A Lean Enterprise Approach to Process Improvement in a Health Care Organization

by

James Casey

B.S. Mechanical Engineering (1996)
Massachusetts Institute of Technology

Submitted to the System Design and Management Program
in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Engineering and Management

at the

Massachusetts Institute of Technology

June 2007

Signature of Author _____

James Casey
System Design and Management Program
May 11, 2007

Certified by _____

Dr. Ricardo Valerdi
Thesis Supervisor
Center for Technology, Policy, and Industrial Development

Certified by _____

Patrick Hale
Director
System Design & Management Program

This Page Intentionally Left Blank

A Lean Enterprise Approach to Process Improvement in a Health Care Organization

by

James Casey

Submitted to the System Design and Management Program

On May 11, 2007 in Partial Fulfillment of the

Requirements for the Degree of Master of Science in

Engineering and Management

ABSTRACT

United States health care costs are rising and demand is increasing as the population ages. An already overburdened system is being squeezed more each year. Process improvements are urgently needed, and some health care professionals are looking to lean production principles for answers. Past lean health care initiatives have resulted in islands of success with limited overall impact. A lean enterprise approach that delivers value to all stakeholders and challenges current operational models can result in efficiency improvements and cost reduction while delivering a high quality of care.

This study examines a single primary care practice. It is shown that an enterprise level perspective assisted health care professionals in evaluating the goals and metrics that influence their behavior. The practice was analyzed through first hand observations and data collection over a four month period. Physicians and staff were shadowed throughout their daily activities to identify waste and evaluate the impact of lean improvements. This data was supplemented with information captured via work sampling, analysis of monthly reports and metrics, and interviews and meetings with key stakeholders.

It was determined that the physician productivity goal was driving dysfunctional behavior, resulting in a deteriorating work-life balance throughout the practice. The potential of this behavior to negatively impact patient satisfaction and quality care delivery also created a reason to change. Lean improvement efforts to address these issues resulted in a redesign of the patient visit schedule to allow more adequate time to address patient care, while also reducing the demand on the overworked physicians and staff. Success with the process led to the realization that medical professionals employ an approach to patient care that emulates lean enterprise principles. Diagnosing a patient complaint is analogous to investigating the cause and effect associated with wasteful processes. This characteristic of the industry, along with the short cycle times of patient care relative to lengthy processes in other industries, suggests the strong potential of health care to achieve swift improvements based on rapid experimentation, thus offering a possible proving ground for new lean enterprise approaches.

Thesis Supervisor: Dr. Ricardo Valerdi
Title: Research Associate
Center for Technology, Policy, and Industrial Development

This Page Intentionally Left Blank

Acknowledgements

I extend both gratitude to and admiration for the people who make up the primary care practice which was the subject of this thesis. They are a dedicated and loyal group, willing to try new approaches. It was a pleasure to be a part of their team, if only for a short while.

Sincere thanks to Ricardo Valerdi, for guiding me through this endeavor. His dedication and commitment have been most appreciated. His advice offered insight and clarity to help me stay my course. Thanks as well to Steven Spear for initiating contact between myself and the practice. He followed our progress and offered useful council, as a valuable complement to Ricardo.

Much appreciation goes out to my health care advisors who aided me on my foray into the industry. To Joseph Gesmundo, his open mind and willingness to share knowledge was welcome. Lisa Brugnoli-Semeta is a true student of lean. I applaud her enthusiasm, and encourage her to never let her passion wane. And I would be remiss not to praise Irma Gomez. She was always eager to offer assistance. I am grateful to her for all her support. And to Albert Assad for his advice and encouragement as I neared completion of my thesis.

Thanks also to all my SDM friends; they have made my return to MIT a truly amazing and rewarding experience. They are a diverse and uniquely talented group. Particular thanks to my EVSMA teammates who first explored lean health care with me. Without their hard work and dedication, my experience with that project and this thesis would not have been as rewarding as it has proven to be. To Bob Corby and Vince Mahe, I offer thanks and appreciation for helping me see things from a different point of view. To Luis Maseda, I am grateful for your efforts and contributions to all the teams we were on while at SDM, burning the midnight oil. And to Ignacio Aguirre, you never let us down with your hard work, support and encouragement throughout the last year and a half. Not to forget those from outside the lean class, particularly Regan Wong who always kept us on our toes, and Mo Glynn, a great worker and a great taxi service.

Last, but not least, to my loving and supportive family and life-long friends; their support and encouragement have carried me through the whirlwind ride that is SDM. My parents, especially, have provided motivation, inspiration, and dinners out. But most of all to my wonderful fiancee, Mary – none of this would be possible without you.

bbff

This Page Intentionally Left Blank

Table of Contents

This Page Intentionally Left Blank

List of Figures

This Page Intentionally Left Blank

List of Tables

This Page Intentionally Left Blank

Chapter 1: Introduction & Motivation

The topic for this thesis was developed based on my professional experiences with lean manufacturing and my exposure to lean enterprise at MIT. As an operations manager and manufacturing engineering manager at a vacuum equipment manufacturer, I was employed within the US remanufacturing organization. Remanufacturing is defined as the overhaul and maintenance of a product to return is to as new specification using original equipment manufacturing processes and standards. Within the US operations, I led the manufacturing engineers and production operations in a lean journey of process improvement. This was a new initiative of cultural change and operational improvement for both the organization and me. Through the journey, I began to see waste and the opportunity for lean improvement everywhere. One might say that I was bitten by the lean bug.

My initial focus was on lean production, but as the organization gained experience applying lean methods to the remanufacturing processes, I began considering the potential for lean applications in warehouse operations, office practices, and product design. I later began to see opportunity in areas such as finance and health care. Since not all of these applications involve a tangible product, I began thinking about the service aspect of lean methods. The remanufacturing operation combines both of these, since it is a service organization with tangible product processes. The customer was buying a remanufacturing service for their existing product, so it combined the manufacturing aspects of lean with a service offering which delivered the value. This helped to further open my eyes to applications in service industries and attracted my attention to health care, specifically.

Health care looked to be a new area that sparked interesting parallels to lean production methods. It is an industry that provides a service to the patient without any central product offering for sale, yet there is a production like environment with procedures and tests incorporated into the delivery of the service. I recall seeing some workshops and seminars advertised by the Lean Enterprise Institute (LEI)[1] and had uncovered some discussion articles as well. However, I had not entered into any real exploration of lean health care.

[1] http://lean.org/

For many people, health care is a critical component of maintaining a happy and healthy life. In 2004, nearly 84% of the US people made at least one or more visits to a doctor's office, emergency department or home health care visit. This total number of visits was over 1.1 billion, with more than 900 million of them being to physicians' offices (NCHS, 2006). Physicians' offices include specialist, as well as primary care physicians. Primary care physician services include annual physical examinations, as well as follow-up visits for treatment of minor medical issues, such as high blood pressure, diabetes, and asthma, among others. With populations rising and health insurance for all capturing focus in politics and media, these numbers will only continue to grow.

Through the System Design and Management Program (SDM) at MIT, I found a way to get involved in health care improvement. *Integrating the Lean Enterprise*, an MIT course in the Engineering Systems Division, provided an opportunity to test the application of lean principles in the health care domain, during the fall of 2006. A primary health care organization was selected as a study site for the exploration of specific methods from the course. This resulted in valuable outcomes for both parties. On one hand, the health care provider was exposed to unfamiliar lean enterprise concepts. On the other, researchers involved in the study were able to apply and learn about the challenges and opportunities available in this area while fulfilling requirements for the course.

Considering the rising costs of health care and the views presented from the media and politicians that our health care system is broken (Watson, 2005), this project proved to be an exciting and challenging experience. Public frustrations reported in the media with long wait times for appointments, poor patient communication, crowded emergency rooms (UAMS, 2006; Spear, 2005), among other things, further identified a need for enterprise improvements. As I gained more exposure, I decided to focus my thesis in this area. Through a strong relationship with our sponsor enterprise and sponsorship within the Lean Aerospace Initiative (LAI) at MIT, an area of exploration was identified in the practice.

Goal of this Study

The analysis conducted during the *Integrating the Lean Enterprise* project showed that the practice had achieved success with lean methods, but they were isolated events with specific processes. The improvements were feats to be proud of and they helped to develop lean understanding within the practice, but they had limited impact outside of their focused area of operation. Could the practice expand beyond these islands of success? Could a lean enterprise approach be successful? This formed the goal of my thesis and the central question:

> *How can a lean enterprise approach impact process improvement efforts in health care?*

Despite the lean successes they had achieved, the practice began to see that they had only scratched the surface. Through our collaboration and exploration, the nurse manager and medical director gained some insight into the impacts of a lean enterprise. They began to see how stakeholder relationships could be strengthened and realized the need to foster more fluid interactions across functional boundaries within the practice. Their lean self-assessment surprised them, as they came to understand how far they still had to go. This was an enlightening point in their journey, but it was also discouraging. Could they improve? Could they move beyond islands of success and employ a lean enterprise approach? Noting their concerns, but also observing their enthusiasm and desire to improve, I believed they could embrace a lean enterprise approach and was excited to explore this question further with the practice.

Together with the nurse manager we identified a key goal in support of their lean transformation and a plan to achieve that goal. This motivated the following hypothesis for my thesis:

> *A lean enterprise approach can improve the efficiency of a primary health care organization by providing a consistent quality of care while reducing one hour per day per person*

The most striking problem facing the practice is the lack of efficiency with the core operations during the patient visit sessions, which are continuous blocks of time during which physicians

perform patient examinations. While this problem has been observed in a primary care practice, the results of improvement activities should apply to all types of health care facilities, including hospitals, specialist offices, and imaging and testing labs. The operations of this primary care practice included both a morning and afternoon session for patient physician visits. Each session was scheduled in a three and a half hour period, however, the session never ended on time and most physicians routinely ran late. It was common to have a physician still conducting patient appointments an hour and a half past the end of the session.

It was observed that these over-runs in a session impacted and was impacted by all aspects of the practice. The non-physician staff would often need to remain long past the session end to check patients in or out (front desk), to check vitals (medical assistant), to draw lab samples (medical assistant and/or nurse), and to administer immunizations (nurse). Conversely, these non-physician activities also impacted the physicians' schedules, as well as each of the other processes. Peak loads at check-in can delay appointment schedules and cause the operation to run behind. Similarly, delays in checking vitals, drawing labs or administering immunizations can cause the physician to run late, or the front desk to extend hours to check patients out and schedule follow-up appointments, as necessary.

The practice sought to eliminate the wastes observed in the process and save one hour a day per person. Rather than squeeze in more patients, they decided to give the physicians and staff more time to address fewer patients more effectively, thus providing a higher quality of care that better meets the patient needs. The time they saved would allow physicians and staff to add value through further education, additional patient services, or, simply, more personal time to reduce stress and improve the work-life balance, for example. This represents a departure from traditional views of primary care as a mass production plant feeding other specialties. Rather than focusing on billable hours, like a law firm, they would focus on a higher quality of care.

To achieve this goal, the practice employed a lean enterprise approach to improving practice operations. This considered all functional interactions and impacts, as opposed to some of the siloed improvements that had been implemented to date. The work presented in this thesis seeks

to explore the effectiveness of this approach and identify factors that aid and inhibit a lean enterprise approach to primary care process improvements.

Lean Enterprise Background

In 1985, the International Motor Vehicle Program (IMVP) was launched in the new Center for Technology, Policy and Industrial Development at the Massachusetts Institute of Technology (MIT) (Womack, et al., 1990). This occurrence sparked a chain of events that introduced the world to lean concepts and began an evolution in production and management culture that has now spanned over twenty years, and is the motivating focus of my thesis work. The IMVP was a global partnership of automotive corporations, government agencies and university to perform a detailed study of the automobile industry and the Japanese techniques that had enabled Toyota to soar to excellence and threaten the survival of the world's automobile manufacturers.

Throughout the course of this study, an MIT MBA student and IMVP researcher, John Krafcik, coined the term "lean production" to identify the Toyota methods, because they achieved more with less. The Toyota Production System (TPS) and lean production were introduced to the rest of the world in 1990 with the publication of *The Machine That Changed The World* (Womack, et al., 1990). TPS, or lean production, was a result of the competition in the Japanese automobile industry after World War II. The mass production techniques pioneered by Henry Ford would not suit low volume production, so Toyota found it necessary to design and build cars more cheaply. While lean production is generally thought to be in contrast to mass production, it is in fact a more generalized case of Henry Ford's methods, while mass production is the special, high volume case. Lean production allows efficient manufacturing of low volume and high variety by using standardized components and quick tool changeover, among other things. Note that Henry Ford's original Model T also incorporated interchangeable and easy to assemble parts, yet on a low mix of product (Womack, et al., 1990).

Lean production is the elimination of waste to produce more flexible and adaptable manufacturing processes. Toyota incorporates worker empowerment to identify and eliminate muda, which is a Japanese word for waste, and stop the production line in the event of a problem. Seven wastes are identified in lean production as explained below:

- Defects – mistakes in the process, or non-conforming product or parts
- Over Production – too many parts or final product
- Transportation – unnecessary movement of goods
- Movement – unnecessary motion of people in the process
- Waiting – idle resources waiting to process product or resources
- Inventory – excess quantities of raw material or components
- Over Processing – excessive, unnecessary processing of product or material

Elimination of these seven wastes is a key principle of lean production (Womack, et al., 1990).

The Machine That Changed The World asked the question: Can lean production from Japan be applied to the rest of the world's automobile industry? Once the TPS secret was out, the automobile manufacturers and other industries still struggled to implement lean production methods with the same success as Toyota. The simplest explanation for this is that they tried to copy TPS, rather than understand how Toyota came to develop the new techniques that helped them succeed. Even in the case of the GM-Toyota New United Motor Manufacturing, Inc. joint venture, GM failed to grasp a complete understanding of how Toyota developed improvements. GM had complete access to the plant operations and production techniques, but they never captured the cultural change needed to succeed at developing lean behaviors.

As the world sought to master lean production and catch up with Japanese manufacturing, James Womack and Daniel Jones sought to study further, not what lean production is, but how to implement it. What are the principles of lean thinking and how does one apply them? As a result, they published *Lean Thinking* (Womack & Jones, 1996). Lean thinking extended the elimination of waste to include the creation of value. They further describe five tenets of lean thinking as:

- Specify Value – as defined by the customer, expressed in terms of a specific product (a good, service, or both) which meets customer's needs at a specific price at a specific time.
- Identify the Value Stream – as the set of all specific actions required to bring a specific product (good, service or both) through the end-to-end process view.
- Flow – make the value creating steps flow in the value stream
- Pull – the concept of subsequent steps pulling the flow of value from previous steps in the value stream
- Perfection – as value is pulled through a continuously flowing value stream, perfection begins to seem achievable

Lean Thinking extends lean production to go beyond manufacturing and to include the entire enterprise. The value stream represents the end to end processes through the entire enterprise. A new concept of the lean enterprise is introduced to represent an organization that can transform the value stream towards the direction of perfection. *Lean Thinking* now asks the question: Can lean production from Toyota be applied across the enterprise and in other industries?

This concept of a lean enterprise continues to evolve through the work of the Lean Aerospace Initiative (LAI). In 1993, leaders from the US Air Force, MIT, labor unions, and defense aerospace businesses launched LAI (originally named the Lean Aircraft Initiative) to transform industry, reinvigorate the workplace and reinvest in America under the philosophy of lean. Their stated mission is to research, develop, and promulgate practices, tools, and knowledge that enable and accelerate the envisioned transformation of the greater United States aerospace enterprise through people and processes. LAI promotes collaboration and cooperation between industry, government and academia to foster rapid lean deployment through communication of best practice (LAI, 2007).

In 2002, LAI published *Lean Enterprise Value* (Murman, et al., 2002) which further explored the question: Can lean enterprise be applied in the large-scale dynamics of the Aerospace industry, where programs extended across multiple organizations, including government agencies? This extends the concept of value beyond the customer to include all stakeholders. Stakeholders include anyone who delivers and/or receives benefit from the enterprise, including, among others, suppliers, partners, employees/workers, and shareholders, in addition to the customer. Value creation must include value for all stakeholders. That in and of itself creates difficulty, in that not all stakeholders may possess the same needs. They may, in fact, have conflicting values. However, a goal of achieving lean perfection is to transcend this paradigm and transform into an enterprise that can deliver value to all stakeholders.

Lean Enterprise Value also introduced five guiding principles that extend the existing body of lean thinking.

- Principle #1 - Create lean value by doing the job right *and* by doing the right job
- Principle #2 – Deliver value only after identifying stakeholder value and constructing robust value propositions
- Principle #3 – Fully realize lean value only by adopting an enterprise perspective
- Principle #4 – Address the interdependencies across enterprise levels to increase lean value
- Principle #5 – People, not just processes, effectuate lean value

These guiding principles reflect the extension of lean thinking to include all people and processes that comprise the entire enterprise and/or a network of enterprises. In *Lean Enterprise Value*, three themes, lean, enterprise and value, combine to deliver an enterprise perspective focused on the elimination of waste with the goal of creating value along entire value streams that may span organizational, national and international boundaries. LAI expands the scope of lean in a clear departure from the localized view of lean production that began with the misconceptions of TPS.

Lean in Health Care

While many aerospace and automotive firms, as well as other manufacturing companies, sought to master the principles of lean thinking, other industries were also struggling with process improvement – health care was one of these industries. For more than a decade, health care costs in the US have continued to rise (Watson, 2005). By 2006, health care spending represented nearly one-sixth of the US gross domestic product, and continues to rise faster than the economy, despite more than 40 million uninsured individuals (Herzlinger, 2006).

At the same time, error rates in hospitals were also rising, incorrect or inaccurate administering of medication to patients, instances of operating on the wrong body part or, in one case, almost performing a procedure on the wrong patient (Chassin & Becher, 2002), were beginning to become more common. According to a 1999 study by the Institute of Medicine of National Academies, *To Err is Human* (Kohn, et al., 2000), medical mistake comprise the sixth largest cause of death in hospitals. In addition to rising costs and sinking quality, capacity constraints are also looming ominously as the aging "baby boomers" of the post-World War II era, are beginning to tax health care systems further. They are anticipated to live longer and demand higher expectations in quality of care as all patients continue to become more educated consumers of health care (Aronzon, 2006). The quantitative impact of the aging baby boomer generation is forecast to result in a doubling of the post-sixty-five year old population from 37 million in 2005 to 74 million in 2029 (NCHS, 2006).

As health care faces these growing problems, the industry has begun to look for ways to reduce costs and improve quality. Dr. Daniel Aronzon, President and CEO of Vassar Brothers Medical Center, identifies the key challenges to health care as accountability, transparency, safety, capacity, cost and efficiency (Aronzon, 2006). Many hospitals and health care delivery systems have hired consultants, engineers and management experts in an attempt to deliver process improvement initiatives, while others have developed new innovations in health care business models with some success, e.g. MinuteClinic, a Minneapolis-based chain of walk-in clinics staffed by nurse practitioners (Herzlinger, 2006).

A number of organizations have looked to manufacturing firms to develop process improvement initiatives that address their challenges. While they may not all use the terminology of lean, they have adopted many of the TPS principles and practices to production line style improvement of patient care. The industry began asking the same question as Aerospace did years before: Can lean thinking be applied to health care? The following examples show attempts to do just that.

Kaiser Permanente facility in Northern California has revamped its large primary care department using lean production methods to reduce inventory in the appointment backlog (55 day wait times for an appointment) to deliver an open-access system. They worked in conjunction with a university operations research group to develop an excel-based just-in-time scheduling system to support this new process (Miller, 2007; Green, et al., 2007).

Two cancer institutes, Cancer Treatment Centers of America and Clearview Cancer Institute (CCI), employed a value stream approach to improve waste-filled processes in their operations. Cancer Treatment Centers of America used the value stream mapping techniques discussed in *Lean Thinking* to redesign their prescription process to cut a 32 step process in half and reduce turnaround times by 20%. They have since trained lean coaches to address other areas of the hospital (Bonner, 2007). CCI never used the term 'lean', but did employ an end-to-end process view of patient flow through their operation and used value stream mapping concepts to remove up to one and a half hours of waste from a patient visit, with an additional half hour targeted to be removed with a new central communications system (Taninecz, 2007).

In primary care practice, a medical clinic in Dubuque, Iowa developed improved office practices to work smarter, not harder. While not specifically using lean methods, they did improve the process by observing and eliminating waste and applying standardization of tests and processes, empowerment of nurses to identify and implement changes, and implementation of a just-in-time rapid-access appointment scheduling system (Sinsky, 2006).

Other examples of lean thinking in health care can be found in numerous value stream mapping activities at Progressive Healthcare (Bushell, et al., 2002) published by the Association for Quality and Participation. Steven Spear discusses how health care professionals have successful

applied the TPS approach at hospitals and clinics throughout the country, most notably Virginia Mason Medical Center (VMMC) (Spear, 2005). VMMC has gone so far as to adopt TPS as a model for its management system and has visited Toyota factories in Japan to view the Toyota methods first hand.

All of these examples have illustrated successful applications of lean thinking to process improvement activities, but can they move beyond these islands of success? While some examples have shown end-to-end process views and improvements, none of them seem to have fully embraced lean culture throughout their organization. As Spear writes, "so far, no one can point to a single hospital and say, 'There is the Toyota of health care' " (Spear, 2005). This raises the question of sustainability and continuous improvement throughout the enterprise to consider and include all stakeholders.

Closer examination of some of the examples noted above does show evidence of health care professionals questioning why certain process and operations are performed, but I have yet to find an example of a health care enterprise that questions all aspects of the process, including goals, metrics and stakeholder relationships. The examples have addressed doing the job right, but have they addressed doing the right job?

Can a lean enterprise approach, as seen in the aerospace industry, be applied in health care? This is an industry that provides a service without any tangible product. Furthermore, there is no universally accepted definition of the primary customer. Is it the patient who receives the care delivery? Or is it the insurance company who authorizes payment? Or is it the payer who bears the cost, despite being the entity furthest removed from the value delivery? The work of this thesis begins to explore these questions as we follow a primary care practice in pursuit of process improvement to determine if a lean enterprise approach be successful. Table 1 illustrates where health care can benefit from TPS methods, combined with a lean enterprise approach.

Table 1. TPS vs. LEV Methods

Methods Used	Toyota Production System	Lean Enterprise Value
Scientifice Method	X	
Go & See: Observe the Process	X	
Worker empowerment to solve problems	X	
Waste of Movement	X	
Waste of Waiting	X	
Waste of Over Processing	X	
Specify Value		X
Identify the Value Stream		X
Make Value Flow	X	X
Develop Pull	X	X
Strive for Perfection	X	X
Do the Right Job		X
Deliver Value to All Stakeholders		X
Adopt an Enterprise Perspective		X
Look Across Enterprise Boundaries		X
Consider both People and Processes		X

The next chapter introduces this primary care enterprise. Pseudonyms have been used for all names and places associated with the practice throughout the methods, results and discussion within this thesis to protect the identity of the study location.

Chapter 2: The Primary Care Organization

As mentioned in the introduction, collaboration with the primary care enterprise in this thesis began with a group term project in the 2006 fall semester for *Integrating the Lean Enterprise*, a course jointly offered by the Aeronautics and Astronautics Department and the Engineering Systems Division at MIT. Together with a team of four SDM colleagues, we conducted a lean enterprise assessment of a primary care practice at a large area teaching hospital. The project was structured along the guidelines of the Enterprise Value Stream Mapping and Analysis (EVSMA) approach developed by LAI (LAI, 2005).

EVSMA involves the following six steps as detailed in Figure 1:

1. Define the Enterprise
2. Collect Data
3. Construct the Current State Perspective
4. Identify Enterprise Opportunities
5. Describe the Future State Vision
6. Create Transformation Plans

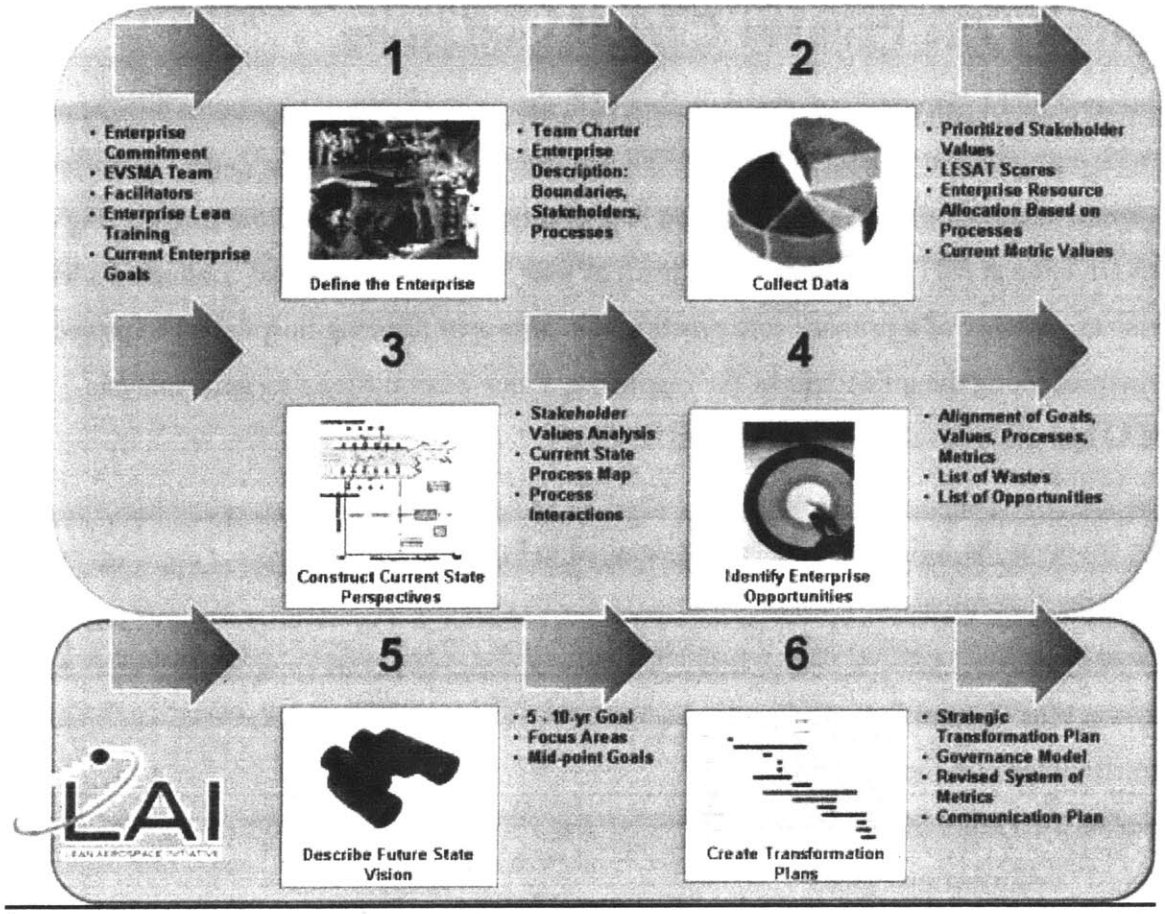

Figure 1. EVSMA Process (LAI, 2005)

The output of this project aided in developing the enterprise background presented in this chapter.

The Health Care Enterprise

The subject organization of this study is a one of five primary care practices managed by a large area teaching hospital in a major metropolitan area. The practice is one of many primary care organizations that serve a city of three million people. It is jointly managed by a nurse manager and a medical director who is also a physician of the practice. Including the medical director, there are currently five physicians on staff with plans to add a sixth in July 2007. Since not all physicians work full time in the practice, the practice reports just over four full-time equivalents. A full time equivalent physician is considered to be one who works eight patient sessions per week. Some physicians have scaled back from full time due to work overload or personal reasons and the medical director splits time between patient sessions and administrative duties. There are also currently four residents who see patients once a week, but that number can vary

throughout the year as residents come and go. A few part time specialists are associated with the practice, as well, including a physiatrist (one day a week), a mental health social worker (three days a week), a nutritionist (one day a week), and a diabetic nurse educator (2 days a week).

The nurse manager splits time between triage (attending to urgent patient medical needs via phone and in person) and managing the daily operations of the practice, whiles a second part time nurse and the diabetic nurse fill in on triage about three days a week. Other full time staff include a licensed practical nurse (LPN) (responsible for immunizations, prescription refill requests and certain patient treatments), three medical assistants (two primarily to conduct vital sign readings and prepare patients for their visit and one to run the limited in-practice lab capabilities), and four front desk personnel (one managed care support and referrals specialist, two people responsible for scheduling, check-in and phone and office reception, and one senior person responsible for checking patients out, as well as overseeing and supporting front desk activities, filling in during busy times, entering patient visits billing/coding information into the system, and mentoring new staff). The practice also employs a part time office assistant (responsible for accounts payable, payroll, and other administrative tasks) and a part time medical records staff person (manages the paper-based medical records).

The structure of the practice is illustrated below in Figure 2.

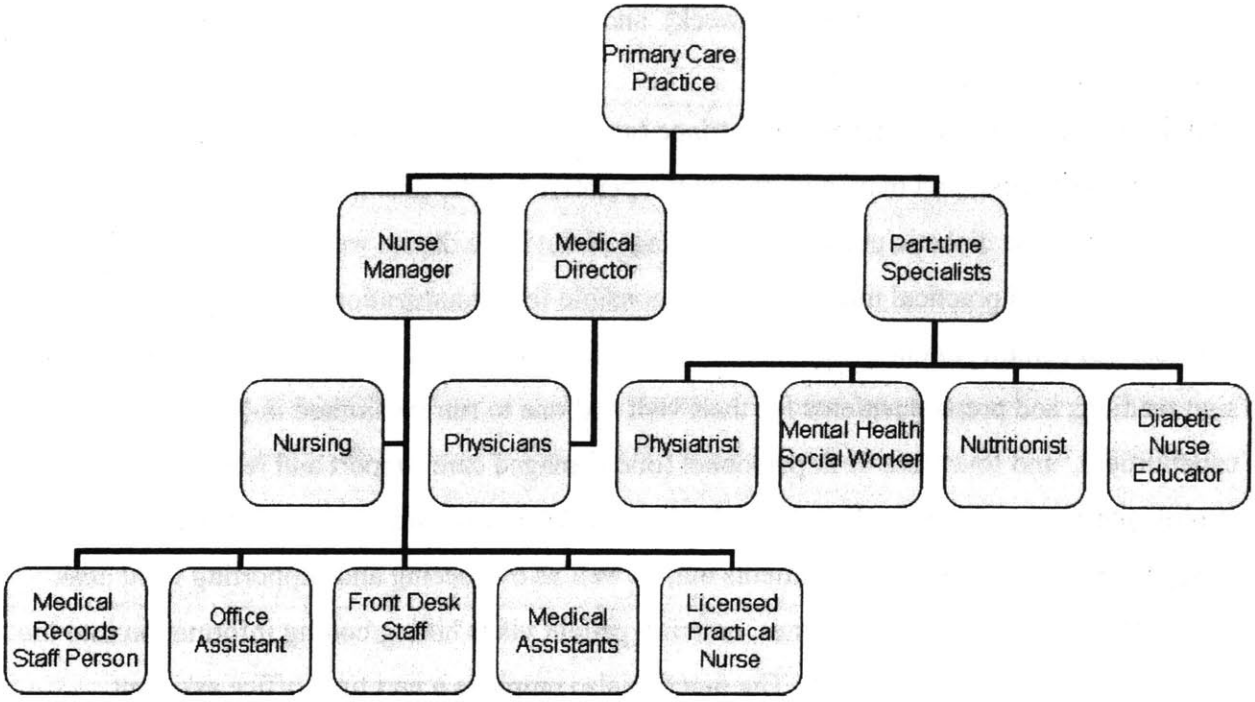

Figure 2. Structure of the Primary Care Practice

The practice conducts an average of 1100 patient visits per month, and growing, with a capacity for just over 1400 based on the existing schedule design. The 1400 visit capacity is rarely, if ever, achieved though. On average there is a 10% vacancy rate, or percentage of unfilled appointment slots, that results in about 1 gap, or hole, in the appointment schedule per physician per session. Additionally, the practice experiences an average no-show rate of nearly 10%. These constitute waste in the process and result in an average expected monthly volume of only 1140 visits, rather than the full 1400. While the no-shows are cause for concern, the schedule gaps are, in some ways, more surprising since there is a local shortage of primary care services. According to the practice, they are one of the only major primary care practices currently accepting new patients in the immediate area.

As noted previously, the practice is organized as part of a major area teaching hospital. The hospital structure includes a primary care services support group that cooperates with all five primary care practices on improvements, goal and metric setting and reporting, budgeting and financial reporting, and general administrative efforts. The hospital provides central

management of all IT systems, including support, upgrades, improvements and maintenance. Additionally, the hospital manages all major contracts, communications and agreements with insurance companies, key medical suppliers, medical records storage, government agencies and industry groups. The practice focuses on relationships with patients, pharmacies, minor suppliers and the surrounding community. Figure 3 depicts this view of the architecture of the extended enterprise.

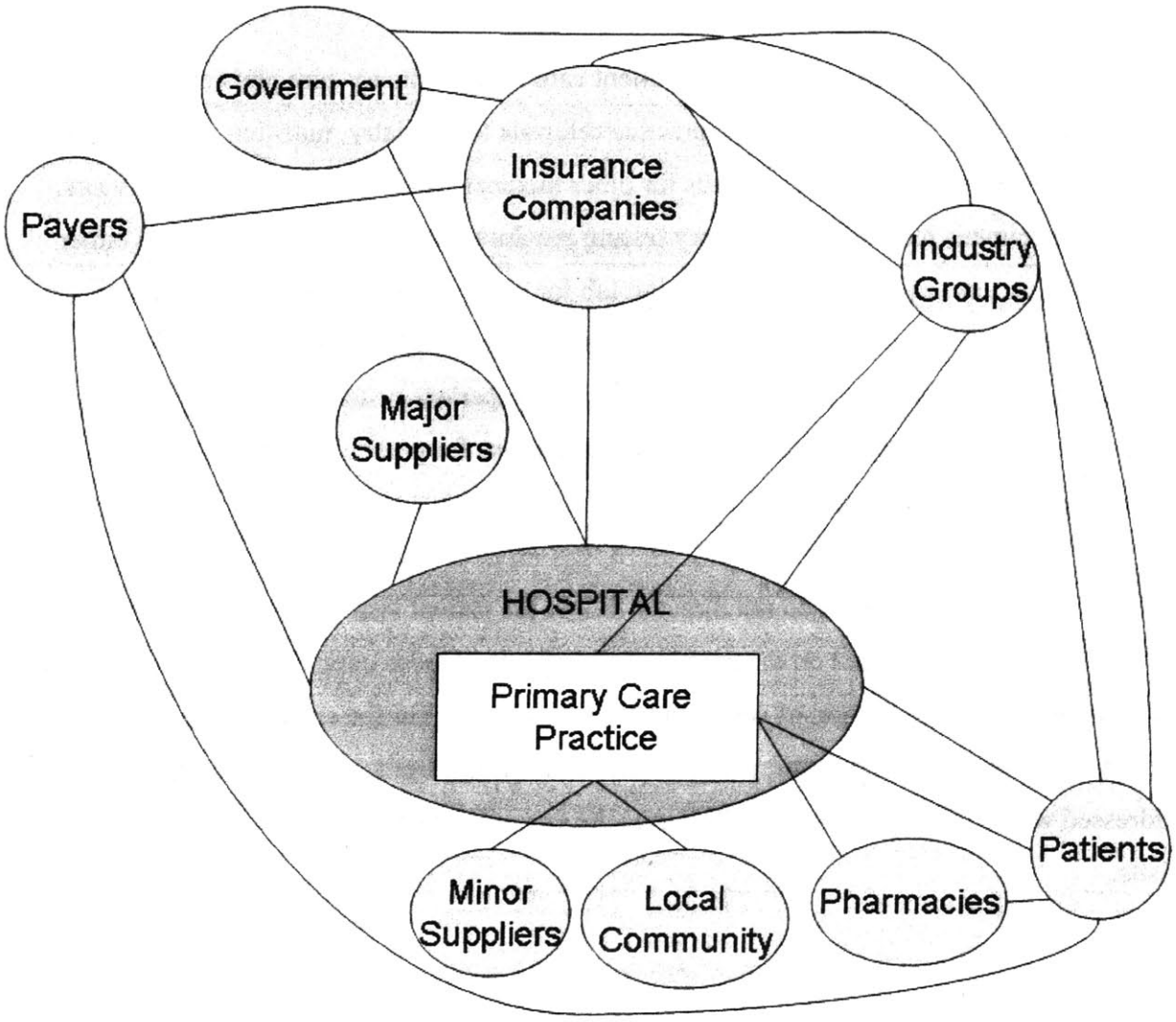

Figure 3. Architecture of the Extended Health Care Enterprise

There are close connections between the practice, patients, pharmacies, minor suppliers, and the local community. The practice is then enclosed within the larger hospital organization which manages interactions with the government, insurance companies, and major suppliers. Industry

groups interact with the government and insurance companies, in addition to the hospital and the practice. The industry group to practice interaction is primarily one way, in that the industry groups survey patients on the quality of care of a practice and then deliver reports on each practice for public use. The payers are the corporations providing health care or the self-insured. They either contract with an insurance company to offer care to their employees who are the patients or, in rare cases, pay the hospitals directly.

Current State

The practice operations focus on routine patient care by the primary care physician (PCP). Additional services offered include in-practice referrals to physiatry, nutrition, mental health and diabetic care, as well as outside referrals for other medical specialties and imaging services. Most all specimens for routine laboratory testing are drawn at the in-practice lab, and either tested in-house, or sent to the central hospital lab for more extensive testing. Results are communicated back to the physician through the electronic medical records system, so that medical chart processes can move toward a goal of a paperless system. The practice LPN manages inventory for and administers all immunizations for practice patients and also manages prescription referral requests.

Some of these other activities do not directly follow the patient visit process, however, they provide relevant background on the practice and impacts of these operations must be considered with respect to the elimination of waste and creation of value for the entire enterprise. The core process of patient visits, however, provides the focus of this thesis, though other activities are addressed where relevant. Figure 4 illustrates the current state process associated with patient visits.

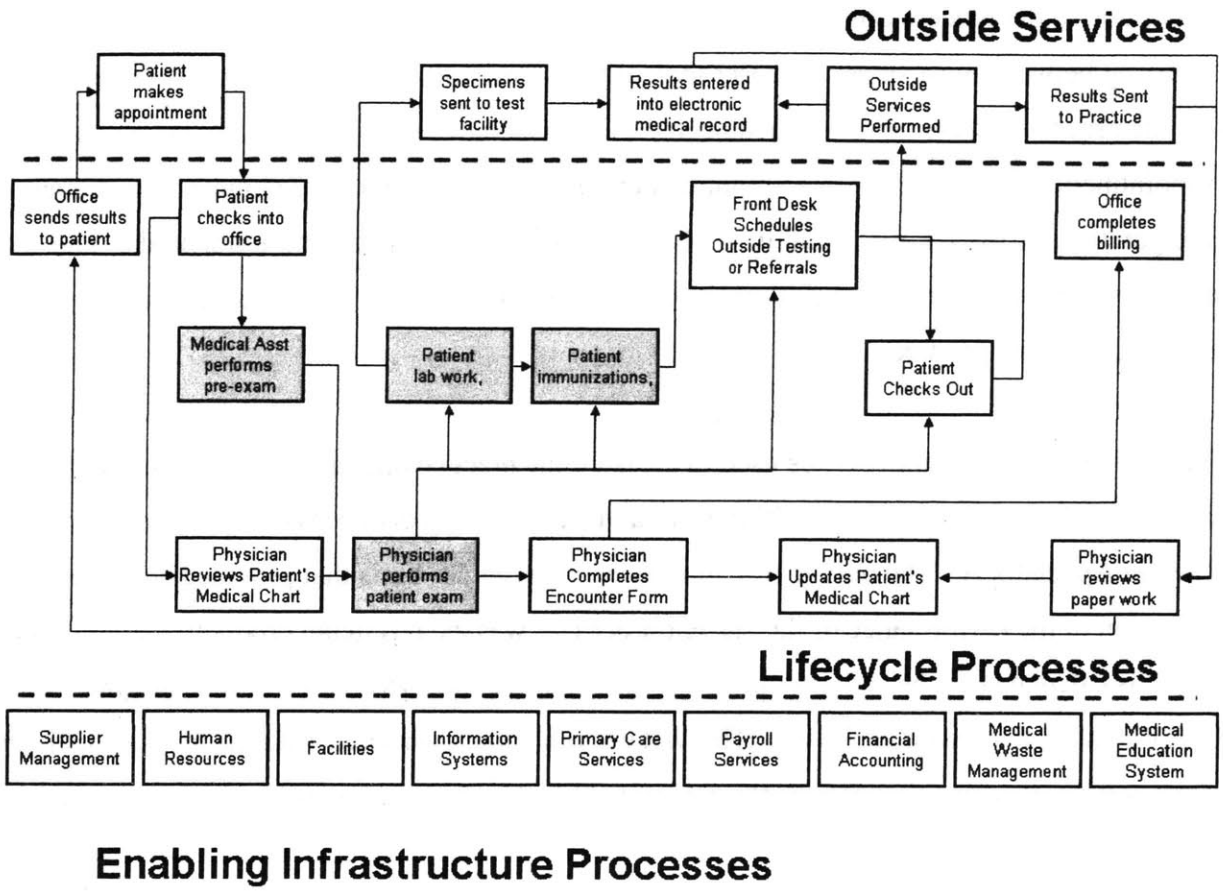

Figure 4. Current State Processes

As seen in the current state process diagram above, we identified only four steps that add value in the eyes of the patient, identified by the shaded boxes in the figure. These steps all involve the patient receiving some level of care, though, only one of these is the most valued step to the patient: the physician exam. However, there are another nine steps that add value from the point of view of the physician and health care professionals. The total times associated with each group of these processes result in a 50/50 split on average. There are also enabling infrastructure processes that support the practice operations, identified as the boxes below the bottom line, and outside services that provide various testing capabilities not available at the practice, identified as the boxes above the top line. Neither of these adds much value to the patient. The outside services may add value, but they add a level of inconvenience for the patient by not being located on-site at the practice.

In addition to the process times that each patient experiences, there are often also wait times occurring between most steps. A closer look at the times built into the current system revealed that the process is driven by the schedule and the available resources, but not by the patient need. Appointments are scheduled on 15 minute intervals based on a widely used method in primary care practice. However, the actual time of patient visits seldom meets these standards. The staffing and process steps are based on traditionally used methods, not necessarily the needs of the patients in the practice.

Furthermore the goals and metrics used to measure the practice operations were poorly defined and rarely, if ever, monitored, resulting in weak measurements of success. These metrics are listed in Appendix A. The only metric monitored on a regular basis that provided any direct indication of the performance of the current processes was the physician productivity goal. This metric is calculated as the sum product of patient visits per session and work related value unit (WRVU) associated with each visit. The WRVU is a value associated with the level of difficulty of the service provided that defines the associated billable charges for each visit or procedure. None of the other metrics provided any real-time feedback on the practice operations and several were difficult to monitor, or were not monitored at all.

In addition to processes, goals and metrics, the project team conducted a stakeholder value delivery analysis. The overall results of this analysis can be seen in Figure 5. Our interpretation revealed that the practice views all of the stakeholders shown below as highly important, but does not always deliver on that value. There were conflicting results regarding value delivery to the patient. The direct patient information revealed satisfaction with physician care, but mixed satisfaction levels regarding wait time. The industry group that surveys patient satisfaction with health care services reported middling delivery of value from the practice. These differing results cause us to question the value deliver to patients. Similarly, the employees report high marks on their receipt of value, though they complain of long hours and delays in the process.

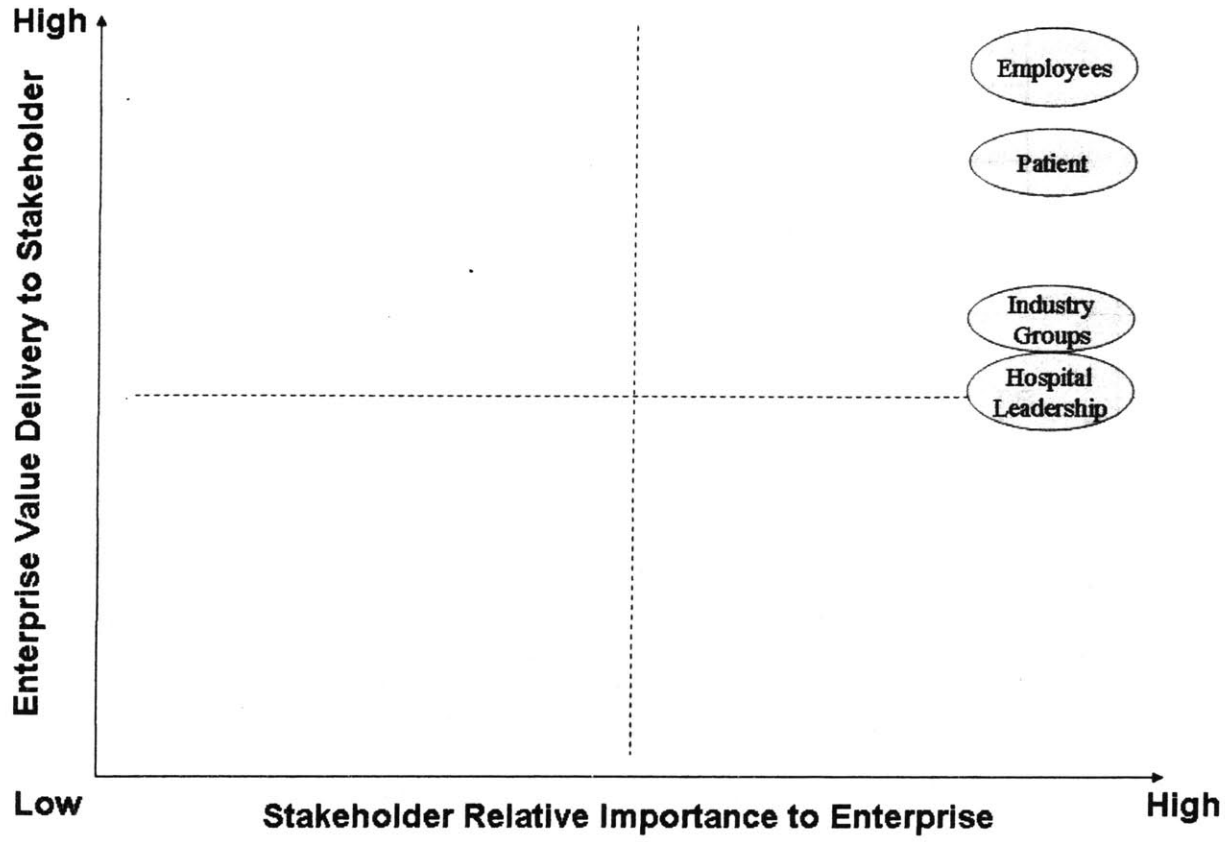

Figure 5. Stakeholder Value Comparison

Finally, the EVSMA lean self assessment was completed by the nurse manager and medical director using LAI's lean enterprise self assessment tool (LESAT) (LAI, 2001). It revealed some surprising views. There were large gaps between where they desired to be and the level at which they actually perceived themselves. A snapshot of this data is shown in Figure 6. The theme running through these results was a lack of an enterprise perspective. They had experienced several islands of success with lean thinking, but had not yet made the enterprise connections.

Desired State - Overall LESAT Score			
Current	**Desired**	Gap	**Variance**
1.8	**3.7**	1.9	**< 0.5**

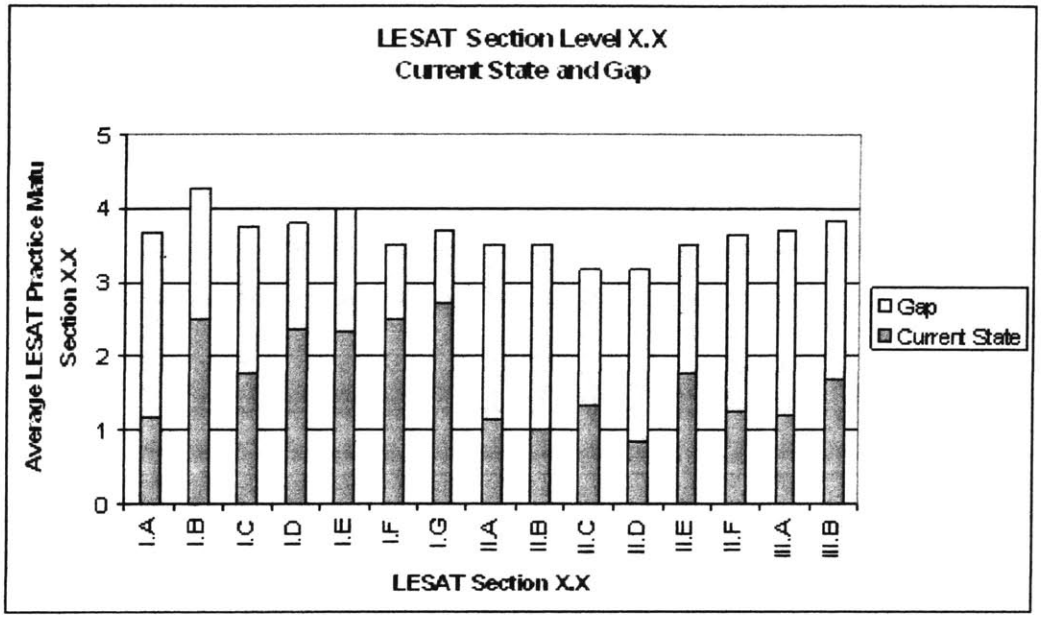

Figure 6. LESAT Results

Future State

Based on the lean enterprise assessment conducted, the project team worked with the practice to develop a future state vision for the enterprise. A Big Hairy Audacious Goal (BHAG) (Collins & Porras, 1994) was defined for the practice, resulting in the following BHAG:

> To achieve a pediatric-to-adult ratio of 2:3 and a 10% increase in the number of patients over age 50 category by having a constant incoming rate of 10 new patients per month while also achieving 100% work/life balance for staff and physicians, achieving 100% customer satisfaction for patients, [and improving the financial independence of the practice to become self-sustaining[2]]

[2] This part of the goal was added during the thesis planning to reflect the financial goals of the practice

The BHAG was further broken down into six sub-goals. For purposes of this thesis, I have decomposed these sub-goals in the following section to develop a focus that could directly impact the individual work performed by all staff and physicians within the enterprise, and address the research question posed.

BHAG Sub-goals

1) Grow the practice by 10 new patients per month

With a waiting list of nearly 300 patients looking to enter the practice, there seemed to be no shortage of available new patients. Additionally, the existing physician templates allow available slots for more than 30 new patients each week.

2) Increase the number of pediatric patients to achieve a pediatric-to-adult ratio of 2:3

At the outset, the pediatric-to-adult ratio was believed to be 1:4. The first step was to determine the actual quantity of pediatric patients in the practice, and then to determine how many pediatric patients there were on the waiting list of new patients.

3) Increase the number of patients over age 50 by 10%

The number of existing patients over the age of 50 was not consciously known when we began our work. However, based on the physician productivity numbers and the levels and types of visits experienced, it was believed that an increase in the number of patients over age 50 would aid the practice. This would be beneficial both for the overall practice productivity billing and the increase in experience and exposure of the practice physicians and staff to medical issues more common in later life stages. The latter benefit was recognized as being more important to the quality of care delivered.

4) Achieve a 100% work/life balance for staff and physicians

While everyone working in the practice generally enjoys their working environment, most all agree on one thing: if they could get an hour a day back, they would be happier. The detailed results of the stakeholder analysis, as presented in Figure 5, support this assessment.

5) Achieve 100% customer satisfaction for all patients

In general, patients of this practice are pleased with their service, though different patients have different needs, and different physicians have different styles. Based on the results of the stakeholder value analysis done in the prior assessment of the enterprise, it was determined that all patients value their time, and in particular, time with their doctor. By making the practice more efficient and optimizing time spent with the physician, the patient will realize a higher quality of care and gain the value they seek with less wasted time in the process.

6) Improve the financial independence of the practice

Currently, the practice serves as a loss leader for the parent hospital. The intention of this subgoal is to ensure that the level of investment required does not increase above what is currently being committed. Improving the efficiency of all staff and physicians should allow an increase in value added activity and improve patient satisfaction, thus ensuring patient retention and encouraging growth of the practice. Additionally, an important criteria concerning financial independence is ensuring accurate billing and collection of payments associated with each visit. This includes both payments by insurance companies and patient co-insurance payments.

Our Focus on One Goal for all – 1 hour back

The focus of this thesis is to reduce the amount of time required by staff and physicians each day by one hour. Achievement of this goal would then allow some time for physicians and staff to address issues and obstacles that are further impacting the practice. These would yield process improvements and result in further time savings, as well as quality improvements and aid the practice in achieving the previously identified BHAG. Considering the six subgoals and individual lean initiatives that were ongoing within the practice, this immediate focus was observed to be the most critical to achieving the goals of the practice.

Reviewing the subgoals, it was concluded that the first goal of bringing in ten new patients a month was achievable under the existing state of the practice based on the size of the new patient waiting list and the quantity of appointments that were designated for new patients. An average of 1 new patient appointment per session per doctor was planned which is more than the target goal. Along those lines, the specific goals of increasing the number of pediatric patients and

patients over age 50, while also achievable under the existing state of the practice, would likely require some marketing and advertising resource to attract the target demographic of new patients. However, with a new patient waiting list of nearly 300, and an already overworked practice, the results of such efforts would likely prove unnoticed for some time. Thus, the deficit experienced in the work-life balance goal would hinder any efforts to bring in more patients, and with them more work.

Furthermore, the practice currently employed five physicians with the capacity for a sixth for whom active recruiting activities were underway. The addition of a sixth physician would likely occur within the next 6 months and would provide a mechanism for the reduction of the new patient waiting list. Similarly, any further actions to increase the patient population prior to the addition of the sixth physician could adversely affect the current customer satisfaction level due to a resultant work-life balance degradation and reduction in the time spent with each patient due to more patients being seen.

Leaving all else unchanged; it seemed that any growth in the practice whether involving all new patients, pediatrics or those over age 50 would ultimately result in additional burden on the practice to maintain care of a now larger patient population. Given the current state of the practice, this would undoubtedly result in further degradation of both the work-life balance of physicians and staff and the customer satisfaction goal. Considering this situation, it was determined that the initial focus required a review of the core processes involved with patient care. What activities consume the largest amount of time and resource? Where are the barriers to delivering value? What wastes can be eliminated or minimized in an effort to improve the efficiency of the practice?

This Page Intentionally Left Blank

Chapter 3: Methods

With the goal of reducing the workload by one hour per day per person, we began addressing the operations in detail. The practice can be divided into three areas: 1) Front Desk Reception Operations, 2) Medical Assistant, Lab & Immunization, and 3) Physician Examinations. The following methods were used in combination, some of which had already been in use previously, though sporadically, by the practice: 1) Scientific Method; 2) Shadowing; 3) Work Sampling; 4) Quantitative Data Collection; 5) Qualitative Information Capture; and 6) Pugh Concept Evaluation. The data collected could then be used to identify specific goals and metrics to be measured and monitored as the practice continued on their journey to achieving their BHAG and/or the direct goal of giving 1 hour back to each employee.

Scientific Method

The scientific method served as the overarching theme guiding this thesis work. The practice was familiar with the use of this approach to identify an issue and then address that issue directly to improve the situation. The scientific method has been employed as a common approach to problem solving activities and underpins the Toyota Production System (Spear & Bowen, 1999). The scientific method encompasses an iterative combination of the following four steps:

1. Observe (a problem, phenomenon, issue, etc...)
2. Formulate a hypothesis (to explain why the issue is observed and how the process might be altered to yield an improvement...)
3. Predict (the result of the improvements ...)
4. Test (the prediction by implementing the changes...)
5. Reassess (the hypothesis and prediction, based on the test results)

Some examples of lean initiatives where the practice has successfully utilized the scientific method were witnessed as follows:

1. Appointment Time Capture Work Sampling
2. Medical Assistant 5S Improvements[3]
3. Front Desk 5S Improvements
4. Exam Room 5S Improvements

[3] *Lean Thinking* (Womack & Jones, 1996) explains the 5S method to improve organization and create a workplace suited for visual control and lean production.

The goal of giving an hour back was driven by the general observation that each patient visit session routinely ran over the scheduled 210 minute block. All three groups, physicians, medical assistants and the front desk staff, were regularly servicing patients beyond the scheduled end of a session. Identifying this issue served as the first step in the scientific method and our starting point in the journey.

Based on this observation, and the Appointment Time Capture work sampling, noted above, it was concluded that the session schedule and duration was not accommodating the patient work load as designed and some changes would be required to allow all the work to be completed within the session schedule. Specifically, the hypothesis contained the view that follow-up appointments, which are the majority of total visits, were too short, as well as new patient appointments, while certain types of urgent sick visit appointments were scheduled for more time than was required.

A prediction was made that a new schedule design would allow sufficient time for the patient visit as well as completion of the related medical chart documentation by the physician. This new schedule design incorporated an extra five minutes per visit for follow-up appointments (increased from 15 minutes to 20 minutes), an extra ten minutes per visit for new patient physicals (increased from 30 minutes to 40 minutes), and a concession for specific urgent sick visits to be 5 minutes shorter (decreased from 15 minutes to 10 minutes). Annual physical exams would keep the existing 30 minute allotment. The principle idea was to allow the proper amount of time for each visit type using clear, consistent criteria.

The next step was to test the prediction by putting the new schedule into place and see if we could achieve the expected outcome: complete all patient visits and medical chart documentations within the 210 minute session. This was done by implementing the new schedule in two phases. The first phase involved one physician for 5 sessions, while the second phase added another physician and encompassed a total of 7 sessions, with one session shadowed per day in each phase. The results of these sessions will be presented in Chapter 4.

The above discussion explains how the scientific method was applied at a high level to address the goal of giving one hour back to the physicians. In a similar manner, the scientific method was used to approach the goal of giving an hour back to the medical assistants as well. While some discussion will address results obtained from those improvements, the focus of this work was centered on the new schedule for physician appointments. The remainder of this chapter will introduce other methods used to support the improvement process towards the goal of giving one hour back to all physicians and staff.

Shadowing

Having identified an observed problem, shadowing proved to be a useful way to gather data on specific areas of operation. This essentially consists of following a physician or staff member around for the duration of a session and observing everything they do. The shadowing activities were conducted in a manner that was non-intrusive to the process. While the patient's consent was requested prior to observing any activity, they were also informed that observations were focused only on process flow and intended to observe how the physicians and staff conducted there duties. There was no interaction with the observer during the process. Recently, the practice had conducted some new medical record system trials which involved an observer shadowing use of the system, so the physicians, staff and many of the patients at the practice were well accustomed to independent observers. The participants later reported that they often forgot there was an observer in the room.

Most of the shadowing activities involved the physicians, though some shadowing was performed with the medical assistants and front desk staff. Since the physician examination activities are downstream from certain medical assistant and front desk processes, we decided that it would also be useful to conduct some shadowing of the staff in these areas to aid in our understanding of any impacts that they may have on the physicians' activities.

Physician shadowing was used to evaluate the amount of time associated with appointments. This included both the patient visit duration and the time taken to complete the related medical chart documentation. These shadowing activities involved two of the five physicians during sessions conducted under schedule design changes. These two physicians were also shadowed

during sessions under the existing schedule to provide a comparison for analysis of the performance of the schedule design changes. Two additional physicians were shadowed during ordinary sessions under the existing schedule template to provide a general comparison of physician style and approach to a patient visit and develop a set of qualitative observations regarding the physician process.

The physician shadowing employed a structured approach using a shadow template to capture specific information, while at the same time allowing the ability to record free-text comments as applicable. The physician shadowing template, as shown in Appendix B, was used for recording the following data for each session

1. Scheduled Appointment Time
2. Visit Billing Code
3. Patient Type (New or Established)
4. Appointment Type (Urgent, Follow-up, Annual Physical, New Patient Physical)
5. Number of Problems Addressed
6. Observations That Effected Visit Length (Delay or Speed-up)
7. Chart Review (Start/Stop Time)
8. Patient Encounter (Start/Stop Time)
9. Documentation/Medical Chart Note (Start/Stop Time)
10. Observations that Specifically Prolonged the Physician Time Spent.

Items 6 and 10 are free-text fields that enhanced the data from the investigations. These free-text comments and general notes captured during physician shadowing were later used to develop a punch list of observations that impact the time spent by the physician and/or the flow of patients through the practice.

In contrast to the physician shadowing, the medical assistant shadowing opportunities were less structured. The primary responsibility of the medical assistants is to bring the patients in from the waiting room, check their vitals and set them up in an exam room ready for the physician. However, they also perform other roles as well, such as chaperone exams, clean rooms, and back-up on lab work. Since their tasks vary frequently throughout the session, the shadowing activity was conducted more informally.

The medical assistant shadowing was performed by observing their movements and task completion and recording each task, the time begun, the time completed and any relevant comments regarding the task. This data generated a list of all the tasks they completed for the duration of the observation period which was typically one session. This data was organized as follows: Task Start Time, Patient Scheduled Appointment Time (if applicable), Task Finish Time, and relevant notes regarding the Task. The Front Desk shadowing activities were conducted in the same manner as was done with the medical assistants though on a more limited basis. The patient visit process is presented in Figure 7 as a reference to the area of focus for data collection.

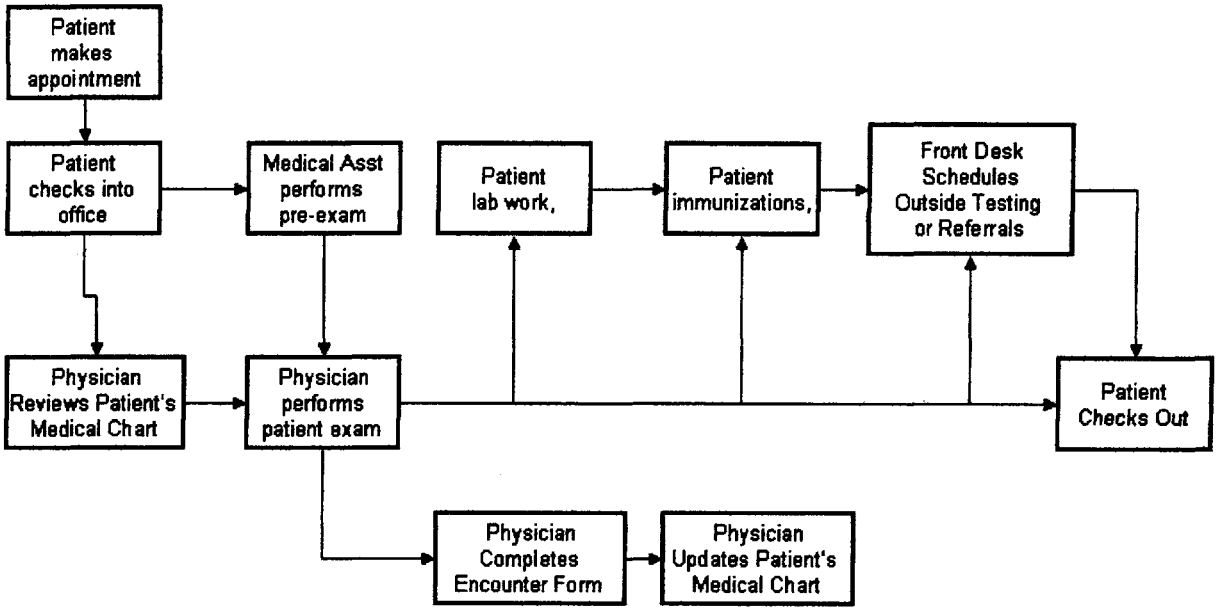

Figure 7. Patient Visit Process

Work Sampling

In addition to shadowing activities, a work sampling technique was used to collect data for the new schedule design, as described below.

The Appointment Time Capture work sampling was conducted over a three week period from December 21, 2006 through January 10, 2007. The activity was developed by the nurse manager and launched immediately following the completion of our lean enterprise assessment, the work preceding this thesis as discussed in Chapter 1. The data captured from this work sampling

activity was analyzed as part of this thesis to aid in initial development of the new schedule, discussed above in the physician shadowing session. The Appointment Time Capture involved a random sampling of patient appointments to assess an estimate of the actual time needed for a patient visit.

The Appointment Time Capture work sampling process was as follows:

1. Patient calls for an appointment. Front desk staff assesses the appointment time need based on an appointment determination checklist.
2. The appointment is scheduled normally, but with a comment in the scheduling system identifying the estimated time required.
3. Upon check-in, the appointment determination checklist is repeated with the patient to confirm the time required. This time is then confirmed with the estimated time required comment entered in the scheduling system at the time of the appointment scheduling.
4. The estimated time required is then entered on the Time Required for Appointment Card, and the card is placed in the Patient Traveler.
5. Upon completion of the appointment, the physician would enter the actual time required for the appointment. This time was intended to include both the time duration of the patient visit and the time taken to complete related medical chart documentation.
6. The cards would be collected at the end of the session for data analysis at the end of the work sampling period.

Quantitative Data Collection

Various data collection activities were used to monitor the effects of the improvement activities and supplement data captured during the shadowing activities. Following the Appointment Time Capture activity, the Time Required for Appointment Cards were collected and matched with their respective encounter forms via the medical record number. An encounter form is a documented record of the patient visit used for billing purposes, and the medical record number is a unique identification number assigned to each patient. The following data was collected from the encounter form: 1) gender; 2) year of birth; and 3) visit billing code. Based on the visit billing code, the following data was added to each entry: 1) type of visit (office or preventative); 2) type of patient (established or new); 3) billing description of visit; and 4) WRVU billed for

visit. Relevant data associated with the Appointment Time Capture activity is discussed in the following chapter on results.

Other data collection was also possible using the reporting function of the Patient Tracking System. The *Late Patient Report* and *Patient Arrival Time Report* were used in support of the new schedule design, as discussed in Chapter 4.

Two additional data collection exercises involved the physician's impact on the scheduling of follow-up appointments. The assumption is that if a patient schedules their next appointment as they are leaving the office or, at the very least, later that same day, then there is a high probability that the patient will provide accurate information on the time required for the next appointment, as identified by the physician. One way to capture this data was using the practice follow-up slips and physician visit counts, and the second method was through a query of the scheduling system.

The first method entailed collecting and tallying the practice follow-up slips for each physician each day. These numbers were compared to the number of patient visits completed by that physician. A percentage of physician-prescribed follow-up appointments could then be derived from this data. The number of patient visits completed each day was captured for each physician through one of two methods: monthly practice report or patient tracking system. The monthly practice report is a daily count of patient visits, no shows, and cancellations. The patient tracking system provides a detailed report of patients seen each day by physician. Each of these means could be used to confirm the number of patients seen each day by physician.

The scheduling system query method compared data from two separate queries to determine how many patients scheduled a future appointment on the same day as a completed appointment. A two month period was selected to produce a list of visits performed and appointments scheduled. The data included the following six fields:

1. Medical record number
2. Primary care physician
3. Visit type
4. Date when appointment was scheduled
5. Scheduled date of appointment
6. Appointment status (arrived, canceled, bumped, no show, pending, rescheduled).

These two data sets were then cross-referenced by medical record number to compare the date when appointment was scheduled (for a visit type of 'follow-up') with scheduled date of appointment (for an appointment status of 'arrived') to determine if the appointment was scheduled on the same date as the completed appointment. This data was compared for each physician to calculate a percentage of follow-up appointments that are scheduled on the same day as the previous appointment. The analysis was run through three iterations to avoid duplication.

One final data collection source that was available as necessary was the monthly practice report introduced above in the practice follow-up slip data collection activity. This report detail a daily record of the number of patients seen, no shows and cancellations by provider. This report is compiled manually each day using the encounter forms and daily schedule report from the scheduling system.

Qualitative Information Capture

Capturing stakeholder input proved a critical complement to the other methods described above. Throughout the duration of work performed on this thesis, the input from the physician and staff stakeholder groups added insight and understanding to the discovery process. These encounters took place in three distinct forms: 1) 'Lunch with Linda', 2) provider meetings, and 3) stakeholder interviews.

'Lunch with Linda' is a half hour brown bag lunch that occurs every Wednesday for all staff and physicians. The setting is an open forum with opportunity to ask questions, identify issues, and discuss ideas. Lunch is usually free of any formal agenda, but the last five or ten minutes are usually allocated to progress updates on lean activities and discussions centered on the lean board. The lean board provides a central focus of lean information for the entire practice to see with information relevant to all. It includes high level elements of the BHAG, identification of subgoals, communication of active improvement initiatives, and publication and tracking of results. 'Lunch with Linda' provides a weekly opportunity for the entire practice to get together as a unified lean team. They afforded me an opportunity to capture reactions from the practice to many of the improvement activities currently in process.

Provider meetings occur every other Tuesday for an hour and a half, resulting in a one hour reduction in the morning appointment session. At this meeting, the physicians, medical director, and nurse manager meet to discuss practice performance, medical updates, organizational issues, and progress on active improvement activities, e.g. the new scheduling changes and the new patient tracking system. During the course of my thesis work, these meetings also offered the opportunity to present some of the findings from my work and discuss implications, applicability and further work.

Key stakeholder interviews with physicians and staff were conducted throughout on both an as-needed and an as-available basis. The practice environment was often hectic and chaotic during patient appointment sessions, so it was important to plan and be prepared for an interview at all times. They were often brief, typically no more than five minutes, and they were focused, e.g. centered on a specific improvement activity or issue, so they proved to be very efficient and useful. Despite their hectic schedules, staff and physicians were often eager to participate in these interviews and provide feedback on both obstacles and improvements. The stakeholder interviews offered specific and direct feedback on improvement activities and operating practices in real time. This allowed us to quickly incorporate this feedback into changes in the improvement activities.

In addition to meetings and interviews, the practice commonly used a technique they referred to as a 'huddle'. These were quick responses to real-time issues. If a problem came up during the course of regular operations, the staff was encouraged to solve it immediately. They would stop what they were doing and gather together to correct the issue and eliminate the waste. This is similar to pulling the andon cord in the TPS approach. All workers have the power to stop the line when they encounter a situation that does not meet standard practice. While these huddles could be quite effective when used, the staff had not yet fully embraced the concept. The chaotic nature of their operations made it difficult for them to adapt to the new lean ideal. However, there were several successful experiences during the course of this thesis.

Pugh Concept Evaluation

Based on the physician shadowing activities, other observations, meetings, interviews and huddles, we used a design evaluation method borrowed from systems engineering to select a new schedule design. The method, Pugh concept evaluation, was developed by Stuart Pugh (1991) and involves a process of both convergent and divergent thinking to explore the design space. This process of 'controlled convergence' begins with an initial number of concepts, which are reduced down to the best ones. Then new concepts are added based on what you have learned from the first round evaluation. Repeat the evaluation process through several rounds until you have identified the best concept. The Pugh method uses matrices to allow for clear, systematic evaluation of multiple concepts to achieve the best design, results of which are presented in the next chapter.

Chapter 4: Results

The methods discussed in Chapter 3 generated both qualitative and quantitative data to support improvement activities designed to give one hour back to all physicians and staff. Comparison of data collected from existing and improved processes supported the implementation of five primary improvements, as follows:

1. A new schedule design that balances all criteria against achievement of the goal
2. A budget proposal to allow each physician 6 shadowing sessions per year
3. Reduction of waste and improved communication for medical assistant operations
4. Increased efficiency with immunizations and prescription refills for nursing
5. Enhanced understanding of front desk capacity and staffing needs

A New Session Schedule Design

A new session schedule design was developed based on the findings from the shadowing activities, work sampling, data collection, and meetings, interviews and huddles. This new schedule design was selected through a Pugh concept evaluation exercise using both qualitative and quantitative data to systematically compare multiple scheduling concepts. The Pugh team consisted of the nurse manager, medical director and senior front desk staff person and the process comprised four one-hour sessions, in addition to many interim huddles and key brainstorming exercises, spanning a two week period. Results of the Pugh process are discussed later in this chapter.

The criteria from the Pugh process were developed from the data gathered and through a brainstorming session with the Pugh team. The findings and analysis of the data enabled the team to conduct a thorough evaluation of all concepts against the selection criteria. A total of 11 criteria were identified with 4 being labeled as most important, as shown in Table 2.

Table 2. Pugh Concept Evaluation Criteria

Criteria	Meaning	Criteria Ranking
WRVU	Achieve WRVU Standard	1
No Shows	Minimize Impact of No Shows	2
Late Pts	Minimize Impact of Late Patients	2
Session Complete	Complete all work within the session	1
Scheduling Ease	Ensure ease of Scheduling for the front desk	2
Appropriate Appt Times	Book appointments with the appropriate amount of time for the patient need	2
No Schedule Gaps	Prevent gaps in the schedule	2
Physician Satisfied with Visit	Physician is satisfied with the time provided and the level of care delivered during the visit	1
Patient Satisfied with Visit	Patient is satisfied with the time provided and the level of care delivered during the visit	1
Level Loading of Staff	Minimize (level out) the peaks and valleys of staff loading	2
Exam Room Capacity	Accommodate the existing exam room layout	2

These criteria will be reviewed in further detail in the discussion that follows regarding the relevant data used to inform the schedule design process. This data was generated from physician shadowing activities under both new and existing schedule templates, various work sampling activities, and review of practice monthly report records and patient tracking system reports. Interviews, meetings and huddles also served to inform the Pugh process and will be discussed where relevant.

The New Schedule

As noted in Chapter 3, the new schedule was developed based on two phases of session scheduling changes. The two phase approach allowed for revision and refinement based on the data gathered in the shadowing activities. The following sections will detail the results that support the new scheduling development activities, including results from the Appointment Time Capture, as well as the Phase 1 and Phase 2 changes.

Appointment Time Capture Results

The Phase 1 scheduling changes were developed based on the results of the Appointment Time Capture work sampling activity conducted prior to the work involved in this thesis. This work sampling activity yielded an assessment of the time required for an appointment and also tested

the appointment scheduling script for front desk personnel to use in determining an appropriate appointment time. The relevant data is shown below in Table 3 and Table 4.

Table 3. Scheduled Appointment Time

The scheduled appointment time was...		
Response	**Count**	**Percentage**
Adequate	151	63.71%
Too Short	23	9.70%
Too Long	17	7.17%
Not Adequate	7	2.95%
No Response	39	16.46%

Table 4. Required Appointment Time

The Required Appointment Time is...		
Time (minutes)	**Count**	**Percentage**
10	44	22.22%
15	14	7.07%
20	82	41.41%
30	42	21.21%
40	9	4.55%
Unidentified	7	3.54%

Out of 237 samples, there was nearly a 64% success rate associated with the new scheduling script based on physician responses that 151 appointments were adequately identified with the required time. Furthermore, the 198 responses received indicate that less than 10% of the appointments would be adequately served by a 15 minutes schedule. On the contrary, 41% and 22% would be better served by 20 minute and 10 minute appointments. If we also consider the breakdown of appointment types as per the existing schedule templates, we see the results in Table 5 below.

Table 5. Distribution of Visit Types

Existing Schedule Template		
Appointment Type	**Count**	**Percentage**
Urgent	2	18.18%
Follow-up	6	54.55%
Annual Physical	2	18.18%
New Physical	1	9.09%

While not a perfect match, the appointment type breakdown in Table 5 suggests some synergy with the required appointment time distribution in Table 4. This would support the hypothesis that physicians and patients would be better served with a schedule that allows the appointment times shown in Table 6 below.

Table 6. New Appointment Times

New Schedule Template	
Appointment Type	**Time (minutes)**
Urgent	10
Follow-up	20
Annual Physical	30
New Physical	40

This was the premise used to support the Phase 1 schedule design changes. All appointments would be schedule based on 10 minute blocks, as defined in Table 6. The only exception was that only certain urgent appointments would be scheduled for 10 minutes, as defined in the front desk scheduling script. Very specific sick appointments were suitable for 10 minutes, but more complicated urgent visits would be scheduled as 20 minutes.

Phase 1 was then scheduled and physician shadowing planned to assess the effectiveness of the new appointment structure. The results of Phase 1 were used to further refine the schedule design changes for Phase 2. The findings from evaluating both phases against the existing schedule were then used in the Pugh concept evaluation process.

The Schedule Change Results

The data used to evaluate performance of the schedule changes were as follows:

- Primary metrics (used to conduct a top level assessment)
    - Average physician productivity per session (expressed as WRVUs)
    - Average session duration (expressed in minutes)
    - Average number of medical charts remaining to be updated per session (expressed in notes)
    - Physician satisfaction with session pace and time available (expressed as a subjective opinion in reference to the datum of the existing schedule)

- Secondary metrics (used to supplement understanding of primary metrics)
    - Average number of patient visits per session (expressed in visits)
    - Average number of schedule gaps experienced per session (expressed in gaps)
    - Average number of no-shows experienced per session (expressed in no-shows)
    - Average number of available appointment slots per session (expressed in slots)
    - Average billing level per visit (expressed in WRVUs)
- Tertiary metrics (used to add a comparison of time spent per visit)
    - Average Time Spent with Patient Encounter (expressed in minutes)
    - Average Time Spent Updating Patient Chart (expressed in minutes)
    - Average Total Time Spent per Visit (expressed in minutes)

Phase 1

The Phase 1 schedule design changes involved one physician for a total of five sessions and 36 patients. This physician was also shadowed under the existing schedule for an additional two sessions and 20 patient visits to allow comparison with Phase 1. The results of Phase 1 are shown in Table 7 below.

Table 7. Phase 1 Results

Metric	Type	Units	Schedule	
			Existing A	Phase 1A
Average Physician Productivity	Primary	WRVU/session	9.62	8.04
Average Session Duration	Primary	minutes/session	215	197
Average Number of Charts Remaining to be Updated	Primary	notes/session	3.0	2.6
Overall Physician Satisfaction with session pace	Primary	none	DATUM	+
Average Number of Patient Visits	Secondary	visits/session	10.0	7.2
Average Number of Appointment Slots	Secondary	slots/session	12.5	9.2
Average Number of Schedule Gaps	Secondary	gaps/session	1.5	1.4
Average Number of No-Shows	Secondary	no-shows/session	1.0	0.6
Average Visit Billing Level	Secondary	WRVU/visit	0.96	1.12

The column labeled Existing A contains results from shadowing Physician A under the existing schedule and the column labeled Phase 1A contains results from shadowing Physician A under the Phase 1 schedule. These results for phase 1 are discussed below.

Phase 1A Primary Metrics

A review of the primary metrics shows an inverse balance between the physician productivity metric and the physician satisfaction with the session pace. The 9.62wrvu recorded under the existing schedule was reported to be typical of the average productivity experienced by the physician, who generally meets the productivity goal of 9.66wrvu on a regular basis. Considering the average productivity for the Phase 1 sessions of 8.04wrvu, we note a 1.6wrvu per session deficit producing an unfavorable result.

The other primary metrics, however, show positive results in the session pace, as well as the physician's ability to finish earlier with the same number of, or one fewer, charts remaining to be updated. The session duration for Phase 1 is 17 minutes shorter with an average of 0.4 fewer charts to update. These results suggest some initial progress towards the goal of reducing the time required by the physician, though possibly at the expense of reduced productivity for the session. Further insight is found in the secondary metrics.

Phase 1A Secondary Metrics

The secondary metrics reveal that the average number of patient visits per session in Phase 1 was only 7.2 versus an average of 10.0 under the existing schedule. It is also noted that every session was not completely filled with patient visits under either schedule. This data can be used to calculate a session utilization rate, defined as the number of visits divided by the number of available appointment slots. We see that the schedules experienced a nearly equal average session utilization rate of 80% for the existing schedule and 78.26% for Phase 1.

The session utilization rates can now be dissected further into the contributory elements: the rate of schedule gaps and the no-show rate. While the quantities of schedule gaps and no-shows per session are lower for Phase 1, their respective rates per session yield more insight. We define these rates as follows:

- average rate of gaps = the number of schedule gaps divided by the total number of available slots in the schedule
- average no-show rate = the number of no-shows divided by the sum of no-shows and visits

The Phase 1 sessions have a higher rate of schedule gaps, 15.2% for Phase 1 and 12.0% for the existing schedule, and a slightly lower rate of no-shows, 7.7% for Phase 1 and 9.1% for the existing schedule. The higher rate of schedule gaps would result in a lower average productivity, while the lower rate of no-shows would result in higher productivity. Further examination of these results provided additional insight into issues with the Phase 1 schedule design.

Rate of Schedule Gaps

Based on the physician's experience, the rate of schedule gaps was believed to be higher than typical, so we conducted a huddle with the physician, nurse manager and front desk supervisor to better understand the cause of the gaps. It was noted that one or two gaps in a schedule is not uncommon since there are two appointment slots reserved in every session for same day urgent appointments that usually get filled, but can often remain empty. Additionally, if a patient cancels an appointment in the same week, it is not always easy to fill the appointment with such short notice. Based on this information, an average of 1.5 gaps per session was deemed reasonable. However, after reviewing the schedules more closely, we concluded that the distribution of gaps in the Phase 1 schedule was spread across a wider range with one session containing four gaps.

Further discussion and review revealed that the Phase 1 schedule was prone to have 10 minute gaps in the middle of the schedule that could only be filled by a specific type of 10 minute urgent appointment. This was a result of the Phase 1 scheduling process following a less rigid schedule template than the existing schedule. The general rule for Phase 1 was to schedule physical exams at the beginning and end of the session and schedule follow-up appointments adjacent to

another scheduled appointments working in towards the center, thereby reducing the probability of gaps occurring in the middle.

In practice, the Phase 1 scheduling process did not work, as the physical exams were not consistently scheduled only at the beginning and end of the session. The 10, 20, 30, 40 minute nature of the Phase 1 schedule then resulted in a 30 minute space where a 20 minute follow-up would then leave a 10 minute gap. In the existing schedule this issue did not occur since all appointments were scheduled on 15 and 30 minute intervals. The typical three physical exams could be scheduled anywhere in the session and there would still only be 15 minute slots available which could be filled by both follow-up and urgent appointments. In this way, the existing schedule design provided more flexibility in scheduling appointments. The team concluded that the Phase 1 schedule was more difficult to arrange than the existing schedule and therefore more prone to the occurrence of gaps.

No-Show Rate

The no-show rate on the other hand was lower in Phase 1 than in the existing schedule. However, according to the monthly statistics for the practice, the six and twelve month average no-show rates were currently running at 10.4% and 9.9%, respectively. The lowest no-show rate in the last 12 months was 5.8%, while the highest was 16.6%. Based on these numbers, the no-show rate of 7.6% for Phase 1 was lower than typical, and therefore, the average productivity level associated with those sessions was higher than to be expected, when controlling for other variables.

WRVU per Visit

As a final note on secondary metrics, the average visit billing level calculated per visit for Phase 1 was 1.12wrvu and lies within the average range for the practice, which varied between 1.00 and 1.16 over the last six months. However, the average visit billing level for Physician A was only 1.03 over the previous six months. The average visit billing level for Phase 1 was 8.4% higher than the six month average for the physician, which indicated a higher than expected result and raises further concerns that the average session productivity achieved in the Phase 1 may be higher than typical based on the visits completed.

This observation only highlights a need to explore the issue further, as many factors can affect the average visit billing level. Some possible interpretations could include the following:

- Any additional time spent conducting the patient visit may have led to a higher level of care delivery which then warranted a higher billing level, suggesting a typical result.
- The sample size of visits was too small to achieve a representative average, and if additional sessions were to be conducted, the average visit billing level would be lower, suggesting a higher than typical result.

Average Time Spent per Patient

Based on the results of Phase 1, specifically the primary metrics relating to physician satisfaction, session duration and number of charts remaining to be updated, one additional set of data was reviewed for further evaluation. The average times spent per patient encounter, chart updating and the total for the visit is shown in Table 8 below.

Table 8. Phase 1 Average Visit Times

Metric	Type	Units	Schedule	
			Existing A	Phase 1A
Average Time Spent with Patient Encounter	Tertiary	min/visit	15.95	19.97
Average Time Spent Updating Patient Chart	Tertiary	min/visit	6.50	9.94
Average Total Time Spent per Visit	Tertiary	min/visit	22.45	29.92

This data indicates that while Physician A reported experiencing a more relaxed pace of the session with less stress of running behind schedule, the physician also spent more time per patient visit. This would explaining why the physician only finished seventeen minutes earlier, on average, than the existing schedule, despite seeing fewer patients during the same three and a half hour session block.

Physician A spent an additional four minutes during the patient visit and three and a half minutes updating the patient's medical chart, on average. This seven and a half minute total is more than the Phase 1 changes were intended to yield; however, the implication of this is not entirely clear. It may be that the physician spent more time than necessary because the session schedule was not completely full, or that the patient visits required more time than standard, as may be indicated

by the higher average visit billing code. These are just possible explanations, however, and additional shadowing and data analysis is needed to further understand whether the additional time utilized would typically be expected.

Phase 1 Summary

The key results from Phase 1 are as follows:

- The productivity goal was not met
- The schedule design did not adequately prevent schedule gaps
- The number of available appointment slots was too low to compensate for the average no-show rate
- The pace of the session produced less stress for the physician and allowed more time to address the patient visit and relevant medical records documentation.

In general, the sessions conducted under Phase 1 proved more satisfying for the physician both personally and professionally, however, the financial impacts to the productivity losses were too large.

Based on these results, we redesigned the schedule and prepared for Phase 2 with the plan to shadow the same physician, plus an additional physician.

Phase 2

For Phase 2, several key changes were quickly made to the schedule and incorporated in the plan. This was based on the initial results from Phase 1 and performed quickly to support the encouragement of rapid experimentation. The changes were made to address the issue of too few patient visits experienced per session. The new appointment times were generally accepted to be more appropriate for the visit needs, but the following changes were made to improve the session utilization and capture more data.

- The session appointment block was extended from three and a half hours to four, thus filling the entire session with patient appointments.
- The new patient appointment standard was adjusted to allow 30 minutes for certain new patients and 40 minutes for others, based on the appropriate level of care required.
- A second physician was added to practice under the Phase 2 schedule

Under Phase 2, Physician A now completed three sessions and saw 23 patients, while Physician B completed four sessions and saw 30 patients. Physician B was also shadowed under two sessions of the existing schedule consisting of 18 patients in total. Both physicians' results are presented below in Table 9.

Table 9. Phase 2 Results

Metric	Type	Units	Physician A		Physician B	
			Existing A	Phase 2A	Existing B	Phase 2B
Average Physician Productivity	Primary	WRVU/session	9.62	8.56	8.11	7.47
Average Session Duration	Primary	minutes/session	215	201	244	206
Average Number of Charts Remaining to be Updated	Primary	notes/session	3.0	4.7	3.5	2.5
Overall Physician Satisfaction with session pace	Primary	none	DATUM	+	DATUM	+
Average Number of Patient Visits	Secondary	visits/session	10.0	7.7	9.0	7.5
Average Number of Appointment Slots	Secondary	slots/session	12.5	11.0	12.5	11.0
Average Number of Schedule Gaps	Secondary	gaps/session	1.5	3.0	2.5	2.5
Average Number of No-Shows	Secondary	no-shows/session	1.0	0.3	1.0	1.0
Average Visit Billing Level	Secondary	WRVU/visit	0.96	1.12	0.90	1.00

The results for both the existing schedule and Phase 2 have been shown separately for each physician. Note that Physician A is the same physician from Phase 1 and Physician B is the additional physician added for Phase 2 only. The discussion of results is separated by primary and secondary metrics below, as was done with Phase 1.

Phase 2 Primary Metrics

Again we see an inverse balance between physician productivity and physician satisfaction with the session pace. The average productivity for Physician A has increased from Phase 1, however, suggesting that some of the changes have produced the desired results. We also see that the average productivity for Physician B is lower for Phase 2 than for the existing schedule, but that Physician B fell far short of the session productivity goals under both schedules. If we then compare the productivity difference between the two schedules for each physician, we see that

the Phase 2 sessions resulted in an 11% lower productivity for Physician A and an 8% lower productivity in Physician B, as compared to the existing schedule. The significance of this is not clear, but does lead us to explore the results under secondary metrics, as done in Phase 1, but first we review the other primary metrics.

We see that Physician A has finished all patient visits earlier under Phase 2, as was also observed in Phase 1. However, this time the average number of charts remaining to be updated has increased to 4.7. This suggests that the physician was less effective at completing all work associated with the patient visit session in Phase 2 than in either Phase 1 or the existing schedule. Physician B on the other hand finished 38 minutes earlier than in the existing schedule, and left one less chart, on average, remaining to be updated. Physician B appears to have shown progress towards the goal of reducing the work by one hour per day, and both physicians report being more satisfied with the pace of the session under Phase 2. As with Phase 1, the secondary metrics can provide further data for evaluation.

Phase 2 Secondary Metrics

Beginning with the average number of patient visits, we see that the result for Physician A has only increased by 0.5visits per session in Phase 2 as compared to Phase 1, despite the increase in average available appointment slots per session from 9.2 to 11.0. This yields a session utilization rate of only 70% in Phase 2, while the existing schedule exhibited an 80% result. With Physician B, we see a similar result in the number of patient visits per session: 7.5 for Phase 2, compared with 9.0 for the existing schedule. Since the number of available slots under each schedule is the same for both physicians, we get a comparable result for the Phase 2 session utilization, 68%, and a 72% result for the existing schedule.

No-Show Rate

Considering the impact no-shows on the results, we see that Physician A experienced less no-shows for an improved no show rate of only 4.13%. This is lower than the minimum no-show rate experienced by the physician in the past six months, so cannot be expected to represent an average session. This will have a further negative impact in the session productivity expectations under Phase 2.

Physician B, on the other hand, experienced the same average number of no-shows per session in both the existing schedule and Phase 2. In both cases, the no-show rate was higher than the six month average for the physician and equal to, or higher than the maximum rate seen: 10.0% for the existing schedule, 11.8% for Phase 2, and a six month average of 6.1%, with a high of 7.6% during the same period. This suggests that the no-show rate experienced has negatively impacted the average session productivity under both schedules and a higher result can be expected, on average, for Phase 2, all other variables remaining the same.

Rate of Schedule Gaps

Physician A saw an increase in the average number of gaps in Phase 2 as compared to Phase 1. With a 27% occurrence rate of gaps, this result was nearly double the rate of gaps experienced in the existing schedule. Physician B experienced the same average number of gaps for both the existing schedule and Phase 2, and, in both cases, the result was considered typical of the physician's average session.

Further review of the session details revealed that while Physician A did experience one 10 minute gap, five of the remaining eight gaps were primarily the result of same day urgent slots that were not filled. The other three gaps were follow-up appointments that were either cancelled or not filled by patients, likely due to some outside influences unrelated to the schedule changes. Physician B however, had five 10 minute gaps and five gaps due to empty follow-up appointments. Considering all six 10 minute gaps from both physicians collectively, each physician experienced no more than one per day, and three of them resulted from the scheduling of a 40 minute new patient appointment. This qualitative data suggests some improvement in the expected rate of gaps under the Phase 2 schedule design, as compared with Phase 1.

WRVU per Visit

To conclude the secondary metrics review, we note that Physician A has again achieved an average visit billing level of 1.12wrvu for Phase 2, which is the same as for Phase 1. This is again 8.41% higher than the six month average and thus raises concerns that this result may be higher than could be expected typically. The fact that it has occurred twice does not necessary

indicate a trend, as the patient visit sample size is too small to make any generalizations regarding a change in the average visit billing level. Though, it does present the potential for future investigation.

Physician B, on the other hand, experienced a slightly lower than average visit billing level for Phase 2 and a much lower average for the existing schedule: 1.00wrvu for Phase 2, 0.90wrvu for the existing schedule, and a six month average of 1.02. This low result for the existing schedule would help explain the low average productivity experienced during the shadowing session. However, the result for Phase 2 was not low enough to raise the expected average productivity that could be achieved under this new schedule.

Average Time Spent per Patient

As with Phase 1, we reviewed the average times spent per patient encounter, chart updating, and the total for the visit. The results of these metrics are shown below in Table 10.

Table 10. Phase 2 Average Visit Times

Metric	Type	Units	Physician A		Physician B	
			Existing A	Phase 2A	Existing B	Phase 2B
Average Time Spent with Patient Encounter	Tertiary	min/visit	15.95	19.48	17.94	16.57
Average Time Spent Updating Patient Chart	Tertiary	min/visit	6.50	8.74	9.06	8.60
Average Total Time Spent per Visit	Tertiary	min/visit	22.45	28.22	27.00	25.17

We see that, while Physician A still spent more time per patient visit in Phase 2, this was slightly less time, on average, than in Phase 1. Phase 2 resulted in 0.5min less per patient encounter and 1.2min less per chart for a total of 1.7min less per visit than in Phase 1. Physician B, on the other hand, spent slightly less time per visit in Phase 2, as compared with the existing schedule. The patient encounter took nearly one and a half minutes less and the chart update took almost half a minute less per patient, which yields just under a two minute per visit total reduction. Based on a ten visit session, this could result in a 20 minute savings, if these results are indicative of future performance.

While this data represents a relatively small sample size, it should be noted that aggregate observations of the practice operations suggest that Physician B is often running behind under the current schedule. A new schedule that provided the appropriate amount of time for each visit could better suit the physician's style and approach, thereby neither increasing nor decreasing the time spent per visit, but rather producing a schedule that better fits the need. As noted, though, in the Phase 1 results section, further work is needed to better understand the time spent per visit data.

Phase 2 Summary

The key results from Phase 2 are as follows:

- The productivity goal was still not met, though the results showed improvement
- The schedule design did not fully prevent schedule gaps, but has improved over Phase 1.
- The number of available appointment slots, though increased from Phase 1, may still be too low to compensate for the average no-show rate. Further analysis is required here.
- The pace of the Phase 2 sessions also produced similar results to Phase 1. The physicians reported less stress and more appropriate time to address the patient visit and relevant medical records documentation.

The sessions conducted in Phase 2 demonstrated improvement over those in Phase 1; however, the financial impacts to the productivity losses were still problematic.

Engaging the Pugh Process

Following Phase 2, the medical director, nurse manager, senior front desk person and I gathered to brainstorm the next steps in refining the new schedule. Some significant progress had been made; however, there were still several issues with the latest schedule design. In parallel with the shadowing of the new schedule design sessions, other data collection activities were continuing, including meetings, huddles, and an outside health care lecture or two.

Additionally, a number of new ideas for session schedule redesigns were now on the table, from minor redesigns through radically new concepts. Considering the time and resource, including

financial impacts to the physician productivity goal, required to continually implement new schedule designs, the team needed a systematic method for evaluating these ideas. I introduced the Pugh concept evaluation method to address this need.

Based on my records from various meetings, interviews and huddles with members of the practice, as well as my independent observations, I drafted a preliminary Pugh concept evaluation matrix. Further review and discussion among the medical director, nurse manager senior front desk person and I resulted in the initial Pugh matrix shown in Table 11. This included eleven criteria, or requirements, for the session schedule design and twelve concepts to be evaluated against the existing schedule, referred to as the DATUM.

Concept	15/30 Sched	20m Appts	Physicals Grouped	Overlap Appt Times	Wave - 15/30	11 Pt Visits	10 min Interval Appts	15/10 Hybrid	3 Pts per hour	Weekly Wave	Monthly Wave	10 min Interval, w/make-up times	Physician Defined Appt Times	
Criteria	Existing Schedule: 15 & 30 minute appt times	All appts are scheduled as 20m in length	Physicals are grouped together in the schedule	Pilot appts are schedule with a 5 minute over lap with previous and following appt	appts double booked, with the following slot blocked	Pilot Schedules designed to allow a total of 11 appts per session (overlap where needed)	Pilot Schedule: 10 minute intervals with a script for appt time scheduling	A hybrid of the existing and pilot schedule to allow more flexibility in scheduling	Pilot Schedules designed to allow a total of 3 appts per hour (over lap where needed each hour)	Pilot Schedule for 3 out of 4 sessions, and a wave version of the old schedule one of every 4 sessions	Pilot Schedule for 3 out of 4 weeks and a wave version of the old schedule on one week each month	Pilot Schedule for all sessions, with a make-up session (or partial session) every 2 weeks or month or similar.	Standard Scheduling applies for call-in appts, but Physicians define the duration on follow-up forms at time of patient visit	**Criteria Ranking**
WRVU	DATUM													1
No Shows	DATUM													2
Late Pts	DATUM													2
Session Complete	DATUM													1
Scheduling Ease	DATUM													2
Appropriate Appt Times	DATUM													2
No Schedule Holes	DATUM													2
Physician Satisfied with Visit	DATUM													1
Patient Satisfied with Visit	DATUM													1
Level Loading of Staff	DATUM													2
Exam Room Capacity	DATUM													2
+/- Tally														
Xtra Points for Top Criteria														
Quantitative Score														
Resultant Determination														

Table 11. Pugh Concept Evaluation Matrix

Further Defining the Criteria

Before conducting the Pugh evaluation, we confirmed understanding of each of the criteria and gathered any additional data that was necessary and readily available.

1. WRVU – Achieve the WRVU Standard

This criterion required that the schedule allow the physician to meet the current productivity standard for each session. Based on the 9.66wrvu per session target and the six month practice average of 1.06wrvu per visit, as per the practice productivity reports, a requirement of 9.11 visits per session is required to satisfy this criterion. This resulted in a minimum requirement of ten visits per session to achieve the goal, while the existing schedule yielded an average of 11 appointment slots per session. It was also noted that no-shows affect this goal.

2. No-Shows – Minimize the Impact of No-Shows

There are other patient care management related activities that can be completed during time made available due to a no-show. However, no-shows cause fewer patient visits per session and, consequently, a lower session productivity result. Based on the data in the monthly practice reports, the six month average no-show rate for the practice was 9.7%, which ran from a physician minimum of 5.7% to a maximum of 12.8%. Based on ten patient visits per month, this meant an average of about one no-show per day.

3. Late Patients – Minimize the Impact of Late Patients

Throughout the shadowing activities, meetings and discussions, the late patient issue continued to come up. A late patient or two can easily cause a physician to run behind, and once they begin to fall behind, the stress level compounds and can often make matters worse. My qualitative observations have shown that once a physician begins to run behind, it is hard, if not impossible for them to recover and complete all work within the session. The only data readily available regarding the late patient rate comes from the patient tracking system. This system only identifies a late patient as someone who is more than fifteen minutes late and, consequently, an early patient is one who is more than fifteen minutes early. The practice considers a patient who is fifteen minutes late as a no-show and requires them to reschedule, except under special circumstances. Based on the patient arrival report, the practice has an average late patient rate of

nearly 5%, and an early patient rate of nearly 30%. However, this data does suggest that an estimate of a 10% late patient rate would be reasonable, thus resulting in about one late patient per session and that is all it takes to impact the session pace.

4. Session Complete – Complete All Work within the Session

The shadowing sessions provided the best qualitative understanding of what impacts the ability to complete a session on time. Late patients, inadequate appointment times and double booking or overlapping appointments were acknowledged to have the greatest impact on this criterion.

5. Scheduling Ease – Ensure Ease of Scheduling for the Front Desk

Qualitative discussions and observations identified that a rigidly structured schedule design and little variation in appointment times and/or decision-making regarding the appropriate appointment time all improved the ease of scheduling.

6. Appropriate Appointment Times – Book Appointment with the Appropriate Amount of Time for the Patient Need

The results from the Appointment Time Capture work sampling activity, as well as the shadowing activities provided evidence to suggest that the 10/20/30/40 minutes intervals based on a scheduling script was the most effective way to meet this need. Additionally, the two activities for collecting data on the same day follow-up appointment scheduling rate yielded useful insight. The results varied between the two data collection methods, but, in general, between 35% and 50% of follow-up appointments are scheduled on the same day the patient has an appointment. This provides some insight into the control the physician can have over the duration of routine follow-up appointments for specific patients. This may be the best time for the physician to identify the appropriate time needed for the appointment. In a few limited cases, this tactic has been successful for physicians in the practice, but it is seldom used to deviate from the standard appointment times.

7. No Schedule Gaps – Prevent Gaps in the Schedule

The shadowing data and monthly practice reports have provided some data on this. However, gaps due to cancellation and scheduling vacancies are generally independent of the scheduling

design. Therefore, the primary concern is to prevent 10 minute gaps in the schedule. As a general rule, gaps should be prevented, as they are waste in the process that adds no value.

8. Physician Satisfied with Visit - Physician is Satisfied with the Time Provided and the Level of Care Delivered during the Visit

This is primarily a subjective assessment, however, some qualitative data from the shadowing and interviews can inform evaluation along this requirement. The general goal is to minimize double booking or overlapping visits and to schedule the right amount of time to address the patient need.

9. Patient Satisfied with Visit - Patient is Satisfied with the Time Provided and the Level of Care Delivered during the Visit

Based on the stakeholder analysis data produced during the lean enterprise assessment, performed prior to this thesis work, the patients value time with their physician as most important. Based on this information, we can only make a subjective estimate on how well each concept ensures that the appointment will be scheduled with the appropriate time to address the patient's needs. However, qualitative observations during the physician shadowing suggest that this is generally well met with the 10/20/30/40 minute appointment intervals.

10. Level Loading of Staff - Minimize (level out) the Peaks and Valleys of Staff Loading

Review of the current physician schedule templates and qualitative observations during general practice flow shadowing has demonstrated that appointment types and times should be staggered among the various physicians to avoid six patient appointments all being repeatedly scheduled at the same time. The Arrivals by Time of Day data from the patient tracking system, as seen in Figure 8, shows that there are recurring peaks and valleys in patient arrival times. It may be possible to minimize this phenomenon and level out the patient arrival times by staggering the physician's appointment schedules.

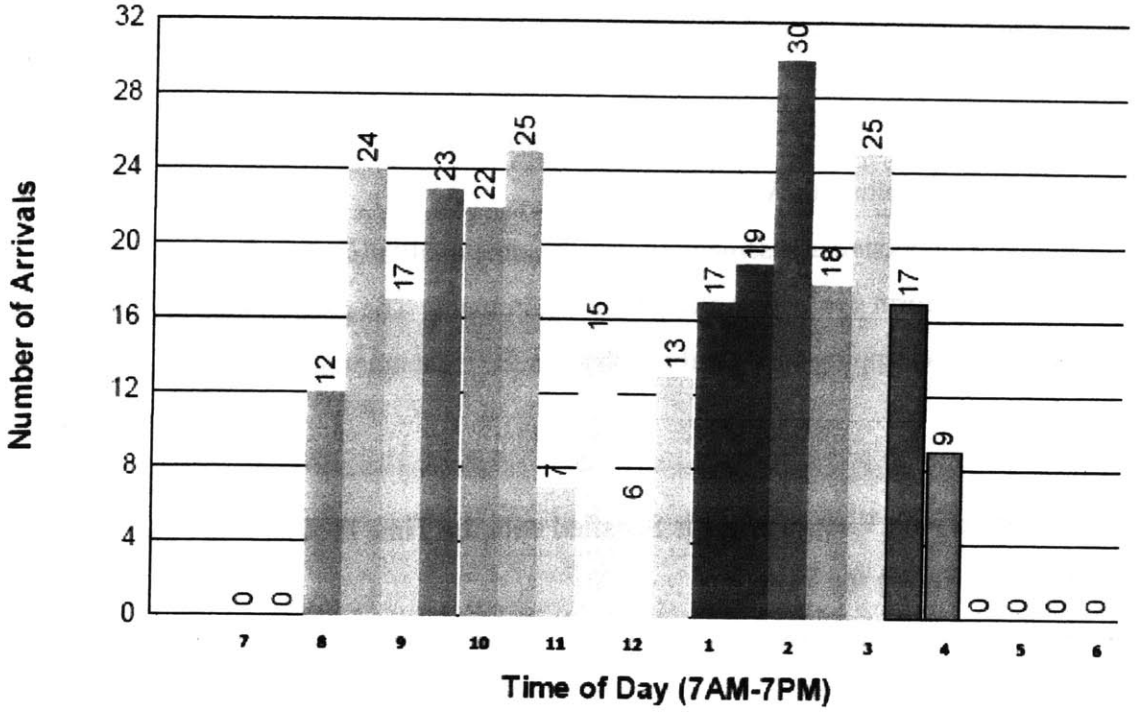

Figure 8. Patient Arrivals by Time of Day

11. Exam Room Capacity - Accommodate the Existing Exam Room Layout

The existing room layout provides sufficient capacity now, as each of the existing five physicians has two rooms dedicated to them. However, when the sixth physician comes on board in July, the ten rooms will be shared among them. This makes it more critical to finish a session on time so the next physician can use the exam rooms. Every session of every day, all ten rooms will be regularly in use by practice physicians, residents and/or specialists.

Pugh Results

Based on the eleven criteria described above, I led the nurse manager, medical director and senior front desk staff person through evaluation of the twelve concepts against the existing schedule design. See Appendix C for detailed results of the Pugh process. All criteria were weighted equally at first, but upon review of the results of the Round I evaluation, we saw some things that did not agree with some of the qualitative assessments. We then reviewed the criteria and decided that four of them should receive more weight, as they were more important than the other seven. These four criteria were: WRVU, Session Complete, Physician Satisfied with Visit,

and Patient Satisfied with Visit. After re-scoring the matrix and performing a qualitative evaluation of the results, we finalized Round I by omitting six concepts and carrying the highest scoring six on to Round II.

Before a Round II evaluation, we conducted a new brainstorming exercise and developed three new hybrid concepts based on of the best positive attributes of all concepts. We specifically reviewed the criteria where the accepted concepts scored worse than the DATUM, and attempted to incorporate new ideas and/or omitted ideas that would improve these negatives. Now using the top rated concept from Round I as our new DATUM, we conducted a Round II evaluation omitting another three concepts and selecting a winning design.

Finally, we conducted Round III with our winning design as our new DATUM and the remaining concepts as our six alternatives against which to rate our DATUM. The results of Round III produced confirmation that our winning concept was the best, and also provided some next best alternative concepts that could be considered at a later date as the practice made further improvements to their operations, thus changing the needs of the schedule design. It was agreed by all that this was not the end, but rather the beginning of the journey of continuous improvement. As the practice evolves, the schedule design should be revisited to ensure that it still addresses all the needs of an appointment session.

A Proposal for Physician on Physician Shadowing

The new schedule design is only one aspect of the improvement initiative to deliver a one hour time savings per physician. In addition to providing the appropriate appointment time for each patient's needs, a lean culture of continuous improvement also encourages the practice to review the physicians' processes to identify and eliminate waste. This included developing a best operating practice (BOP) model for the physicians and staff.

Based on the quantitative results of the physician shadowing, which spanned 4 physicians across 19 sessions and 148 patient visits, the average times for a patient visit are shown in Table 12. This information serves as a foundation for investigating and understanding the patient visit characteristics on the journey to developing best practice.

Table 12. Average Patient Visit Times

Visit Type	Average of Pat Enc	Average of Document	Average of Total Visit
Urgent	12.80	7.15	19.95
Follow-up	17.03	8.71	25.75
Physical	28.74	10.52	39.26
New Patient	29.42	11.11	40.53
Grand Total	**19.60**	**8.93**	**28.52**

After compiling a list of qualitative observations and feedback obtained during physician shadowing, interviews and bi-weekly provider meetings, I met with the nurse manager and the associate vice president for medicine and primary care services and discussed the importance of effective knowledge share between the physicians. They currently seek each other out for advice and input on how best to treat a patient's condition, but the physicians rarely collaborate on operational improvement involving patient encounters and the management of care. Based on the specific findings presented via the list and backed by anecdotal evidence from my work, it was agreed that the best way to foster and support an operational knowledge share process was through physician on physician shadowing.

Less than a week later, I received news that this view was shared by upper management and an allowance had been submitted in the practice's budget to allow six sessions per physician for shadowing and development of best practice. Plans for this initiative would involve a variety of activities to collect, develop and share knowledge, including the following recommendations:

- Reciprocal shadowing between two physicians where one physician would shadow another for half a session, then switch roles for half a session and compare their observations following the end of the session.
- Light sessions with only 3 to 5 patients interspersed with discussion blocks for physicians to shadow each other and then share experiences. This would allow them to trial new approaches, immediately critique their effectiveness, and then make changes to improve the method. This would allow rapid experimentation with patient visit management.
- A regular agenda item during biweekly provider meetings to discuss findings from physician shadowing activities, share ideas and develop some universal approaches to patient care and best practice.

The physician shadowing proposal would facilitate the development of best practice and improved efficiency with patient care, while also maintaining the flexibility to adapt to individual physician style and approach. The goal is not to destroy physician autonomy, but rather to provide a culture for physicians to actively share ideas and experiences, while continually improving both individually and collectively. Each physician could employ new techniques to yield more focused and effective patient visits.

Addressing Staff Improvements

The medical assistants, nurses and front desk personnel serve vital roles supporting practice operations. In addition to physician improvements, these areas were also reviewed to attain the goal of saving one hour a day per person. Dedicated shadowing, general observations and more meetings, interviews and huddles all contributed to identifying and assessing improvement initiatives for these roles. Focus on these activities produced two types of results: 1) communication and operational visibility improvements in the medical assistant and nursing operations and 2) a capacity assessment for front desk staffing.

Medical Assistant Improvements

Medical assistant shadowing identified both quantitative and qualitative observations, similar to the physician shadowing results. One key observation was that the MAs were routinely circling the offices to update their knowledge of the state of the session.

- Exam room status: occupied or vacant; cleaned or not cleaned
- Waiting room status: number of patients arrived and waiting; waiting for free physician, unavailable physician or physician falling behind
- Session status: number of patient no-shows; patients added to schedule; patients canceled or rescheduled

This created extra movement, did not add value to the patient visits and resulted in waste activity by the medical assistants.

A visual room card system was implemented to identify the state of exam rooms, but it required continual updating and monitoring by the medical assistants. A patient was given a room card

when placed in an exam room, so that all staff could see the missing card and know the exam room was occupied. The patient would place the card in a bin upon leaving the office, and the staff would then reposition the card in the exam room hook on the board to signal an empty room. This system had large inherent delays and required regular staff action to keep the board updated. If the patient needed labs or immunizations, the card would remain out of place despite the exam room now being vacant. Oftentimes the patient would leave the office and forget to return the card, resulting in an inaccurate signal to the staff that a vacant exam room was still full. Even with the card tracking system, the medical assistants continued to make their rounds to determine exam room and patient status, resulting in the same wasted effort and activity.

A computerized patient tracking system was implemented shortly thereafter to track patient flow through the practice. The system monitored arrived patients in the waiting room, at the medical assistant station, in the exam room, at the lab, at immunization, as the checkout desk, and, finally, in final checkout status upon full completion of their visit. All staff and physicians utilized the system to monitor patient location and discharge the patient from their area to the next step in the process, as dictated by the patient needs. The system greatly improved communication within the practice, allowing anyone to see the status of individual patients. One could look at the entire practice and also filter by physician and/or location to receive real time information on the state of the session.

This system achieved several results:

- Elimination of the need for medical assistants to conduct rounds through the practice to identify empty rooms and arrived patients
- The system provided a picture of the practice for medical assistants to view which exam rooms were full, which patients were arrived, what time their appointment was, and how long the current patients had been in the exam room.
- The practice view allowed the medical assistant to make structured decisions about which patient should be brought in next, how many physicians were ready for the next patient, and how many patients needed to be brought in now, i.e. did the medical assistants need to call for additional help to bring several patients in at once to prevent a slowdown in physician operations?
- The system allowed the front desk to see how far ahead or behind a physician was running to inform patients of their estimated wait time, as well as aiding them in assessing whether or not a late patient would need to be rescheduled, or would the physician be able to fit them in still.

The new patient tracking system eliminated waste by reducing non-value added movement of the medical assistants, and provided a structured approach to determining patient priority and activating additional staff during peak periods. Physicians now also had access to the status of their next patient and were able to monitor when their exam rooms were occupied without moving about the practice unnecessarily. This gave the physicians more information and helped to reduce their uncertainty regarding when the patient would be ready for their examination, e.g. if they saw a patient had arrived, but was not yet in an exam room, they could now see if the patient was at the medical assistant station, in the lab, at immunization, or with a nurse prior to entering the exam room.

The patient tracking system also provided reporting functionality that enabled the practice to determine the time consumed by medical assistants activities, lab work and immunization, as well as time spent in the exam room and waiting room. This allowed the practice to set and monitor standards for how long a patient should remain in each area and how much total time is consumed for a patient visit from check-in to check-out.

In summary, the new system yielded the following results:

- Improvement in visibility of patient flow through the practice
- Reduction in time through elimination of waste in medical assistant operations. A new standard time was identified for the medical assistant to bring the patient in, check their vitals, and move them to an exam room.
- Implementation of standard practice for patient prioritization decisions

Nurse Improvements

Encouraged by improvements in the medical assistant operations and considering concerns with the hectic activities of the immunization and prescription nurse, the practice discussed potential areas for improvement with immunizations and prescription refill requests. At a 'Lunch with Linda', the issue was presented and several ideas considered. That week an operational change was implemented to convert prescription refill requests from voicemail to fax requests.

The new process included instructions for patients to contact their pharmacy rather than the physician's office to request prescription refills. The pharmacy would then fax the physician's office directly requesting the refill. This request could then trigger action to update the prescription order in the patient's electronic medical chart. The prescription refill order would be e-faxed to the pharmacy and the patient could then pick up their new prescription with minimal delay.

Within two weeks, the new prescription refill process witnessed the quantity of faxes and voicemails flip from a 30/70 ratio to a 70/30 mix. Note that certain types of medication still require initiation of prescription refill requests through the physician office to ensure safety and promote review of the use of specific controlled substances. Through partnership with the pharmacies, the prescription refill process was enhanced to eliminate waste, improve quality and streamline the process. By receiving the request direct from the pharmacy, the practice was able to ensure that all relevant prescription information was available to address the refill request. Previously, when patients called the refill line, they would often leave a voicemail with incomplete information which then required the prescription nurse to call the patient back to

verify the details. This waste was eliminated in the new process, thus reducing unnecessary rework.

Another improvement in the nurses operations involved pre-visit preparation of immunization needs. Traditionally, the physician would examine the patient and then order the required immunizations. In the new process, the nurse would review the session schedule to identify specific types of immunizations that were due and prepare to administer them prior to the physician's examination of the patient. The initial trial of this process resulted in more efficient use of the time for both the patient and nurse during a session. It also served as an in-process quality check to ensure that the patient received the required immunizations without relying on the physician to order them. These standing orders for immunizations reduce the amount of defects associated with missed immunization requirements.

Front Desk Capacity Review

The front desk serves as the gateway into the practice. All scheduling, check-in and check-out activities are the responsibility of the front desk. This area also symbolizes the face of the practice and is often the first recipient of patient complaints, issues and miscellaneous requests. These occurrences, coupled with patients who are misinformed or are missing necessary information, can cause variation in the operations performed and result in delays that can ripple throughout the practice.

Shadowing activities, interviews and discussion at 'Lunch with Linda' were used to assess the front desk operations in an effort to understand capacity constraints and obstacles that may hinder operations throughout the practice. As a result, we determined an estimate for both current/non-ideal and future/ideal state standard process times associated with front desk responsibilities.

These results identified issues with the current phone system, as well as personnel requirements. The existing phone system could result in the phones ringing off the hook while personnel were tending to other patients and they would need to answer the phone and ask the person to hold for a moment. This caused a disruption to the current task at hand and delayed the process further.

Additionally, the phone system was limited in its reporting capabilities, thus preventing the practice from assessing its call statistics, including volume, wait times and peak periods, among other metrics.

A new phone system was implemented to address these issues. The new system included advanced reporting features, as well as enhanced operational functionality, such as queuing incoming calls, identifying the number of calls in queue and operators logged on via a current status display, and enabling staff to log in and log out of the system, as necessary. With the new system in place, the practice was now capable of better managing the front desk operations. Dedicated roles were now developed for check-in, check-out and call answering, with cross-training in place to allow personnel to adapt to variation in peak activity in any of these areas.

Additionally, the reporting functionality would now allow the practice to assess capacity needs and make adjustments were necessary. Based on the process time estimates, at least one additional staff person was required to handle the existing volume and the increase expected from the sixth physician starting in July. Through the data received in the phone system reports, the practice could identify any capacity issues in the operation and plan for additional personnel, if necessary, and identify improvement activities to eliminate waste and develop a more efficient process to free up time for the existing staff to perform additional value added services, including some recommended new initiatives listed below:

- Call patients who no-show to determine some reasons and develop corrective actions to minimize future occurrence, i.e. revamp the appointment reminder system, update the patients information, or other ideas that may present themselves.
- Proactively contact patients to adjust their appointment times due to unforeseen circumstances, i.e. schedule cancellation, physician running ahead of schedule, physician running behind schedule, or some other developments during the session.
- Survey patients with the question of the day. This is a new idea that was generated to create a more interactive relationship with the patient as part of the team to improve the practice and shape the future of the enterprise. The preliminary idea is to have a question of the day, week, or month for the patient to provide input. The question would be a simple one with a set answer, i.e. yes or no, a or b, or similar. A sample question might be: Which is more important to you: A) The physician spends as much time as you wish and addresses all of your concerns within the visit, but you may experience long wait times during your appointment or B) the physician addresses only your scheduled, or most critical, concern during this visit, but the physician runs on time and sees you at your scheduled appointment time? This allows the patient to provide input into the type of care that they receive and the manner in which they receive it.

Future improvements to front desk operations will aid the practice in continually presenting a welcoming and pleasant experience for patients. This stakeholder relationship can then become stronger with the patient becoming an integral player participating in a true partnership with the enterprise.

This Page Intentionally Left Blank

Chapter 5: Analysis

The discussion in Chapter 4 presented the results from the team's improvement activities. These activities were the focus of this thesis and the means to test the hypothesis presented in Chapter 1.

> Hypothesis: *A Lean Enterprise approach can improve the efficiency of a primary health care organization by providing a consistent quality of care while reducing one hour per day per person*

The approach taken by the team was to achieve this goal of a one hour savings per day by closely examining the practice operations, identifying and eliminating non-value added wastes, developing improved process and sustaining standard practices. The evidence presented demonstrates that a lean enterprise approach can be effectively applied to process improvement in a primary care practice.

Each of the five primary results offers support for this conclusion.

1. The new session scheduling results show that the patient visit can be completed earlier and with fewer charts remaining to be updated.
2. The physician on physician shadowing budget proposal represents a new approach for primary care that supports rapid experimentation to improve physician processes.
3. The patient tracking system has removed some of the institutional barriers between the front desk, medical assistants, nurses and physicians through a simple system to connect all aspects of patient care management from check-in through check-out, while reducing waste in the medical assistant operations.
4. Changes to the prescription refill process have engaged both the patient and pharmacy stakeholder groups to eliminate waste and create value. Additionally, implementation of standing orders for immunization has begun to reduce the defect rate and increase efficiency in these operations.
5. Close evaluation of front desk operations has resulted in a streamlined phone system with visual signals to alert staff in real time when the backlog exceeds the capacity of the standard operating process.

The quantitative data from the physician shadowing showed that the existing schedule based on 15 minute appointment intervals was insufficient to accommodate the needs of patient care. In fact, the average times for each type of patient appointment were more closely matched with the new 10/20/30/40 minute appointment times. We showed that under this new schedule concept the physician was more likely to complete a patient session in the allotted time. Noting that not all results from Phase 1 and Phase 2 proved the new schedule, the team acknowledged that the scheduling design was a complicated instrument with many factors affecting the time required. However, controlling for other factors, the new appointment times were found to be more appropriate to the patient need overall.

The one factor that most contradicted the success of the schedule design changes was the physician productivity metric. While this metric was not met under either Phase 1 or Phase 2, this does not preclude the new schedule designs from showing potential to contribute to achievement of the one hour savings goal. The findings gathered during the shadowing activities supported the Pugh concept evaluation process to identify a more appropriate schedule design that balances all criteria in pursuit of the one hour savings. This result is the product of a successful culture of continuous improvement, following the tenet of the scientific method: observe, hypothesize, predict, test, and reassess, then repeat.

Further consideration of the productivity results creates a new interpretation of their meaning. Recalling the BHAG discussed in Chapter 2 and the generally believed goal of primary care leads us to question the benefit of the productivity goal. The original BHAG addresses growth, work-life balance and 100% patient satisfaction, yet no mention of financial indicators. We added the goal of improving the financial independence of the practice to reflect the reality of survival within the constraints of the current health care industry. Similarly, the goal of primary care is to provide efficient, effective, high quality care management to patients. The productivity goal, while perhaps a good financial indicator, appears to be driving practices that minimize the time with the patient, yet without any incentive to improve the quality of care.

The productivity goal resembles the need to adhere to a goal resulting in dysfunctional behavior in the operational practices. In many cases, the physician's need to deliver a high quality of care

overrides other factors, yet the schedule is driving patient appointment visit times to meet the productivity goal, thus resulting in physicians who are overworked and overburdened leaving them little or no time or energy to improve their own processes. Furthermore, as the goals and metrics that define the delivery of high quality care continue to become more difficult and labor intensive to achieve, the time required increases. Similarly, as pressures increase to reduce rising health care costs, the productivity goal becomes more and more important to the financial health of the practice. All of this begins to squeeze the physicians tighter and tighter between conflicting goals.

These conflicting goals create a difficult environment for improving work-life balance and creating time for improvements. Through the work done on this thesis the practice and the organization's central primary care services support team has recognized this, and is now beginning to review the productivity goal. New measurements are being considered and trialed to redefine the metric of a successful patient appointment session. WRVUs billed per session per minute are being reviewed, along with other factors such as total number of patient visits completed per session, number of charts to be updated following the last patient visit of the session, number of no-shows per session and WRVUs billed per patient.

Results from the shadowing sessions have raised many questions and encouraged the practice and the larger enterprise to review their goals and metrics. They have taken a lean enterprise approach to doing the job right and this includes setting standard times appropriately and correctly sizing the system to operate to these standards. They have revisited the standard time for a patient visit and have realized that it needs adjustment. They also see the need to further improve on that standard to meet patient demand more effectively both in quality of care and quantity of patients seeking care. The work on the new schedule is just the beginning.

One way to improve on the patient visit standard is to develop and share best practice. In addition to developing an appropriate appointment schedule, physician shadowing revealed a need to develop a universally accepted standard practice to approaching a patient visit. While some level of autonomy allows the physician to be flexible and adapt to patient needs, some standardization will help to structure appointments in a manner that allows repeatable results and

steady flow throughout the process. The concept of physician on physician shadowing supports development of a structured patient encounter that allows the physicians to follow similar practices, yet adapt them to fit their own personal style. This further evidences the practice's desire to do the job right.

As discussed in *Lean Enterprise Value* (Murman, et al., 2002), doing the job right is only part of the goal. It is also important to do the right job. What does it mean to do the right job in this case? That is the second goal of physician on physician shadowing. The qualitative results of the physician shadowing activities include observation of tasks that may not be the right job for the physician. There are tasks that may be best left to a nurse or medical assistant. Other tasks could be improved or made more efficient if better information were available to the physician, including information that could be collected by a nurse or medical assistant prior to the physician examination. Still other tasks may be deferred to a more appropriately scheduled visit or eliminated altogether through enhanced patient education and information.

The decision by the practice and organization to budget a productivity allowance for physician shadowing and to foster and encourage regular experimentation and knowledge share among physicians is a result of their commitment to develop physician best practice. The practice has shown a desire to look at the enterprise and determine what the right job is and how to do it right. This is further evidenced in their other improvement efforts involving the medical assistants, nurses and front desk staff.

The implementation of the patient tracking system is a classic example of using visual signals to improve communication, eliminate waste and create value in an operational environment, in this case the environment of patient care. The patient tracking system succeeded in eliminating several wastes in the medical assistant's processes, including waste in over production, movement, waiting and over processing. These are four of the seven primary wastes, as identified by Murman, et al. (2002). The waste in movement has been detailed during the discussion of results in Chapter 4. The medical assistant rounds to determine the status of exam rooms and the waiting room have been eliminated as unnecessary movement through the real-time monitoring capabilities of the patient tracking system. Over production and over processing

have also been eliminated in that the medical assistants no longer bring a patient back for vitals check before an exam room is available just to send them back to the waiting room to await the physician. The patient tracking system regulates the flow and timing of activities to prevent a medical assistant from checking the patient's vitals too early in the process. Additionally, the waste of waiting has been eliminated as well, since the medical assistant can continue to work at their station until signaled to bring the next patient back. Prior to this system, the medical assistant would often wait at the front desk while the next patient was being checked in. This was an unnecessary waste that has been eliminated, among several others not discussed here.

The medical assistant improvements have also provided focus to allow the medical assistants to do their job right, while the elimination of waste has allowed them to further assist with the practice's vision for each person to do the right job. There has been a time savings due to the efficiency improvements of the patient tracking system operation, as well as the reporting functionality which has replaced some monthly reporting on appointment session statistics that was produced manually by the medical assistants. These results have allowed the medical assistants to now be available to assist the physicians by gathering information from the patients and managing the patients' expectations for the physician exam. Some new improvements have been proposed that involve the medical assistant conducting a pre-exam interview with the patient to aid in the physician's efficient approach to the visit. By eliminating unnecessary tasks from the medical assistant process, they now have the time to assume these added responsibilities and aid the physician to perform the right job as well.

Similarly, the improvements in the prescription refill and immunization operations have allowed the nurse to focus on the value-added activities. The pharmacy is now doing the right job of requesting the prescription refills for the patient and eliminating the waste of defects by providing all relevant information via fax to the physician's office. This allows the nurse to more efficiently process prescription refill requests and focus on the more value-added process of identifying the need for and preparing standing immunization orders. This makes more efficient use of the patient's time and also reduces defects by ensuring patient immunizations are up-to-date. The practice is placing quality at the source, and ensuring that the nurse responsible for administering the immunizations is equipped to identify which patients require them and

which patients do not. The nurse is now doing the right job and the physicians can focus on other facets of patient care that require their area of expertise.

Finally, the front desk is working on better inventory and resource management through real-time monitoring of their phone systems and adjustment of their staffing to move resource where needed, including manning the phones, checking patients in and checking patients out. By managing their resource more effectively, they can take on new value-added tasks that may include calls to reschedule patients to fill cancellations and calls to no-shows to improve the practice's processes and reduce the no-show rate, thereby reducing defects in the schedule.

All of the results presented offer evidence to support the hypothesis that a lean enterprise approach improves efficiency in a primary care organization. However, it is not so much the results that prove this, but rather the processes that achieved these results. The focus is less about developing the right schedule, or the right BOP, or the right medical assistant process, but rather, the journey of developing that process. The approach used was one of dynamic discovery whereby changes are implemented and monitored to understand their impacts, then revised and tried again. The work done on the schedule design changes provides a clear example of this. The information from each phase was used to inform the next change, and thus the next phase, with a goal of continuous improvement. The learning is not in the end result, but rather in the journey along the way.

When *The Machine That Change The World* (Womack, et al., 1990) introduced auto manufacturers and the world to the manufacturing techniques employed at Toyota and how to implement those methods, many readers and organizations misinterpreted the significance of the story. The goal was not to go out and copy a Toyota factory, but rather to understand how Toyota decided what that factory should look like, how it should be run, and how to continually improve upon each new iteration. Every factory, workforce and situation is different, so the Toyota solution may not work for all, or any, but the process of observing an issue and questioning why will work in every situation. This is what we have found during our work with the primary care organization.

The improvement initiatives explored in the practice were not cookie cutter copies from another practice or organization and industry, but rather they were the result of observations and ideas by the people involved. These were observations that came from both within and outside the practice and ideas that were explored in the practice operations. Each new idea that was trialed led to real-time observations and new ideas or improvements to the original idea. These was not copy exact, but rather try and try again, but each time use the knowledge of past trials to enhance and improve on the next one. As the patient process continues to operate, changes were made in a dynamic nature, reacting to the real-time observations and results from the previous changes. This approach of dynamic discovery has proven to be the guiding structure behind the improvement activities.

As the process of dynamic discovery continued to unfold, we found a suitable analogy in the medical profession: The SOAP process used to structure a physician's medical chart note, and consequently the approach to a patient visit at the practice. A SOAP note (Herschel, et al., 2001; Bates, et al., 1991) is structured as follows:

- S – subjective data – this is the history or data gathering part of the patient visit
- O – objective data – this is the physical examination and lab work or other testing
- A – assessment – this is the diagnosis of the problem based on the evidence
- P – plan – this is the treatment of the problem or prescribed follow-up work

Physicians are trained to use the SOAP note process in documenting the patient visit. Consequently, this is the typical structure observed to conduct a patient visit where the physician interviews the patient to gather the history of present illness (HPI) and past medical history (PMH), examines the patient and orders lab work or tests, makes a diagnosis of the problem, and develops a treatment plan. HPI and PMH map to S, exam and labs/tests map to O, diagnosis maps to A, and treatment plan maps to P.

Considering that physicians already possess the mental model of documenting, and administering, patient care as the SOAP process, the leap to extend onto operational improvement is intuitive. The difficulty is less about the dynamic discovery approach, but rather the act of generating the ideas and finding the time to enact some of these improvements and evaluate their effectiveness. Physicians are accustomed to medical challenges, yet now they must think about patient flow

and operational processes. This is a mindset that they can gain through practice and rely on their own experience approaching patient problems to address operational ones with the same evaluation techniques. In some ways, they are ready to embrace a lean journey, and the improvement initiatives presented here support the assessment that some of them have already made that leap.

The more difficult challenge for the practice is to develop realistic goals that balance the needs of all stakeholders. The practice has demonstrated success employing a lean approach to process improvement and in developing a lean enterprise vision. As they continue along the lean journey, however, they will need to also focus on the enterprise relationships. They have already begun efforts to pull certain stakeholders closer. The patient satisfaction initiatives, like the "question of the day" survey and other activities, are designed to involve patients in improving the services delivered by the practice. Similarly, a few activities have included collaboration with pharmacies and suppliers on process improvement. Other stakeholder groups must also be targeted as they continue to develop as a lean enterprise.

The productivity goal provides some direct evidence to support this imbalance among stakeholders, and the central primary care services support team has acknowledged this issue in their attempt to explore new goals and metrics for physician productivity. This imbalance is analogous to the concept of the iron triangle, popularly referred to in project management (de Weck, 2006; Atkinson, 1999). The iron triangle symbolizes the struggle between cost, scope (or sometimes quality) and schedule in any large project. The concept illustrates that a project cannot achieve all three goals at once, and that improvement along one dimension generally comes at sacrifice to another. For example, to reduce the cost of the project, either the project schedule will slip, or the scope must be reduced. You cannot complete a project on time for less money and still achieve the planned scope.

This concept can be redefined to address the challenge of primary care as shown in Figure 9. In this case, the iron triangle metaphor is modified for the health care domain. Time is the time spent during the patient visit, quality represents the quality of care delivered to address the patient issue, and scope represents the number of issues addressed during the patient visit. If the

physician must stick to the schedule then either the quality or scope must give, i.e. the patient will receive a lower quality of care, but all issues will be addressed, or the patient will receive a high level of care on the highest priority issue(s), but the patient will need to come back for another appointment to address other, lower priority issues. Conversely, if the physician wants to deliver a high quality of care for all patient issues, then the visit will go over the scheduled appointment time, the physician will run behind schedule and patient satisfaction, with respect to wait time, will go down. However, patient satisfaction, with respect to the level of care, may go up, which leads us to ask the question "what do patient's value most: more time with the physician or less waiting time?"

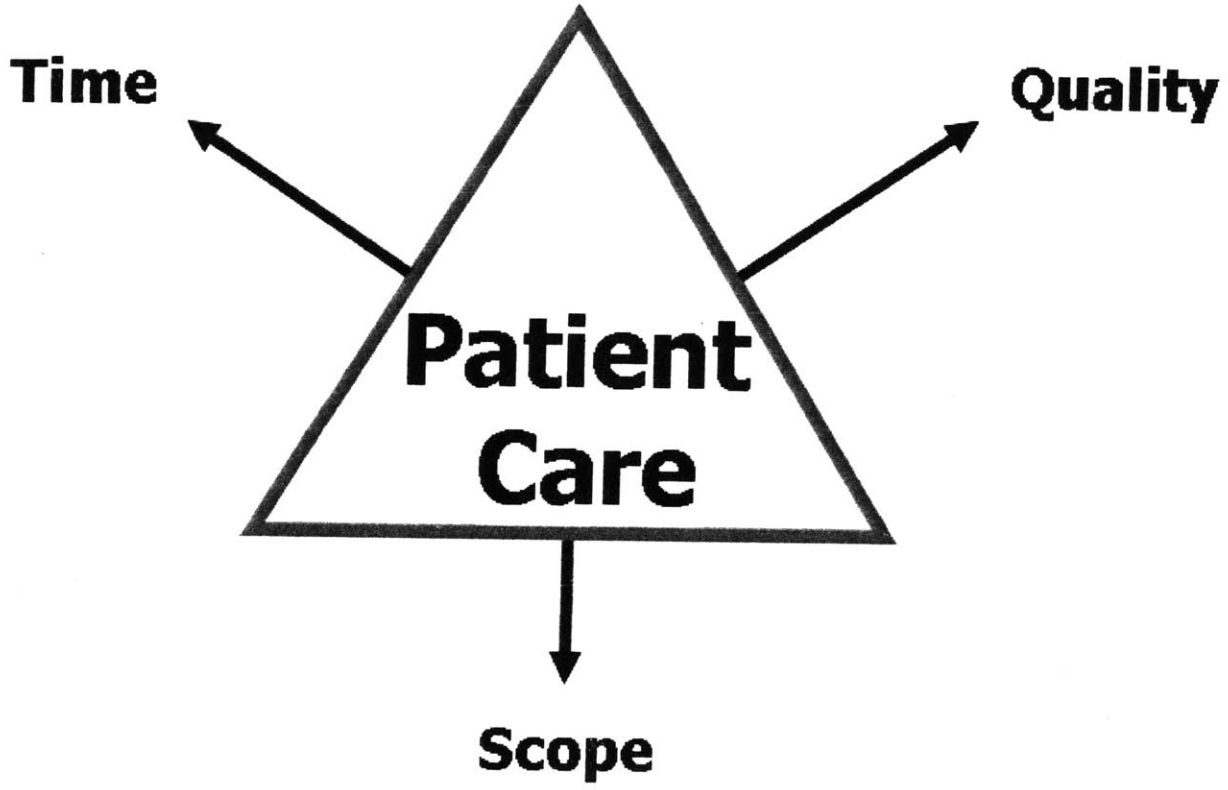

Figure 9. Iron Triangle of Primary Health Care

With this model in place, the primary care organization can move forward along their lean enterprise journey and begin to engage more stakeholders in the problems they face together. A key factor in furthering the goal of saving one hour per person lies in the stakeholder engagement. As an illustration of this point, if the productivity goal remains the same, it will likely dominate changes to the schedule to achieve more visits in less time. Assuming that patients favor high

quality delivery of care and can accept multiple return visits to address additional issues, then the impact will be felt by insurance companies and payers (those who pay the insurance, e.g. corporations, government and the self-insured) in the form of a new charge for each additional visit. At some point, the insurance companies or payers will decide that this plan does not work and they will push back to reduce cost, which could result in an adverse reaction, e.g. reduced payments per visit, thus returning the primary care organization to the same predicament it is in today. This scenario serves to point out that an arms length relationship with a key stakeholder can be detrimental to the organization and can hinder true lean enterprise transformation.

Chapter 6: Conclusions

Primary care, and health care in general, has traditionally operated in a siloed structure where one group performs an operation and then passes the patient across to the next group in line. In our case, the front desk checks patients in and passes them along to the medical assistants who check the vitals and move the patient to the exam room to await the physician. The physician then enters shortly thereafter and examines the patient, orders lab work and tests, and passes the patient on to the next step (labs, imaging, or similar), or sends them on their way with instructions to schedule another appointment at the front desk.

This process can lead to isolated individual operations, much like a traditional design and manufacturing firm where groups perform their tasks then throw the design over the wall for the next group to pick-up, e.g. a product design team sends a design to manufacturing and washes their hands of it for manufacturing to pick it up from there. More recently, there has been a lot of work in the area of product design to break down these walls and create integrated product teams incorporating all aspects of the product life cycle from requirements definition through design, manufacturing, field support and retirement (Magrab, 1997). Health care presents a similar dilemma, and is showing a need to also break down the barriers and remove the silo effect.

As health care looks to a lean enterprise approach to deliver a more efficient and effective form of quality care, the silos will need to open up with groups working together as teams employing a holistic end-to-end process view of the system. The primary care organization studied in this thesis has, more recently, begun to experience the benefit of that approach. They have come a long way in the past six months. Their eyes have been opened to an enterprise perspective, in contrast to a focused process centric view of local optimization. As the practice began their lean journey more than two years ago, they started by looking at specific, localized problems and developing solutions to address the issue in a specific area, e.g. optimization of the patient vitals process whereby the medical assistant activities were reviewed and wastes identified and removed. This was an isolated event that considered the preceding and succeeding operations only superficially.

These early projects were beneficial improvements and excellent opportunities to learn and foster a lean culture, but they had limited impact to the enterprise as a whole. The practice must move beyond these islands of success as described by Murman, et al. [2002] and apply their efforts across functional lines within the enterprise and eventually across organization lines and into the extended enterprise to include all stakeholder groups. The approach they have taken, as discussed in this thesis, to achieve the goal of reducing one hour per person per day is a step in the direction of a lean enterprise view. They have begun to consider interactions between the front desk, medical assistants, nurses and physicians, and are looking at improving the methods by which these groups interact and communicate as a unified practice. They are looking beyond functional boundaries and envisioning a seamless process with common stakeholder benefits and goals.

The initiatives discussed in the previous chapters employed a combination of methods designed to address an end-to-end process view of patient care. While most of the work presented here focused on the physician processes, the impact of and to other areas, which have already demonstrated islands of successful lean implementation, was also considered. Improvement activities were explored in the front desk, medical assistant and nursing areas, in parallel with the new schedule changes, to increase availability of resources. This would further benefit the overall process improvement activities, as the practice was revisiting roles and responsibilities and exploring cross-training potential to support the initiative to do the right job.

We have seen that the lean enterprise efforts of a primary care organization often encounter the same obstacles as other industries, such as aerospace and automotive. They can experience that same 'over the wall' phenomenon and siloed effect, as well as a desire to implement a cookie cutter approach to practice optimization. The cookie cutter approach is a classic mistake that occurs when applying lean principles. All organizations, divisions and groups exhibit differences. It is these differences that cause difficulty when a successful solution in one application is inserted into a process in a different application, thereby implicitly assuming that all applications are shaped by the same cookie cutter. The unique aspects of each distinct process will often not exhibit the same response. The solution generally fails because while the two distinct processes may be similar, they are rarely, if ever, identical.

The primary reason behind the failure of the cookie cutter approach is that the organization has only considered the processes, but not the people, in deciding to implement a solution from another area without testing the validity of its application. True lean thinking is the antidote to this behavior. A lean enterprise approach incorporates the dynamic discovery that has been demonstrated in this thesis. It highlights the use of the scientific method to observe, hypothesize, predict, test, and reassess, then repeat using the knowledge gained from previous cycles. The primary care practice can combat the tendency to favor a cookie cutter approach by learning from the automobile and aerospace firms that have been both successful and unsuccessful in their lean endeavors. By studying the work of large automotive manufacturers in attempting to copy individual Toyota operations, rather than Toyota's more generalized approach to process improvement, primary care can better understand the mistakes of these attempts and realize the benefits of applying the improvement methods, rather than the specific solutions of other organizations.

Additionally, they can look beyond Toyota and the automotive industry and gain additional insight and knowledge from other industries like aerospace. Organizations like Airbus and Boeing can offer examples where they have addressed a different scope of issues than the automobile industry. Additionally, studies have shown that there is also much to be learned from comparison of airline operation, as a service industry example. Southwest Airlines has shown more success than its competitors in fostering close relationships with stakeholders and achieving an enterprise structure that it more adaptable to changing market forces and can quickly adapt to variation in demand (Piepenbrock, 2006).

We have already seen where methods and ideas from other disciplines can be adapted to improvements in primary health care. The Pugh concept evaluation method proved very effective in considering all relevant criteria to select a new schedule design. The iron triangle from project management has also shown promise in articulating the problem of balancing multiple stakeholder needs, specifically those of the patient, the insurer/payer and the physicians who desire to deliver the highest quality of care. One can conceivably find many concepts from numerous engineering disciplines that can be easily adapted to primary care improvement.

A number of these methods have been effectively employed to generate improvements toward the goal of giving one hour back to all staff and physicians. All of these methods combined under an umbrella of dynamic discovery in which changes were made to continually revise and refine the operations in the direction of desired improvement. The improvement initiatives presented here have demonstrated the impact that a lean enterprise approach can have on a primary care organization. In some ways, this application may have been easier than efforts in other industries. While the observations of one primary health care practice is not enough to generalize about the entire health care industry, we have seen evidence suggesting that the health care environment may be more prepared to apply a lean approach.

In chapter 5, we introduced the analogy of process improvement approaches to that of the physician's SOAP note model. This may offer an advantage that health care possesses over other industries. The mental model of medical problem solving is directly applicable to the process of operational improvements. Further understanding of this parallel can be used to the advantage of the primary care practice. If they can harness this potential and channel the same efforts into improvement initiatives, they may find that their initiatives produce more effective results. If they can then extend this understanding throughout the industry, they may experience more efficient progress along their lean journey.

Looking at other unique factors in primary care, we also find that physicians struggle against an innate resistance to change in most patients. The preventive part of health care often entails working with patients to make lifestyle changes to improve their state of health. For example, quitting smoking, exercising and eating right are all things that physicians encourage in their patients, yet they find themselves up against a barrier to change in human behavior. The lean journey parallels this challenge. Lean transformation requires people to look at things differently, not just during the course of an improvement project, but rather all the time. Organizations struggle with how to change individual and group behavior and foster a culture of lean thinkers seeking continuous improvement. This type of cultural change may experience similar obstacles to changes in personal behavior that physicians find in their patients. This presents an opportunity to learn and share knowledge for adaptation to new uses.

This leads us to identify lessons for other industries. Many aerospace and automotive manufacturers, among other product organizations, have struggled for years with lean implementation. The findings from the lean enterprise approach of this primary care practice may shine new light on the problem, as may lean initiatives in other health care environments and organizations. Many industries struggle with the same issues of overcoming cultural change obstacles and developing a community of lean thinkers who identify problems and follow a scientific method style approach to improving the process. Further study of the health care industry may uncover new tools and methods to address these problems. The development of the physicians' mental models that begin in medical school and carry through residency into their patient care practices may provide insight into improved educational methods to aid cultural transformation in support of the lean journey. Additionally, studies of physicians' success with lifestyle changes in patients may yield further insight into new techniques that can aid an organization's pursuit of lean enterprise improvements.

Considering the core focus of health care as a service industry, development of a continuous improvement culture may actually be more progressive, as compared to other industries. Traditional product firms are more prone to fall into the trap of focusing on the product design and performance while forgetting about what the customer wants. Advancements in product or process that produce higher performance may result in unnecessary performance that the customer does not need or will not pay for. The customer is a key stakeholder; yet, firms implementing lean production methods can easily become lost in the process and forget about the customer needs. Conversely, the critical customer service aspect of health care offers a trigger to encourage stakeholder consideration, and, moreover, direct involvement in the lean journey. In fact, one major aerospace firm incorporates this concept into their slogan – "We never forget who we're working for" (Lockheed Martin).

As a final observation, the pace of health care promotes rapid experimentation and real-time realization of results. The high volume of patients and short cycle times produce near immediate response to system improvements, as compared to large aerospace firms, for instance. The takt

time[4] for a medical exam is on the order of one hour, while that of a commercial jet production process is closer to ten years. Lean enterprise approaches in health care can produce results, and corresponding lessons, at a much faster rate than many slower moving product related industries, serving as a possible proving ground for many lean enterprise approaches.

Future Work

This thesis only begins to scratch the surface of applying lean enterprise methodology to health care. While we have shown that a lean approach can improve the efficiency of primary care process improvements, the findings suggest a number of questions for further research.

- What does it mean to do the 'right job' in primary health care?
- What insight can the physician's mental models (e.g. SOAP note and approach to patient lifestyle changes) offer to aid development of a lean process improvement culture?
- Can we redefine the physician productivity measure to encourage efficient and effective care delivery without increasing the cost of care?

Rising health care costs are increasing pressure on care providers to become more efficient. However, we have seen goals and metrics driving dysfunctional behavior which can either lead to less efficient care delivery or a lower quality of care. As the population ages, capacity issues are also becoming more critical. As pressures increase, the need for system level improvements also grows. A lean enterprise approach can bring stakeholders together to deliver high quality, efficient health care to a growing population.

[4] Takt time is defined in *Lean Thinking* (Womack & Jones, 1996) as the pace of production to match the rate of customer demand, or the heartbeat of any system.

References

Aronzon, Daniel (2006). "Applying lean thinking to healthcare solutions." (Cambridge, MA: IBM-MIT/ESD Innovation Lecture Series)

Atkinson, Roger (1999). "Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria." International Journal of Project Management, Vol. 17, Issue 6, p337-342.

Bates, Barbara, Hoekelman, Robert A. & Thompson, Joyce Beebe (1991). A guide to physical examination and history taking (Philadelphia, PA: Lippincott).

Bonner, Steven B. (2007). "Lean thinking can improve health care." Health Care News (April), p18.

Bushell, Sylvia, Mobley, Joyce & Shelest, Becky (2002) "Discovering lean thinking at progressive healthcare." Journal for Quality and Participation, Vol. 25 Issue 2, p20-25.

Chassin, Mark R. & Becher, Elise C. (2002). "The wrong patient." Annals of Internal Medicine, Vol. 136 Issue 11, p826-833.

Collins, J. C. & Porras, J. I. (1994). Built to last: successful habits of visionary companies (New York: Harper-Collins)

de Weck, Olivier (2006). "Project Management Introduction - The Iron Triangle." Lecture Notes (Cambridge, MA: MIT ESD.36 System Project Management).

Green, Linda, Savin, Sergei & Murry, Mark (2007). "Providing timely access to care: what is the right patient panel size?" Joint Commission Journal on Quality and Patient Safety, Vol. 33 Issue 4, p211-218.

Herschel, Richard T., Nemati, Hamid, & Steiger, David (2001). "Tacit to explicit knowledge conversion: knowledge exchange protocols." Journal for Knowledge Management, Vol. 5 Issue 1, p107-116.

Herzlinger, Regina E. (2006). "Why innovation in health care is so hard." Harvard Business Review, Vol. 84 Issue 5, p58-66.

Kohn, Linda T., Corrigan, Janet M., & Donaldson, Molla S. (2000) To err is human: building a safer health system (Washington, D.C.: National Academy Press)

Lean Aerospace Initiative and U.K. Lean Aerospace Initiative (LAI) (2001). "Lean enterprise self-assessment tool (LESAT)", Version 1.0

Lean Aerospace Initiative (LAI) (2005). "Enterprise Value Stream Mapping and Analysis EVSMA," Version 5.0.

Lean Aerospace Initiative (LAI) (2007). "About LAI." Retrieved May 9, 2007, from: http://lean.mit.edu/index.php?option=com_content&task=view&id=18&Itemid=41

Magrab, Edward B (1997). Integrated product and process design and development: the product realization process (Boca Raton, FL: CRC Press).

Miller, Kerry (2007). "An open-access doctor's office." Retrieved February 26, 2007, from http://www.businessweek.com/print/smallbiz/content/feb2007/sb20070212_182930.htm

Murman, Earll, Allen, Thomas, Bozdogan, Kirkor, Cutcher-Gershenfeld, Joel, McManus, Hugh, Nightingale, Deborah, Rebentisch, Eric, Shields, Tom, Stahl, Fred, Walton, Myles, Warmkessel, Joyce, Weiss, Stanley & Widnall, Sheila (2002). Lean enterprise value: insights from MIT's Lean Aerospace Initiative (New York: Palgrave)

National Center for Health Statistics (NCHS) (2006). "Health, United States, 2006, with chartbook on trends in the health of Americans." (Hyattsville, MD: National Center for Health Statistics)

Piepenbrock, Ted (2006). "Architecting World-Class Lean Enterprises" Lecture Notes (Cambridge, MA: MIT ESD.61J Integrating the Lean Enterprise).

Pugh, Stuart (1991). Total design: integrated methods for successful product engineering (Reading, Mass.: Addison-Wesley Pub. Co.).

Sinsky, Christine A. (2006). "Improving office practice: working smarter, not harder." Family Practice Management, Vol. 13 Issue 10, p28-34.

Spear, Steven J. (2005). "Fixing health care from the inside, today." Harvard Business Review, Vol. 83 Issue 9, p78-91.

Spear, Steven J. & Bowen, Kent (1999). "Decoding the DNA of the Toyota Production System." Harvard Business Review, Vol. 77 Issue 5, p96-106.

Taninecz, George (2007). "New facility, new flow, and new levels of patient care." Retrieved February 26, 2007, from http://www.lean.org/Community/Registered/ArticleDocuments/lei_cancer_institute.pdf

University of Arkansas for Medical Sciences (UAMS) (2006). "UAMS sees health care work force shortages worsening." Retrieved May 1, 2007, from http://www.uams.edu/update/absolutenm/templates/news_release_andrea.asp?articleid=5114&zoneid=35

Watson, Carlos (2005). "Health care: the stealth revolution." Retrieved May 1, 2007, from http://www.cnn.com/2005/POLITICS/04/19/quiet.revolution/index.html

Womack, James P., Jones, Daniel T. & Roos, Daniel (1990). The machine that changed the world: how Japan's secret weapon in the global auto wars will evolutionize Western industry (New York, NY: HarperPerennial)

Womack, James P. & Jones, Daniel T. (1996) Lean thinking: banish waste and create wealth in your corporation (New York: Free Press)

This Page Intentionally Left Blank

Appendix A: Practice Metrics from EVSMA Project

The following nine metrics were identified, during the EVSMA project in the fall of 2006, as being indicative of progress toward the strategic goals of the practice. Each metric is identified, along with a target value, where available, and linked to its associated goal. Undefined target values are noted as TBD.

Metric #1 – Mix of pediatric to adult primary care patients
Strategic Goal: To grow the primary care business
Unit: % mix
Target: 40% Pediatric and 60% Adult
Description: The current volume of adult patients is good, but the pediatric numbers are low. The goal is to grow the practice primarily through an increase in the number of pediatric patients, while maintaining minimal growth in the adult portion of the practice.

Metric #2 – Physician Work Related Value Unit (WRVU)
Strategic Goal: To increase physician productivity
Unit: WRVU
Target: TBD
Description: The physician's productivity is measured on how many patients they see each session, with each visit weighted by level of complexity required on a scale of 1 to 5. The WRVU is calculated from both the number and complexity of patients examined.

Metric #3 – Health care industry quality ratings
Strategic Goal: To provide the highest quality of patient care
Unit: stars
Target: 4 stars
Description: The rating compares health care facilities on the quality of care administered.

Metric #4 – Health plan employer data and information set scores

Strategic Goal: To provide the highest quality of patient care

Unit: Various metrics by category surveyed

Target: TBD

Description: The scores compare health care facilities on the quality of care administered.

Metric #5 – Sick time: days

Strategic Goal: To provide a successful work/life balance for all practice employees

Unit: days

Target: TBD

Description: Sick time is one of the measurements used to evaluate the level of work/life balance achieved. A minimization of the number of times people call in sick is believed to be reflective of an improved work/life balance at the enterprise.

Metric #6 – Employee survey

Strategic Goal: To provide a successful work/life balance for all practice employees

Unit: General survey results

Target: TBD

Description: An employee survey has been developed to gauge the level of work/life balance achieved.

Metric #7 – Wait time for an appointment

Strategic Goal: To improve customer satisfaction

Unit: days

Target: < 30 days. High level target is Open Access, i.e. no appointment necessary.

Description: The number of days a patient must wait to schedule a new or follow-up appointment is reflective of the quality of service provided to each patient. Longer delays have an adverse impact on customer satisfaction.

Metric #8 – Number of patient service complaints

Strategic Goal: To improve customer satisfaction

Unit: complaints per week

Target: TBD

Description: The number of patient complaints is directly related to customer satisfaction.

Metric #9 – New Patient Waiting List

Strategic Goal: To improve customer satisfaction

Unit: patients

Target: TBD.

Description: The waiting list for new patients to be accepted into the practice is directly related to customer satisfaction. If new patients cannot be admitted they will go somewhere else, and they may influence others to do so as well through word of mouth network effects.

This Page Intentionally Left Blank

Appendix B: Physician Shadowing Template

In December, 2006, a physician shadowing template was created by Joseph Gesmundo, MD, Lisa Brugnoli-Semeta, RN, Sally Isles, and Steven J. Spear. The template below is a modified version of that template that was used to record data and observations during shadowing activities described in this thesis.

	Patient Characteristics					MD Time Spent						Problems
	Visit Billing Code	Patient Type	Visit Type	Number of Problems	Other Characteristics, That Effected Visit Length	Chart Review Start Time	Chart Review Stop Time	Patient Encounter Start Time	Patient Encounter Stop Time	Documentation Start Time	Documentation Stop Time	Things That Prolonged MD Time Spent
Pt 1 Appt Time												
Pt 2 Appt Time												
Pt 3 Appt Time												
Pt 4 Appt Time												
Pt 5 Appt Time												
Pt 6 Appt Time												
Pt 7 Appt Time												
Pt 8 Appt Time												
Pt 9 Appt Time												
Pt 10 Appt Time												

Appendix C: Pugh Concept Evaluation Results

Pugh Round I

Concept	15/30 Sched	20m Appts	Physicals Grouped	Overlap appt Times	Wave - 15/30	11 Pt Visits	10/20/30/40 Appts	15/10 Hybrid	3 Pts per hour	Weekly Wave	Monthly Wave	10/20/30/40, with make-up time	Physician Defined Appt Times	
Criteria	Existing Schedule: 15 & 30 minute appt times	All appts are scheduled as 20m in length	Physicals are grouped together in the schedule	Pilot appts are schedule with a 5 minute over lap with previous and following appt	appts double booked, with the following slot blocked	Pilot Schedules designed to allow a total of 11 appts per session (overlap where needed)	Pilot Schedule: 10 minute intervals with a script for appt time scheduling	A hybrid of the existing and pilot schedule to allow more flexibility in scheduling	Pilot Schedules designed to allow a total of 3 appts per hour (over lap where needed each hour)	Pilot Schedule for 3 out of 4 sessions, and a wave version of the old schedule one of every 4 sessions	Pilot Schedule for 3 out of 4 weeks and a wave version of the old schedule on one week each month	Pilot Schedule for all sessions, with a make-up session (or partial session) every 2 weeks or month or similar.	Standard Scheduling applies for call-in appts, but Physicians define the duration on follow-up forms at time of patient visit	**Criteria Ranking**
WRVU	DATUM	-	S	+	S	S	-	S	S	S	S	S	-	1
No Shows	DATUM	S	S	+	S	S	S	S	S	S	S	S	S	2
Late Pts	DATUM	S	S	+	+	S	S	S	+	S	S	S	S	2
Session Complete	DATUM	-	+	S	S	+	+	+	+	+	+	+	+	1
Scheduling Ease	DATUM	+	S	S	S	-	-	-	S	-	-	-	-	2
Appropriate Appt Times	DATUM	-	S	S	S	+	+	+	+	+	+	+	+	2
No Schedule Holes	DATUM	S	S	S	S	S	-	-	S	-	-	-	-	2
Physician Satisfied with Visit	DATUM	-	S	S	S	+	+	+	+	+	+	+	+	1
Patient Satisfied with Visit	DATUM	-	S	S	-	+	+	+	+	+	+	+	+	1
Level Loading of Staff	DATUM	+	+	S	S	S	S	+	S	S	S	S	S	2
Exam Room Capacity	DATUM	-	S	S	S	S	S	S	S	S	S	-	S	2
+/- Tally		-4	2	3	0	3	1	3	5	2	2	1	1	
Xtra Points for Top Criteria		-4	1	1	-1	3	2	3	3	3	3	3	2	
Quantitative Score		-8	3	4	-1	6	3	6	8	5	5	4	3	
Resultant Determination		Drop	Drop	Advance	Drop	Advance	Drop	Advance	New Datum	Advance	Advance	Advance	Drop	

Pugh Round II

Concept	3 Pts per hour	11 Pt Visits	15/10 Hybrid	Weekly Wave	Monthly Wave	Overlap appt Times	10 min Interval, w/make-up times	Joe's New Concept	Lisa's New Concept	Jim's New Concept	
Criteria	Pilot Schedules designed to allow a total of 3 appts per hour (over lap where needed each hour)	Pilot Schedules designed to allow a total of 11 appts per session (overlap where needed)	A hybrid of the existing and pilot schedule to allow more flexibility in scheduling	Pilot Schedule for 3 out of 4 sessions, and a wave version of the old schedule one of every 4 sessions	Pilot Schedule for 3 out of 4 weeks and a wave version of the old schedule on one week each month	Pilot appts are schedule with a 5 minute over lap with previous and following appt	Pilot Schedule for all sessions, with a make-1up session (or partial session) every 2 weeks or month or similar.	Pilot Schedule 11pts visit with initial overlap at beginning of 4 hour session with one 4 hour session per day, and an overlap on a 40m New patient Visit	Pilot schedule with physicals grouped & 11pts visit, predetermined overlap where needed with one 4 hour session	Pilot schedule with offset physician schedules with one 4 hour session and same total number of patients as seen by each Dr today, with a predetermined overlap & 10min Urgents where needed	Criteria Ranking
WRVU	DATUM	+	+	-	-	+	+	S	S	S	1
No Shows	DATUM	S	S	+	+	S	+	S	S	S	2
Late Pts	DATUM	S	S	S	S	S	S	+	S	S	2
Session Complete	DATUM	-	S	+	+	-	+	S	+	+	1
Scheduling Ease	DATUM	-	-	-	-	-	-	+	+	+	2
Appropriate Appt Times	DATUM	S	-	+	+	S	+	S	+	+	2
No Schedule Holes	DATUM	S	-	-	-	S	-	S	-	-	2
Physician Satisfied with Visit	DATUM	S	S	+	+	-	-	S	+	+	1
Patient Satisfied with Visit	DATUM	S	S	+	+	-	+	S	+	+	1
Level Loading of Staff	DATUM	S	S	S	S	S	S	S	S	S	2
Exam Room Capacity	DATUM	S	S	S	S	S	-	S	S	S	2
+/- Tally		-1	-2	2	2	-3	1	2	4	4	
Xtra Points for Top Criteria		0	1	2	2	-2	2	0	3	3	
Quantitative Score		-1	-1	4	4	-5	3	2	7	7	
Resultant Determination		Drop	Drop	Advance	Advance	Drop	Advance	Advance	Advance	New Datum	

Concept / Criteria	Jim's New Concept: Pilot schedule with offset physician schedules with one 4 hour session and same total number of patients as seen by each Dr today, with a predetermined overlap & 10min Urgents where needed	Lisa's New Concept: Pilot schedule with physicals grouped & 11pts visit, predetermined overlap where needed with one 4 hour session	Weekly Wave: Pilot Schedule for 3 out of 4 sessions, and a wave version of the old schedule one of every 4 sessions	Monthly Wave: Pilot Schedule for 3 out of 4 weeks and a wave version of the old schedule on one week each month	10 min Interval, w/make-up times: Pilot Schedule for all sessions, with a make-1up session (or partial session) every 2 weeks or month or similar.	Joe's New Concept: Pilot Schedule 11pts visit with initial overlap at beginning of 4 hour session with one 4 hour session per day, and an overlap on a 40m New patient Visit	3 Pts per hour: Pilot Schedules designed to allow a total of 3 appts per hour (over lap where needed each hour)	Criteria Ranking
WRVU	DATUM	S	-	-	S	S	-	1
No Shows	DATUM	S	+	+	+	S	S	2
Late Pts	DATUM	S	-	-	-	+	+	2
Session Complete	DATUM	S	+	+	+	-	-	1
Scheduling Ease	DATUM	S	-	-	-	S	-	2
Appropriate Appt Times	DATUM	S	S	S	S	-	-	2
No Schedule Holes	DATUM	S	-	-	-	S	S	2
Physician Satisfied with Visit	DATUM	-	S	-	-	-	-	1
Patient Satisfied with Visit	DATUM	S	S	S	+	-	-	1
Level Loading of Staff	DATUM	S	S	S	S	S	S	2
Exam Room Capacity	DATUM	S	S	S	-	S	S	2
+/- Tally		-1	-2	-3	-2	-3	-5	
Xtra Points for Top Criteria		-1	0	-1	1	-3	-4	
Quantitative Score		-2	-2	-4	-1	-6	-9	
Resultant Determination		Alternate	Advance	Drop	Advance	Drop	Drop	

This Page Intentionally Left Blank