
- Estimate timeline, budget, and resources.

Measure
- Map the current state through interviews and observation.
- Deline key process metrics (CTQs).
- Assess data accuracy.

Analyze
- Identify waste.
- Locate internal and external sources of variability.
- Ascertain causes of redundancy and errors.
- Prioritize potential changes based on impact and risk.

Improve
- Implement process changes.
- Review outcome and CTQ performance in order to understand the impact of changes.
- Repeat “Analyze” and “Improve” phases until desired outcomes are achieved.

Control
- Establish ongoing accountability and measurements.
- Monitor performance to ensure the sustainability of improvements.

Many organizations struggle with the “Control” phase, which requires sustained focus on gains that have been made through an improvement effort.

II. Toolbox
Lean Daily Management

To achieve improvement goals, providers and staff must have visibility into daily variability and be held accountable for performance so that they can react in real time.

Step 1 – Measure Performance

Step 2 – Visually Track Performance in Comparison to the Goal

Date | Reason for Missed Goal
-----|-----------------------
9/1/2012 | Appointments had to be rescheduled for tomorrow because a provider failed to notify the practice manager of a planned vacation day.
9/7/2012 | New patients did not complete the required paperwork and were not seen by the provider until 30 minutes after their scheduled appointment time.

Step 3 – Understand Reasons for Deviations

Step 4 – Make an Action Plan for Improvement

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Responsible Individual</th>
<th>Due Date</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create a policy that requires providers to notify the practice manager of planned vacation days.</td>
<td>Practice Manager</td>
<td>10/15/2012</td>
<td>Complete.</td>
</tr>
<tr>
<td>Develop a program to ensure that new patients receive their paperwork 7 days prior to their scheduled appointment, and establish a policy that requires patients to have the completed paperwork with them at the time of their appointment.</td>
<td>Practice Manager</td>
<td>10/1/2012</td>
<td>In progress.</td>
</tr>
</tbody>
</table>

Many providers are interested in this approach because of real-time feedback and improvements.
II. Toolbox
Goal Deployment/Strategic A3X

The GDP utilizes an “X matrix” as a strategic planning tool to align improvement efforts with the most critical business objectives.

Implementing Goal Deployment
- The matrix is read by following the “X”s around the square (see highlighted route).
- The A3X is developed at the highest organizational level (e.g., medical group).
- The improvement targets from the top A3X become the breakthrough objectives for the next level.
- This process continues until the point at which action plans can be developed.

Many organizations are utilizing GDP as their only strategic planning tool and aligning all initiatives, including but not limited to Lean/Six Sigma, to one of their top-level objectives. “If it doesn’t fit, it can wait until next year!”

II. Toolbox
Value Stream Mapping

A value stream map (VSM) is a tool used to assess work flow, identify waste, and plan for the reduction/elimination of the waste within a given time frame. All process steps are identified from start to finish.

- VSM provides a common language that helps stakeholders visualize the future vision.
- Identifies value-added and non-value-added time for the patient.
- Identifies deviations between the actual process and the intended process.
- This tool is useful as part of a process-mapping exercise.

To improve a process, you should focus on establishing flow, eliminating waste, and adding value to the patient.
II. Toolbox
Rapid Improvement Events

A rapid improvement event (RIE) is a 3- to 5-day event that brings together a team of stakeholders with the objective of improving a specific process. The goals of the event are to identify improvement opportunities, develop solutions, and implement them quickly.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Tools</th>
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<tbody>
<tr>
<td>Preparation</td>
<td>• Scope the problem.</td>
</tr>
<tr>
<td></td>
<td>• Select a team.</td>
</tr>
<tr>
<td></td>
<td>• Collect outcomes data.</td>
</tr>
<tr>
<td>Day 1</td>
<td>• Identify the current state.</td>
</tr>
<tr>
<td>Day 2 to 3</td>
<td>• Identify opportunities to improve the process.</td>
</tr>
<tr>
<td>Day 4 to 5</td>
<td>• Design and test the future state.</td>
</tr>
<tr>
<td>Action Plan</td>
<td>• Clarify required next steps to achieve the desired future state.</td>
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RIEs can provide immediate benefits, but the organization must develop an action plan and arrange for ongoing monitoring in order to ensure sustainment.

II. Toolbox
Standard Work

“Standard work” is the best-known way of doing something. It is one of the most powerful Lean tools and forms the baseline for continuous improvement.

Elements of Standard Work

- **Takt Time** – The rate at which a process must be completed in order to meet customer demand.
- **Work Sequence** – The order in which tasks are performed.
- **Standard Inventory** – The number of units\(^1\) required to keep the process operating smoothly.

\(^1\) Units may be patients, instrument trays, charts, lab tests, etc.

Standard work is a continuous effort and relies on feedback from staff and providers.
II. Toolbox

Control Charts

Control charts provide a visual method for distinguishing between normal process variability and special-cause process variability.

Traditional Scorecard                  Control Charts                  Conclusions
Collections Rate
Month    YTD

Visits Per Day

Patient Satisfaction

Conclusions:
- Performance is above target, but appears to be deteriorating.
- Improvement efforts do not appear to be having any effect.
- This month's performance was an anomaly and requires investigation.

Control charts supplement management dashboards by providing statistical and trending insights.

II. Toolbox

Sustainment

Without providing the tools to monitor and meet best practices, it is unreasonable to expect sustained improvement over time.

Best Practices ➔ Standards ➔ Habits ➔ Sustained Improvement

- Many organizations forget to allocate time for the sustainment phase of the project.
- Lean daily management is one of the most common accountability tools in healthcare.
- EMR reporting tools may need to be leveraged to support performance improvement efforts.
III. Case Study

Medical Group

Medical Group (400+ Providers)
Part of an Integrated Health System; Rural Dispersed Market

Goal – Increase patient volumes through outpatient clinics.

Background – The medical group’s financial performance was not sustainable, and management was looking for ways to improve outcomes.

Outcomes – Prioritized list of interventions, action plans, and detailed charters that outlined necessary process improvement efforts.
III. Case Study
Medical Group – Process Mapping

There are opportunities for performance improvement throughout the process.

<table>
<thead>
<tr>
<th>High-Level Clinic Process and Control Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
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</tbody>
</table>

III. Case Study
Medical Group – Major Findings

Given the preceding, there are three major areas of opportunity to create a more productive clinic environment:

- **Optimization of Clinical Time** – Maximize the productivity of existing provider time in the clinic through the implementation of more effective master schedules, efficient and effective scheduling processes, and a reduction in lost capacity due to no-shows and last-minute cancellations.

- **Staffing for Throughput** – Identify the ideal staffing model for each clinic, with redefined responsibilities for each support role. Then develop a training and transition plan to maximize the use of existing staff and ensure they are working to the top of their license.

- **Access and Patient Satisfaction** – Capture return and follow-up visits before the patient leaves the clinic space in order to improve patient service and reduce the need for duplicative work.
III. Case Study
Medical Group – Load Balancing

While there is time available for more patients in existing schedules, volumes may not be possible if they are added to the busiest days in clinic.

Assumptions about the flexing of space and master schedules may need to be evaluated.

NOTES: In both figures, the lines indicate the maximum/minimum values; the bars represent the 25th and 75th percentiles.
Standard practice in an orthopedic clinic is three exam rooms per physician in the clinic, plus one additional room if that physician is supervising an APC.

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III. Case Study
Medical Group – Standard Work

To increase appointment availability, session durations could be established. A 4-hour expectation could be standardized, while maintaining independent decision making for the provider in relation to start/stop times.
### III. Case Study
#### Medical Group – Process Redesign

The industry recognizes that dedicated resources are today's best practice for optimizing physician productivity, while successful organizations also design their infrastructure to be adaptable to the evolving nature of healthcare delivery.

#### Current State
- **Nursing Pool**
  - Utilization of Whomever Is Available
  - Limited Clinic Prep
  - Limited Clinic Discharge
  - High Staff Dissatisfaction
  - Provider-Centric vs. Patient-Centric

#### Future State
- **RN Triage and Clinical Support**
  - Team-Based Care
  - MA Assignment
  - RN Scope of Practice
  - Appropriate Staff Levels

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### III. Case Study
#### Medical Group – Opportunities for Error

Unnecessary complexity in the master schedules creates opportunities for error, difficulty finding appropriate slots, and challenges for planning staff schedules.

#### Opportunity – Visit Type Utilization

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Number of Visit Types</th>
<th>Types With Volumes &lt;100</th>
<th>Types With Volumes &lt;10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allergy</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiology</td>
<td>22</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Endocrinology</td>
<td>12</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>General Surgery</td>
<td>20</td>
<td>15</td>
<td>5</td>
</tr>
</tbody>
</table>

- In many specialties, there are visit types with extremely low utilization.
- In general surgery, 95% of all cases are scheduled into the top five visit types.

#### Opportunity – Unclear Visit Types

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Visit Type</th>
<th>Arrived Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urology</td>
<td>Procedure 3</td>
<td>73</td>
</tr>
<tr>
<td>Plastic Surgery</td>
<td>Procedure 4</td>
<td>60</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>(blank)</td>
<td>177</td>
</tr>
</tbody>
</table>

- Without clear appointment types, it is difficult to ensure accuracy in central scheduling.

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#### Opportunity – Undefined Providers

<table>
<thead>
<tr>
<th>Provider</th>
<th>Arrived Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHED, USE479</td>
<td>817</td>
</tr>
<tr>
<td>SCHED, USE97</td>
<td>1,157</td>
</tr>
<tr>
<td>(blank)</td>
<td>10,819</td>
</tr>
</tbody>
</table>

- Without clear schedules, clinic managers find it difficult to plan ahead.
III. Case Study  
Medical Group – Lost Capacity  

While it is important to have some excess capacity in order to ensure reasonable patient access, approximately 28% of existing appointment time is underutilized due to scheduling inefficiencies and no-show rates.

- The ability for schedulers to maximize available provider time varies by clinic.
- All of the clinics have some loss of capacity due to same-day no-show rates, with most clinics in the 8% to 10% range.
- Some clinics may have inherent inefficiencies due to their physical space, such as the GI physicians needing to travel between buildings throughout the day.

Improving the scheduling process could increase volumes without needing to change provider time in the clinics or physician behavior.

Existing Clinic Slot Utilization

NOTE: Assumed 46 weeks per year. Calculations include only physicians who were or are currently employed.

III. Case Study  
Medical Group – Projected Impacts  

Based on benchmarks and existing resources, ECG Management Consultants, Inc., estimated the increase in patient volumes that would be possible without opening new clinic sessions or changing provider clinical practices.

Key Assumptions
- Staffing schedules are able to be adjusted as needed.
- Scheduled visit durations are accurate to reality.
- Scheduled visit durations and visit type mix remain consistent.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Constraint</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 Actual</td>
<td>Actual 2012 visit volumes.</td>
<td>N/A.</td>
<td></td>
</tr>
<tr>
<td>75% Appointment Slot Utilization</td>
<td>Assumes that provider schedules remain as they are, but with an increase in slot utilization up to 75%.</td>
<td>Hours per week.</td>
<td>+12%</td>
</tr>
<tr>
<td>4-Hour Session Standard</td>
<td>Assumes that provider sessions remain as they are, but are extended to a full 4-hour session where they are not already.</td>
<td>Sessions per week.</td>
<td>+20%</td>
</tr>
</tbody>
</table>

Not all of these volumes may be possible to achieve if the critical support infrastructure is not available.
**III. Case Study**

**Medical Group – Charter**

*Charters based on assessment findings become the road map for improvement.*

<table>
<thead>
<tr>
<th>Component</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Statement</td>
<td>Many patients are leaving the clinic building without the necessary follow-up appointments scheduled, creating additional work for the patient, opportunities for miscommunication, appointment volumes not being captured, and additional calls through the call center.</td>
</tr>
<tr>
<td>Scope</td>
<td>Redesign of checkout function after provider clinical visit has been completed.</td>
</tr>
<tr>
<td>Measure Definition</td>
<td>Portion of patients leaving the clinic building with all follow-up appointments scheduled.</td>
</tr>
<tr>
<td>Goal Performance</td>
<td>TBD.</td>
</tr>
<tr>
<td>Tasks</td>
<td>The team will work to establish a reliable measurement for both current performance and the reasons for failure. This information will be utilized to conduct an RIE that ultimately culminates in a new checkout process.</td>
</tr>
<tr>
<td>Timeline and Plan</td>
<td>45–60 days: Change management plan, TBD.</td>
</tr>
</tbody>
</table>

**Standard Project Milestones**

1. Develop project goals and charter.
2. Define process and outcome measures.
3. Map current state.
4. Identify barriers and opportunities.
5. Design future state.
6. Develop strategy and transition plan.

**One-Week Rapid Improvement Event**

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**III. Case Study**

**Medical Group – Performance Dashboard**

**Projected Exam Room Needs**

<table>
<thead>
<tr>
<th>Exam Room, Variance</th>
<th>Actual Visit Durations</th>
<th>Actual Sessions</th>
<th>Minimum Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10.0</td>
<td>8.0</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>6.0</td>
<td>4.0</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td>0.0</td>
<td>-2.0</td>
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<tr>
<td></td>
<td>-2.0</td>
<td>-4.0</td>
<td>-6.0</td>
</tr>
<tr>
<td></td>
<td>-4.0</td>
<td>-8.0</td>
<td>-10.0</td>
</tr>
</tbody>
</table>

**Provider Time Utilization**

<table>
<thead>
<tr>
<th>Performance</th>
<th>BHC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of FTE Quantity</td>
<td>775</td>
</tr>
<tr>
<td>Percentage Scheduled</td>
<td>80%</td>
</tr>
<tr>
<td>Percentage Arrived</td>
<td>44</td>
</tr>
</tbody>
</table>

**Time Allocations**

- Business Operations: 10%
- RN: 33%
- Licensed Practical Nurse: 14%
- MA, Nurse Aide: 30%

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785\02\1380\pptr\E2
### III. Case Study

#### Outcomes

Across-the-board changes have yet to be implemented; however, pilots of key enhancements have demonstrated significant results.

<table>
<thead>
<tr>
<th>Balanced Scorecard Domains</th>
<th>Desired Outcomes</th>
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<td>Quality</td>
<td>Access</td>
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<tr>
<td>Patient and Staff Satisfaction</td>
<td>Cost</td>
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### Questions & Discussion

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Appendix A
Glossary

• **Black Belt** – Black Belts are knowledgeable and skilled in the use of the Six Sigma methodology and tools.
  – Black Belts have typically completed 4 weeks of Six Sigma training and have demonstrated mastery of the subject matter through the completion of project(s) and an exam.
• **Charter** – A document that clearly identifies the purpose of a quality improvement project.
• **Critical-to-Quality** – Internal critical quality parameters that relate to the wants and needs of the customer.
• **Cycle Time** – Total time from the beginning to the end of the process, as defined by the customer.
• **DMAIC** – Define, Measure, Analyze, Improve, and Control. Incremental process improvement using Six Sigma methodology.
• **Green Belt** – An employee of an organization who has been trained on the improvement methodology of Six Sigma and will lead a process improvement or quality improvement team as part of his/her full-time job. The Green Belt’s degree of knowledge and skills associated with Six Sigma is lower than that of a Black Belt.
• **Kaizen** – Japanese term that means continuous improvement, taken from the words “kai,” meaning “continuous” and “zen,” meaning “improvement.”
Appendix A
Glossary (continued)

- **Poka-Yoke** – Japanese term that means “mistake proofing.”
- **Six Sigma** – Methodology that provides businesses with the tools to improve the capability of their business processes. This increase in performance and decrease in process variation leads to defect reduction and vast improvement in profits, employee morale, and quality of product.
- **Spaghetti Diagram** – A method that uses a continuous line to trace the path and distance traveled of a particular object or person throughout a process. It is most commonly illustrated on a floor map diagram that contains the entire process being evaluated.
- **Takt Time** – “Takt” is the German word for the baton used by an orchestra conductor. Lean production uses takt time as the rate that a completed product needs to be finished in order to meet customer demand.
- **Value-Added** – To be a value-added action, the action must meet all three of the following criteria:
  - The customer is willing to pay for this activity.
  - It must be done right the first time.
  - The action must change the product or service in some manner.
- **Value Stream Map** – Lean tool used to document, analyze, and improve the flow of information or materials required to produce a product or service for a customer.