

Working Paper Series

Lean Healthcare: Controlling Cost through Better Care

A capstone project submitted to the faculty of the graduate school of the University of Minnesota. In partial fulfillment of the requirements for the degree of Masters of Health Informatics

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Preface

Lean Healthcare is a healthcare improvement system that systematically addresses the cost, quality and safety issues facing US healthcare today. It allows the healthcare organization to reduce waste and cost while improving quality and safety. Lean Healthcare is also a management system robust enough to handle the complexities of delivering quality healthcare. It is a long term solution that takes enormous commitment and investment from healthcare leadership. In order to become a Lean Healthcare Organization, the Healthcare Organization must commit to a long-term plan to build the infrastructure and culture that will sustain the desired changes. Significant investment in time and resource development will be required at the start but the effort will soon return dividends. It is the right choice to maintain cost and quality levels during this transformational period in US Healthcare.

The Lean Healthcare Improvement System is working at Park Nicollet Health Services in Minnesota. Since implementing Lean, Park Nicollet has become a leader in quality improvement. As an employee, I have seen firsthand how Lean Healthcare is working. Over the last 7 years, I have attended many presentations regarding the changes and improvements being made at Park Nicollet. I have also participated in a week long rapid improvement workshop (RPIW) to develop a decision-making tool kit for the placement of imaging equipment. These changes to improve healthcare are instituted and monitored on an ongoing basis through a powerful Lean Department backed by Senior Leadership. I have come to realize being Lean is the best way we can achieve the goals the Institute of Medicine laid out for Healthcare Institutions in the report *To Err is Human: Building a Safer Health System* (2000). At Park Nicollet, Lean Healthcare has proven to control healthcare costs by eliminating waste while improving quality of care and patient safety.

Most healthcare professionals are too busy or not trained to think about improving processes. During a “continuous” quality improvement (CQI) class for healthcare professionals, I asked my classmate, a registered nurse, “How could you possibly have time to develop these quality improvements while still seeing patients and then transfer this knowledge to others?” Her answer was, “I can’t.” It was clear that there was no mechanism or infrastructure for her to make these changes, implement her changes, and then institute her changes so others could benefit from them. One problem with most quality improvement efforts is they often start off being too specialized and require special focus and understaffed. As a result, quality improvement at her institution only takes place if time is available after all other normal work is completed.

As I progressed through the Master’s Program in Health Informatics a coworker took a job at our Lean Promotion Office. As Standard Work Specialist, his job was to document newly established work standards, their associated job descriptions; training materials; policies and procedures. When he explained his new role, he told me how much more productive and effective we could be if we all applied Lean to our daily work. Our senior leadership at Park Nicollet was meeting on a weekly basis to discuss how applying Lean was solving our operational issues. For instance waste at the hospital and clinics was now being addressed and corrected on a daily basis through the Lean Department by people dedicated to quality improvement. He told me that Lean was unique because, although it was a systematic and proven method, it also had the authority and infrastructure to sustain real change.

Most of my Health Informatics classes focused on addressing the following 3 problems facing US Healthcare: rising healthcare costs; poor quality; and poor patient safety. I soon realized that the great ideas we were proposing to solve our healthcare problems could never be implemented without the right strategy and environment. As I discussed this with my classmates and other healthcare professionals, they all agreed that their efforts to improve healthcare were being wasted. Their organizations had attempted several different quality improvement initiatives but

most came and went without being realized. These initiatives failed because they lacked institutional power, were decentralized and bogged down by “red tape” and politics.

After 8 years of working for a large healthcare system committed to Lean, I have gained the knowledge and insight to form a strong argument for Lean Healthcare. I have studied our current healthcare problems in Minnesota and across the US with healthcare professionals and clinicians from several major healthcare systems in Minnesota. We discussed the complexities of our healthcare systems and the challenges to make them better. I am convinced Lean Healthcare is part of the solution to our current healthcare quality, safety, and cost issues. These benefits will also help with the looming capacity problem represented by our aging population. The following paper is my attempt to convince healthcare educators at the University of Minnesota and other teaching institutions that teaching Lean Healthcare is right for the future of our healthcare community.

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I also want to thank my professors Dr. Stephen Parente and Dr. Stuart Speedie at the University of Minnesota. They were both instrumental in guiding me through the Health Informatics Graduate Program and allowing me the opportunity to learn and understand the complexities and challenges we face in healthcare today. They have motivated me to go out and achieve my goals and be a change agent for healthcare.

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Abstract

Background: The U.S. Healthcare System is no longer affordable or sustainable. The biggest threat to the nation's balance sheet is the skyrocketing cost of healthcare. ^[1] According to a report in 2008 by the Deloitte Center for Health Solutions, over 750,000 Americans seek medical services outside the US per year because of the high cost of care. ^[29] The U.S. must make immediate changes if it is going to maintain or improve current quality and safety levels as more demands are placed on the system. As the population ages, it will become more dependent on healthcare and further overwhelm our healthcare systems. Healthcare leaders must find ways to become more efficient and effective while sustaining current medical access and quality. Healthcare in the U.S. must 'do more with less' money and less people. Lean has proven to be an effective methodology for improving quality and safety while reducing costs at Park Nicollet Healthcare Services.

Results: Park Nicollet Health Services (PNHS) in Minnesota has been following Lean principles for over eight years. Through their Lean efforts they have eliminated waste, improved quality and safety while reducing costs. In 2007, PNHS reported they had made the following reductions in a two year period that resulted in hundreds of thousands of dollars in savings: 76 miles less walking distance for staff per day; 4,328 feet less walking distance for patients per day; 2,924 fewer surgical instruments processed per month; 1,431 excess inventory items removed; 312 miles less travel distance for lab letters, specimens, and Radiology reports per day; 76 hours cycle time reduction per day; 1,111 hours lead time reduction per day total amount from the following processes: Radiation Ordering & Results Reconciliation, Quick Check, Hospital Pharmacy Distribution, GI Outcomes, EC Cardiac Observation Unit; 6 FTEs redeployed; 3,069 square feet space freed up for alternate use; and 3,977 defects eliminated per day. ^[30]

PNHS has been awarded several distinguished awards including the 2008 Highest Value Hospital Award from The Leapfrog Group. This award was given to 13 out of 1, 220 hospitals surveyed. It honors hospitals which provide excellent quality and at the same demonstrate an appropriate use of resources for specific procedures. See Appendix B for all awards received after instituting Lean in 2003.

By instituting a Lean Department and tools such as Rapid Process Improvement Workshops, Standard Work, and Value Stream Mapping to identify and focus on eliminating waste and improving processes, Park Nicollet Health Services has become a leader in quality, patient safety and cost reduction. US healthcare leaders should explore Lean as an approach to solving their quality, safety and cost issues. They should also look to Lean Healthcare Systems like Park

Nicollet Health Services for guidance and as a model for their implementation and execution of Lean.

Introduction

In his opening remarks at the White House Health Care Summit on March 5, 2009, President Obama stressed that the biggest impact to our economic crisis is healthcare costs. He began, "Medicare costs are consuming our federal budget. I don't have to tell members of congress this. Medicaid is overwhelming our state budgets. I don't need to tell governors or state legislators that. At the fiscal summit that we held here last week, the one thing on which everyone agreed was that the greatest threat to America's fiscal health is not Social Security, though that's a significant challenge. It's not the investments we've made to rescue our economy during this crisis. By a wide margin the biggest threat to our nation's balance sheet is the skyrocketing cost of healthcare. It's not even close....If we want to create jobs and rebuild our economy and get our federal budget under control then we have to address the crushing cost of healthcare this year and in this administration. Making investments in reform now, investments that will dramatically lower costs, won't add to our budget deficits in the long term -- rather, it is one of the best ways -- in fact maybe the only way -- to reduce those long-term costs."^[1]

In the last decade, the US as a whole has done little to stop the following issues in healthcare: rising healthcare costs, poor quality and poor patient safety. In 2004, General Motors highlighted the healthcare costs crisis in America by publishing that GM spent \$5.8 billion in annual healthcare benefits.^[2] According to Medicare in 2011, total healthcare expenditures reached \$2.7 trillion, which translates to \$8,680 per person per year.^[3] And according to a report from The Organisation for Economic Co-operation and Development (OECD) in 2011, the US spends two-and-a-half times more than the average country health expenditure per person.^[4]

Despite what US taxpayers spend on healthcare they are not receiving better care compared to other modernized countries.^[5] Ten years after the Institute of Medicine (IOM) published the alarming report entitled *To Err is Human: Building a Safer Health System* (1999) most healthcare organizations have still not solved their problems of patient safety. In 2003, according to the article *The Quality of Health Care Delivered to Adults in the United States*, Americans received only 54.9% of recommended healthcare.^[6] As a result of these reports many new patient safety laws were created but despite efforts there is more to do. In a 2010 study conducted by the Office of Inspector General, an estimated 15,000 Medicare beneficiaries every month experience a potentially preventable medical error that contributes to their death.^[31]

People who work in healthcare understand that patients are often harmed by good people using poor communication and processes that propagate error. The report *To Err is Human* clearly

illustrates this truth. Most of these mistakes could have been avoided by better communication and better processes according the authors of *Internal Bleeding*.^[17] Prominent physicians agree the lack of standards or adherence to standards propagate poor outcomes.^[20]

In today's healthcare environment, patients are told they must be their own advocate and to seek out doctors that meet their physical, emotional and intellectual needs. These communication requirements play an important role in the delivery of quality care. We know poor communication can be linked directly to poor outcomes while good communication leads to the best outcomes. Another known truth about today's healthcare is the lack of consistency in treatment and outcomes of similar ailments among doctors.^[32] Healthcare today needs better communication not only between physicians and their patients but among all healthcare providers to establish and follow "best practice."

Primary care and preventative medicine is the first place to institute best practice measures. This specialty is the most underdeveloped in the US and adds significant financial burden to the healthcare system. According to the OECD in *Health at a Glance 2011*, hospital admissions have been high particularly for asthma and chronic obstructive pulmonary disease (COPD).^[33] These admissions could potentially be avoided if appropriate care is provided in primary care setting. The OECD report claims the shortage of family doctors contributes to the poor primary care performance.

The already heavy burden on the US healthcare systems will only increase as baby boomers age (the generation born between 1946 and 1964). The US Census Bureau reported in 2006, Baby Boomers age 42 to 60 totaled an estimated 78 million and comprised 26.1 percent of the total U.S. population.^[34] On April 1, 2010 the US Census estimated that there were 40.3 million people who were 65 years and over.^[34] According to the Social Security Administration in 2011 there are currently 2.9 workers for each Social Security beneficiary. By 2036, the administration estimates there will be 2.1 workers for each beneficiary.^[35] Just when we thought we were being overwhelmed by the costs, quality and safety issues facing our healthcare system we have an even bigger problem: capacity.

According to the 2008 report from the Institute of Medicine, *Retooling for an Aging America: Building the Health Care Workforce*, older Americans use the largest percentage of our healthcare services.^[8] The committee recommends more workers with the right skills to address the ever increasing capacity issue. The committee also recommends developing and implementing innovative models such that the existing workforce is used more efficiently and the

quality of care is improved. But the following questions remain: *How we are going to achieve these goals? How much time and money should we spend developing new models and implementing them? How many hours per day? How many resources should we allocate while keeping the business running? How can we afford to take the time to do all this with less people?*

One approach to answering these questions is to rethink the way we work and make the necessary changes as we perform our daily work. In order to achieve these goals and make the necessary changes, healthcare professionals need a strategy or method that will allow them the time and means to make these changes while maintaining their current level of care.

When we hear about the issues facing our healthcare system today, most healthcare leaders have said, “We can do better.” We all know we should do better but how? How do we, as healthcare professionals, not become complacent but continue to grow and change in order to adapt to our rapidly changing world? How do we keep up with our changing demographics? How can we move from the current state to our desired future state? Deming reminds us, “It is not enough to do your best; you must know what to do, and then do your best.”^[9] Again, as healthcare professionals, we need to *rethink how we do our work*.

Former Mayo CEO, Dr. Denis Cortese tells us when we look at ways to make our healthcare system more efficient, we find there are different treatments with different outcomes for the same ailments throughout United States. At the same time he says we find wide ranges in efficiencies and effectiveness. Dr. Cortese predicts there is at least 30 to 40 percent efficiency that could be gained if we focus on finding the very best practices and set standards that require all care providers to meet or exceed.^[32]

In his ongoing blog (2/4/2012), current CEO Dr. David Abelson of Park Nicollet reminded everyone that even Steve Jobs, the 17th most powerful man in world at the time, could not receive the coordinated care he needed. From Jobs’ biography, Dr. Abelson learned that *“His treatment was fragmented rather than integrated. Each of his myriad maladies were being treated by different specialists- oncologists, pain specialists, nutritionists, hepatologists and hematologists- but they were not being coordinated in a cohesive approach...”* Dr. Abelson told his audience,

“Coordinating care represents an intersection of clinical quality with the patient/family experience. Coordination enhances the experience of care and supports clinical quality by preventing duplication, errors of omission (I thought specialist x was handling that) and errors of commission (adverse interactions between different treatments).

Park Nicollet's strong primary care base working with excellent specialists naturally coordinates care, but remains unsystematic. The Park Nicollet Care Model/Aligned payment must assure we systematically coordinate care with patients and families. Coordination improves quality, enhances the patient/family experience and reduces costs".^[36]

To address our healthcare problems we need more than the right technology. A hospital may purchase a cutting edge electronic medical record but that does not guarantee the hospital will be world class. The best electronic medical record helps but is only as good as the people using it. We need leadership driving the right technology and methodology that shows us how to work smarter and allows us the time to implement the changes we seek. The solution must enable the workers, while performing the work, to grow, learn, and make the necessary changes to become more productive. There is no question the right tools and technology help, but we also must have the right strategy, the right environment and leadership to keep us moving in the right direction. We must create a culture that promotes improvement and keeps us continuously improving. This is the only way for healthcare organizations to remain viable now and in the future.

Method

Lean became a formal methodology in post-war Japan at the Toyota Motor Corporation as a way to compete with America and other countries. It is based on the Toyota Production System (TPS) and has been re-labeled Lean Production, Lean Manufacturing or just Lean. Today, Toyota is the best-selling automaker in world. Past and present leaders admit Toyota's success is due to their Lean philosophy and learning culture. Leaders who have questioned Toyota's success have realized the value of instituting Lean in their own organizations. It is by no surprise that more and more manufacturing and service industries have begun learning about Lean from Toyota.

During Lean's evolution, early Lean leaders took the best ideas from existing visionaries. Lean took ideas from: Henry Ford and the Ford Motor Company's assembly line; and Clarence Saunders and the Piggly Wiggly store, (the first American self-serve supermarket where shelves were restocked before they were empty). Both Ford's and Saunders' ideas were adopted and improved upon with Lean at Toyota.

Perhaps most surprising to Lean 'outsiders' is that not only is W. Edwards Deming considered to be the father of quality but also the father of Lean. Deming went to Japan after World War II to

help rebuild the country and teach quality to Japanese companies. He consequently helped define key Lean ideas we know today. Deming is so revered in Japanese Industry that the Japanese Union of Scientists and Engineers created the Deming Prize in his honor. This prize is given to worthy companies annually for “excellence in quality.”^[37] Deming saw quality as an entire philosophy of management and said quality was everyone’s responsibility. Toyota was able to institutionalize Deming’s ideas and achieve his goals for quality.

Here are “The 14 Principles of the Toyota Way”, described in the book *The Toyota Way*:

1. *Base your management decisions on a long-term philosophy, even at the expense of short-term goals*
2. *Create continuous process flow to bring problems to the surface*
3. *Use “pull” systems to avoid overproduction*
4. *Level out the workload*
5. *Build a culture of stopping to fix problems, to get quality right the first time*
6. *Standardized tasks are the foundation for continuous improvement and employee empowerment*
7. *Use visual control so no problems are hidden*
8. *Use only reliable, thoroughly tested technology that serves your people and processes*
9. *Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others*
10. *Develop exceptional people and teams who follow your company’s philosophy*
11. *Respect your extended network of partners and suppliers by challenging them and helping them improve*
12. *Go and see for yourself to thoroughly understand the situation*
13. *Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly*
14. *Become a learning organization through relentless reflection and continuous improvement*

(Compare with Deming’s 14 Management Principles can be found in Appendix A)

As one can see, the principles listed above are universal and can be applied to every industry. Toyota uses this as its foundation for quality improvement.

In Deming’s famous book “Out of Crisis”, he talked about creating a stable system. In order to achieve a stable system, Lean begins by simplifying and eliminating all waste. Waste is considered all things that add no value. Once the obvious is removed from the system, the system must be in control. Deming believed control charts and run charts were the only way to determine if a system is in control. He said the problem facing management is that they never start with a system that is in control and thus only get frustrated when they can never achieve their goals. Lean says once the system is in control or ‘standardized’, only then can the system be improved.

Our healthcare system is out of control. Only when the system is in control can management see and achieve real improvement. Lean tools help by dissecting processes and eliminating special causes of failure and get the system in control. Once the process is in control, the system can be measured. Once measured, management can make changes in terms of effectiveness and efficiency. To summarize Lean's steps to achieving improvement is first to simplify and remove waste, stabilize, and then measure. Lean also uses the Deming Cycle PDSA (Plan-Do-Study-Act). Lean is a set of tools that shows us this process for improvement.

History of Lean in US

Lean was formally introduced to the US in 1984 at the New United Motor Manufacturing, Inc. (NUMMI) in Fremont, California. General Motors (GM) and Toyota joined forces to manufacture vehicles to be sold under both brands. GM saw the joint venture as an opportunity to learn about Lean Manufacturing. This joint venture lasted over 25 years until GM pulled out of the venture in June 2009. ^[38]

Before being officially accepted by the healthcare community, Lean needed a makeover. For instance, when Lean began to surface in US Healthcare Systems circa 2000, Lean had a very poor reception in healthcare because of negative connotations like 'do more with less.' As one can imagine, the idea did not go over well at first with healthcare providers or patients. Adversaries of Lean reminded everyone of this popular Lean phrase and said they would not be part of a 'production line of care' (referring to an assembly line at an auto-manufacturing plant). Because of these attacks, many healthcare leaders changed the name of their Lean initiative to Kaizen. Kaizen in Japanese means "continuous improvement". It is ironic, now, as more and more baby boomers start turning 65 and rely more on healthcare, and the US is in a recession that has not been seen since the 1970s, that we will have no other choice but to "do more with less."

As mentioned, an intrinsic part of Lean is the absolute elimination of waste. ^[15] To achieve this, Lean uses two supporting ideas: 'just-in-time' and 'automation with a human touch'. Just-in-time means the right product or service, at the right time, and in the right amount. 'Automation with a human touch' means if an abnormal situation arises; the worker is required to stop the process and fix the problem. Empowering workers to stop, fix and solve problems before the customer is impacted represents built-in quality and safety. In a healthcare setting, 'just-in-time' and 'automation with a human touch' means providing the patient exactly the right care, at the right time, and in the right amount with quality and safety built-in.

Lean is an adaptive strategy that grows or changes to meet the needs of the customer, or in the case of healthcare, the patient. It is also a discipline in which everyone in the organization, not only leadership, is focused on eliminating waste while continuously increasing the percentage of value-added work. *Lean is a discipline* because it *trains* us to continuously improve. It requires self-discipline in order to be consistently improving. A Lean organization is a culture such that it shares attitudes, values, goals, and practices. Deming spoke of management's responsibility to create the proper environment for workers. Lean leaders believe that the most important asset is its people and try to create this learning and "no blame" environment. Lean Healthcare is a philosophy and a set of operating methods and tools that help create maximum value for patients by reducing waste.

Applying Lean to Healthcare

Waste in healthcare is everywhere. Lean identifies and attacks 7 kinds of waste that is universal to all industries including healthcare. These are wastes in *transport* (moving products that are not actually required to perform the processing), *inventory* (product in process and finished product not being processed), *motion* (people or equipment moving or walking more than is required to perform the processing), *waiting* (waiting for the next production step), *overproduction* (production ahead of demand), *over-processing* (resulting from poor tool or product design creating activity), and *defects* (the effort involved in inspecting for and fixing defects).

Overproduction is caused by not understanding what is really needed. Examples of overproduction are making forms that are rarely used, providing copies that were not requested or read, processing documents that sit in queue, and forwarding email unnecessarily forcing recipients to waste time reading them. In 2008, PNHS reduced the number of forms from 100 to 25 by applying Lean tools. ^{[18][30]}

For patients, *waiting* presents a big problem and defines the quality of care. In the worst case, waiting can be the difference between life and death. Some examples of waiting are time spent in waiting rooms, waiting to be seen or scheduled for an appointment, waiting for surgery, or waiting for a diagnosis. By applying the Lean concept of "standard work", Park Nicollet Health Services (PNHS) reduced patient exam lead time on average from 2 hrs to 9 minutes. ^{[18][30]}

Inventory is another waste in healthcare. By using a Lean tool called an ANDON to signal when medications were needed, PNHS was able to reduce inventory by 29% which reduced cost by

50%.^{[18][30]} The risk of keeping stockpiles of medications is not using them by the expiration dates. The result of Lean efforts came in millions of dollars savings in inventory.

Waste of movement is a problem in healthcare for clinicians and staff. A physician or staff member looking for supplies can be a waste time. Clinician walking to use a computer during a patient exam is considered waste because it adds no value. It is important to measure walking time because it impacts productivity as well as waiting. PNHS focused on reducing movement in the Emergency Department. They reviewed the role of the charge nurse and overall patient flow. The team transferred some tasks from the charge nurse role to other team members. This allowed the charge nurse more time to help in the care teams, increasing task time in patient care from 9 minutes to 73 minutes during a two hour time period. The walking distance for the charge nurse was reduced from 1250 feet to 550 feet. The team also collected data on how lead time was impacted by the day of week to plan for adequate staffing. The team also trialed the use of a patient flow coordinator to impact lead time.^{[18][30]}

Lean Healthcare defines medical mistakes or errors as *defects*. These *defects* can have a catastrophic impact on the patient. Defects can show up as errors in the patient medical record or can represent the propagation of a mistake. Lean addresses defects by mistake-proofing processes and empowering all employees in the value stream to “stop the line” if a defect is found. Lean creates the environment to ensure workers feel empowered to “stop the line” when they find a defect and not allow it to propagate. Lean helps spread the sense responsibility to all team members.

James Reason, world renowned psychologist from the University of Manchester, UK, explained the problem with medical errors. He said the medical error problem can be viewed in two ways. There is a person approach and a system approach and each view has quite different philosophies of error management. He explains healthcare is currently based on a system approach with personal focus. He stresses the point that countermeasures or error proofing measures are based on the assumption that although we cannot change the human condition, we can change the conditions under which people work.^[23]

Lean healthcare leaders agree with Dr. Reason that we can change the conditions under which we work but by using countermeasures like error proofing and standard work we can better eliminate defects. The challenge we face is consistency. The moment we become complacent or fail to institute these countermeasures or perform them, mistakes occur. Lean specifically teaches all workers never to become complacent through relentless reflection and continuous

improvement. Lean empowers the people doing the work to make the necessary changes (countermeasures) to prevent mistakes from occurring in the first place.

For healthcare, waste in processing is caused when tests are performed when they are not needed, redundant data is collected, hand-writing information only to be entered online later, or not performing the job right the first time. Lean stresses to do it right the first time and that the little things add up, and anything that is unnecessary should be eliminated immediately. For example, a clinic clerk who does not collect the \$20.00 co-pay before a patient exam adds up in lost revenue, follow-up time including paper work, mail and human resources.

Lean Tools

Lean uses a set of concepts to help healthcare workers ensure a clean, organized and safe workplace and to minimize waste of time. Having everything clean, neat, and in the proper location enhances quality, safety and productivity because it makes things easier to find and problems more visible. This tool is called 5S and is the basic building block for daily management. The 5S tool is often performed prior to making targeted changes. The five concepts each start with the letter “S” and defined below.

Sorting – Separates the necessary from the unnecessary. Unnecessary tools, equipment, and procedures are removed from the workplace.

Sweeping – Makes everything neat and clean by identifying potential problems. Unsafe conditions or damaged equipment are addressed early in the process.

Standardizing – Defines how a task should be performed and lets everyone involved in the process know the “best way” to perform tasks. Process changes are documented as they occur. Changes and improvements using a rigorous process are made by employees who do the work.

Simplifying – Puts everything in its place and organizes material according to how frequently it is used. Visual aids are encouraged in order to promote understanding.

Self-Discipline – Ensures that the principles listed above are followed on an ongoing basis. It paves the way for success in other continuous quality improvement efforts.

Defining Value

Lean brings us back to the basics by telling us to define and redefine value in the value stream. Lean says value can only be defined by the customer or, in the case of healthcare, the patient. The customer expects a product or service at the appropriate time, in the appropriate amount and at an appropriate price with quality and safety built-in. Lean defines the “value stream” as all the

steps required to complete a service or product from beginning to end. As an example, a healthcare provider might begin to define their value stream for a sick patient as: a patient requests care, patient receives care, patient returns to self care. From this basic building block, management can focus on developing value in each step.

Value Stream Mapping

To study the value in a system and identify where the waste is, Lean Healthcare uses a tool called Value Stream Mapping (VSM). VSM is used to show workflow and information flow using process time, wait time, lead time, and first time quality as system metrics. The purpose of this is to visualize the work, document the process, point out problems, build team consensus, focus direction and measure the quality of care. The tool focuses on patient requirements using a systems perspective, linking work and information flow. It also helps to illustrate the complexity of the work by showing different types of services flowing through the value stream and facilitates process redesign to meet specific objectives. Value Stream Mapping allows us to visualize both the current state and the future desired state. It helps us “to open our eyes to existing problems and issues, to identify shortfalls and process breakdowns, and to identify opportunities for improvement.”^[10]

Seven Flows of Healthcare

Once a value stream is targeted for improvement, Lean begins to develop it further by taking into account the 7 flows of healthcare.¹ The 7 flows of healthcare are: flow of patients; flow of clinicians; flow of medication; flow of supplies; flow of information; flow of equipment; and flow of process engineering.^[18]

The *flow of patients* through the hospital or clinic should be continuous. To achieve continuous flow of patients, Lean tries to: load level patient demand; bring services to the patient just when they are needed; and stop the process when problems occur. The second flow is the *flow of clinicians* who provide the most value to the patient. Clinicians must be allowed to deliver quality care quickly, easily, and stress free for both clinician and patient.

The next 4 flows of healthcare support the first two and are based on the just-in-time principle. In order to provide quality care; the correct *medication, supplies, information* and *equipment* must be provided in the right amount, at the right place and at the right time. The seventh flow of healthcare is the *flow of process engineering* and describes how clinicians and staff are free to improve and synchronize the first six flows.^[18]

Standard Work

Standard Work is work performed by the worker. Standard work is measured by time, number of steps, and the number of resources required to keep the process going until completion. It is the responsibility of the worker to document his or her work in terms of standard work. The key idea behind standard work is that it is recognized as an acceptable measure of how the work should be performed. It is also the basis for improvement. With standard work, the workers can measure improvements against their current standards and then rewrite their standard work based on these improvements and bring forth continuous quality improvement.

Another idea of standard work is to share it with others so workers can follow it or improve upon it. "Without standards, there can be no improvement."^[15] Both Lean experts and Deming stressed that any deviation from standard work will cause variations in quality and must be avoided. The same can be said for "best practice" in healthcare when standards of care have been well established for certain treatments. The medical community creates 'best practice' around the idea that there is a treatment or plan of care that is more effective at delivering the best outcomes compared to other treatments. Lean Healthcare uses standard work to ensure "best practices" are followed to achieve the best outcomes.

At Park Nicollet, standard work is followed prior to the start of any invasive procedure or surgical procedure. Each member of the care team is trained to confirm the correct site, procedure, and patient. To help remind them, the care team uses the surgical community's accepted phrase "pause for cause." Because standard work is everyone's responsibility it forces all employees to be interdependent thinkers. Everyone on the team is following a standard process. This idea is especially important in healthcare because there are so many handoffs. Specialists will perform only a small part of the whole, especially when having major surgical procedures.

Measuring Improvement

Before teams begin work on improving a process, baseline measures are taken and documented. After improvements are made, those measures are taken again and reported to indicate progress. At PNHS measurement of the processes are made 30, 60, 90 and 180 days post implementation to understand if the improvements have maintained the gains.

Time is a very important tool for defining improvements. Lean uses 2 measurements and 1 calculation of time to measure standard work and improvements. These are Lead Time, Cycle Time, and Takt Time (pronounced "Tack Tee").

Lead Time in a healthcare setting is the time required to complete a patient care event and includes processing time and waiting time. Lead Time is the total time a patient must wait to receive care after requesting care.

Cycle Time is the time required to complete one cycle of work. For example, cleaning a room after a patient exam in preparation for the next patient can be measured in cycle time. It includes both the value added time and the waste within the process. This does not include the waiting time before and after. Cycle time equals value added plus waste.

Takt Time is the time required to provide a service to meet patient demand. Takt Time equals *available time* divided by *patient demand*. It is also important for establishing continuous flow. It is calculated not measured. *Available time* is directly proportional to Takt Time. If *available time* increases, Takt Time will increase; if available time decreases, Takt Time will decrease. Patient demand is inversely proportional to Takt Time; therefore, if patient demand increases, the Takt Time will decrease. It is important to remember that Takt Time is independent of capacity or number of providers.

Here is a healthcare example for calculating Takt Time. ^[28]

If one shift is responsible for electrocardiograms (EKG) and patient demand for EKGs is 225 during that shift then the Takt Time is:

Takt Time (Electrocardiograms) = 450 minutes* ÷ 225 EKGs = 2 minutes per EKG

* 1 shift = 8 hours – 30 minutes (2 x 15-minute breaks)
1 shift = 480 minutes – 30 minutes = 450 minutes

Regardless of the number of technologists assigned to the task, the available time does not change and therefore the Takt Time does not change. For example, if a hospital assigns only one tech to perform electrocardiograms for 6 hours a day, the Takt Time does not change whether they are being performed by one or five techs. The hospital will not keep up with demand, but the Takt Time does not change. Takt time is simply the pace at which the product or service must be provided in order to meet patient demand. Takt Time is a goal. It tells healthcare administrators how to staff in order to keep pace with demand and helps determine when to reduce process times in order to maintain the same staffing levels. It may be necessary to recalculate takt time on a daily basis or even more than once a day. If demand is greater in the morning than the afternoon, it might be necessary to calculate a morning Takt Time and an afternoon Takt Time.

Rapid Process Improvement Workshop

The Rapid Process Improvement Workshop (RPIW) is one of the most powerful tools Lean uses to target a specific area for improvement. It brings together all the Lean tools and resources to eliminate waste, improve processes, and increase productivity in a specific value stream. The RPIW is referred to as a 'time-out' to make drastic changes to improve healthcare processes. The risk and cost is high every time an RPIW is performed at a hospital or clinic. For one week highly paid and revenue generating participants are committed to improving and nothing else. This

means they are not doing what they are paid to do for the duration of the week. RPIW participants include people who follow the process daily, people from support areas, and a facilitator. It can often include members of senior leadership. Part of Lean's philosophy is that even top executives must go to where the work is being performed and "get their hands dirty".^{[16][19]} This represents number 12 of the 14 principles of *The Toyota Way*.

The goal of the RPIW is to have the team meet in the work area, rapidly develop improvement ideas and implement changes to achieve targets established during the first three weeks of planning. The first three weeks of preparation and planning is the job of Team Lead and Sub Team Lead. The fourth week, called the "RPIW", consists of one day of training and 3 days of implementing improvements and a final day to share results with others called the "Report Out."

The goals of the RPIW can be summarized by the following steps:

1. Go to where the work is done and watch the process.
2. Collect data, down to the second, include the waiting time.
3. Separate value-added activities from the waste and eliminate the waste.
4. Simulate the improved process.
5. Create standard work.
6. Measure the improvements made.
7. Share findings with all others.
8. Audit and review ongoing.

The "Report Out" is one of the most effective and important parts of the RPIW. Participants learn leadership skills by presenting their improvements to others. All employees across the organization are notified of the weekly Report Outs and are encouraged to attend. After the Team presentations, a Lean expert critiques the work each team performed. The expert points out additional ways the team could have eliminated waste or what else the team could have focused on. At the end of the presentation, the audience is encouraged to ask questions. See an example of a RPIW Team Report Out Presentation in Appendix C.

At PNHS, RPIWs are scheduled consistently throughout the year and each team focuses on a specific area. PNHS attempts to schedule between 30 to 40 RPIWs per year. The different teams may work on related or unrelated areas. For example during the same RPIW one team may work on physical therapy processes while the second team may focus on pharmacy, the third team focuses on surgical services and the last may focus on information technology. At Park Nicollet,

depending on the subject, attendance at the Report Outs ranges from 20 to 100 individuals from across the organization. RPIW Results are posted on the internal Lean Promotion Office website for all employees to review.

Lean Communication

Good communication is a pillar for success and Lean takes no exception. Lean maintains good communication by standardizing information in a clear and concise manner that everyone can understand. This may sound simplistic but how many times have we had more than one version of a problem. Lean forces us to document problems so they are visible to all. The Toyota Motor Corporation is very insistent about the way communication is handled throughout their organization. Toyota uses a tool called the A3 Report. The A3 Report (or A3 Form) is a tool that Toyota uses to communicate a problem or an opportunity to upper management. The term "A3" derives its name from the paper size used for the report, which is the metric equivalent to an 11" x 17" paper. This particular size was intentionally chosen for two reasons. First, it is the largest piece of paper that can be faxed through a fax machine. And second, the limited size prevents the idea from getting lost in details. By standardizing and institutionalizing communication tools, it becomes familiar, and it is a living document that can be developed later and by others.

PNHS has adopted a similar form to the A3 called the SBAR. It was promoted by Doug Bonacum at Kaiser Permanente.^[24] His idea came from the US Navy and is a situation briefing model template that lists 4 key components consistent with every type of problem resolution. It allows the communicator to easily organize his/her thoughts and the reader to quickly digest the information. The 4 components are situation, background, assessment, recommendation. It is intended to be a one page summary. It describes a situation succinctly, provides a background so the person reading the information has the context, presents an assessment, and most importantly provides a recommendation. As in most industries, time is limited in healthcare so the SBAR is designed to capture all that is needed on one sheet of paper in order to make a decision.

The SBAR addresses many communication problems including the limitless versions of ongoing issues that no one wants to own. Since time is a rare commodity in healthcare most lengthy reports or emails are often not fully read or understood. Skimming often gives a false sense of understanding. The SBAR works because it draws the reader to each component visually and precisely to what they need to know without having to wade through distracting details. The biggest advantage of the SBAR form is that it uses visual cues to break down the information so the reader can digest it quickly. The SBAR is a very powerful tool and is required for identifying opportunities for improvement and making widespread changes throughout the organization. By

using this tool to build consensus it avoids the lengthy and expensive approval process (“red tape”) that often kill improvement opportunities before they start. Regardless of rank and file, the SBAR is a ticket to being heard and recognized by all levels of the organization. (See SBAR Template and Example in Appendix D)

Lean Infrastructure

At PNHS, the Lean Department consists of 3 teams, each with its own purpose. These are: the Kaizen Promotion Office, the Kaizen Operations Team, and the Kaizen Leadership Team. Each team has a specific role working interdependently to help make changes, from inception to implementation and ongoing management.

Kaizen Leadership Team (KLT)

The Kaizen Leadership Team is tasked with reorganizing service lines along value streams. In 2008 the KLT at PNHS established the following service lines with associated departments:

Surgical/Orthopedic Services - Operating Rooms, Ambulatory Surgery Center, General Surgery, Bariatric Surgery, Vascular Surgery, Audiology, ENT, OB/GYN, Neurosurgery, Ophthalmology, Plastic Surgery, Podiatric Medicine & Surgery, Sexual Health, Urology, Orthopedics, Orthopedic Surgery.

Primary Care - Family Medicine, Internal Medicine, Senior Services, Occupational Medicine, Pediatrics, Pediatrics Specialty, Urgent Care, After Hours Nurses, Family Medicine Residency, Health Source, Health Support, Patient Service Centers

Inpatient Services - Hospital Inpatient Services, Care Integration, Community Care, Emergency Center, and the Hospitalist Program

Specialty Services - Adult Endocrinology, Asthma & Allergic Diseases, Bone Density, Cardiology, Dermatology, Digestive & Endoscopic Procedure Center, EDI, Hospital Pharmacy, Infectious Disease, International Diabetes Center, Laboratory, Mental Health, Nephrology, Neurology, Oncology, Peds Endocrinology, Pulmonary, Radiology, Rehab Services, Respiratory Care, Rheumatology, Sleep Disorders, and Travel Clinic

Corporate Services - Finance, Park Nicollet Institute, Park Nicollet Foundation, Human Resources, Information Technology, Patient Safety & Compliance, Marketing & Communications, and Real Estate & Support Services Patient Safety, Finance, Real

Estate & Support Services, Marketing & Communications, Research Institute, Information Technology, Human Resources, and Kaizen Promotion Office.

Kaizen Operation Team (KOT)

The Kaizen Operations Team is created to embed the Lean principles directly into the healthcare departments across the organization. The KOT's primary function is to work operationally on: RPIWs, Value Stream Mapping, 5S Activities, Supply Chain, 3P Activities (Concurrent Engineering), Statistics/Reports/PQA, Standard Work/Replication/Audits, and Kaizen Communications.

Kaizen Promotion Office (KPO)

The Kaizen Promotion Office supports the Kaizen Operation Team by building the foundation for improvements. The KPO is responsible for: RPIW planning and scheduling; training; consulting; demand analysis; replication processes; and the creation of tools and standards. The team consists of the Executive Vice President, Kaizen Chief Director, Workflow and Visual Control Coordinator, Senior Administrative Assistant, Standard Work Specialist, Audit Coordinator, Project Manager, and one Lead Kaizen Specialist for each of the 5 service lines mentioned above.

The KPO connects the KOT with the service lines together to target areas for improvement. The KPO and KLT work together to determine how initiatives are deployed. The KPO also determines how target areas are supported by the KOT and the KOT staff. Ultimately, when changes are implemented during RPIWs and knowledge is transferred to standard work, then it is promoted and results are discussed openly and follow-up is expected. These improvements become standard work and part of the RPIW participants' job.

Promoting Lean is a very important part of building a Lean organization. At PNHS, KEEP stands for Kaizen Everyday Engagement Program. It is a way for individuals to propose and carry out improvements with help from the KPO or on their own. Employees can go to the company's intranet webpage and submit a KEEP idea online. KEEP recognizes individuals who find ways to eliminate waste and/or improve workflow. Individuals are also ensured that their ideas and suggestions are acknowledged, tracked, and reviewed by the Kaizen Promotion Office. If necessary the Kaizen Office will support the efforts for improvement by supplying resources and materials that may be required.

Leadership

Lean Healthcare requires strong and committed leadership to build the infrastructure to sustain the changes and improvements made. Lean is very different from traditional management systems. It requires drastic changes to current management practices. Therefore, Lean must be initiated and promoted by the CEO and Senior Clinician Leadership and continue to be a top priority. Senior Leadership cannot waiver from this commitment and must be consistent when communicating changes that must be made. The organization must also obtain Lean expertise in order to bring the knowledge of Lean to the organization. This can be accomplished by hiring a Lean consultant or Lean consulting group. The Lean consultant will provide leadership and direction needed to jumpstart the Lean transformation until leadership obtains this knowledge. As with all industries, the Lean consultant must have the right experiences and background. And above all, the consultant must have the *authority* (from senior leadership) to make changes immediately. From the beginning the Lean consultant should immediately institute the following: weekly Lean progress meetings with CEO and Service Line Leaders to review progress towards yearly goals; create a visibility room where progress is monitored; monthly review meetings of corporate health, quality, and data; and set short and long-term goals to improve the healthcare system.¹

Part of Lean leadership's commitment to change involves developing future leaders to carry on improvement initiatives and continue developing and maintaining a learning culture. The moment the decision has been made to become Lean, the organization should start educating its future leaders. Like Toyota, Lean Healthcare leaders must grow in-house leaders versus looking outside the organization. It is important to select future leaders from every level of the organization regardless of rank. By investing in training, management ensures fast and effective Lean implementation as well as sustainable bottom line gains. Training should include: dealing with resistance; building buy-in; sustainable behavior and promoting cultural changes.

PNHS has committed to putting 50 future leaders per year through an 18 month certification program. PNHS's Lean certification requires 24 weeks of full-time commitment. By building leaders from all levels of the organization the organization can start to reduce the need for costly middle management by enabling their people to grow, learn, and become multi-skilled workers who can lead others.

Instituting Lean

In 2001, the Institute of Medicine followed up *To Err is Human* with the report called *Crossing the Quality Chasm: A New Health System for the 21st Century*. In this later publication, investigators performed a more detailed examination of the immense divide between what we know to be good health care and the health care that people actually receive. In this report, the Committee on Quality of Health Care in America issued 13 recommendations. These recommendations were separated into “aims” and “rules.”

As a result of these recommendations, many healthcare organizations began initiatives to meet these aims and implement these rules. They began their efforts by incorporating the six recommended aims of health care into their mission, vision, values, and strategic plan of their organization. Many organizations like Park Nicollet Health Services (PNHS) in Minnesota soon realized this was not enough.

Three years later PNHS had tried a number of improvement initiatives including the Institute for Healthcare Improvement’s (IHI) approach to rapid cycle process improvement (Deming Cycle); and the Six Sigma tool, Define-Measure-Analyze-Improve-Control. Leadership at PNHS, again, realized from their efforts that these approaches were necessary but not enough to move from the present state to their desired future state.

In 2003 Senior Vice President for Park Nicollet Health Services, Mike Kaupa contacted John Black, a Lean consultant, who a year earlier had helped implement Lean at Virginia Mason Medical Center in Seattle. With the help of John Black and associates, PNHS began its own Lean journey and shortly thereafter found that Lean embraced all six IOM Aims to improve the delivery of care. PNHS began to adapt the Lean philosophy to its own healthcare delivery system. Like Virginia Mason, they also discovered that using this system engineering approach could accelerate and sustain quality of care improvements while reducing costs.

In 2004, Park Nicollet Health Services was the American Medical Group Association’s (AMGA) Acclaim Award Recipient for their report, *Applying Production Principles from Toyota to Improve Patient Care*. The AMGA Acclaim Award is given to physician-directed organizations for quality improvement efforts which measurably improve health outcomes and quality of life for their patients. The award is to bring national recognition to the recipients and to promote the effort being made in healthcare quality improvement.

In the report *Applying Production Principles from Toyota to Improve Patient Care*, Park Nicollet staff writers explained how Lean principles embrace the IOM’s Recommended Rules published in

the report, *Crossing the Quality Chasm*. Park Nicollet discussed how Lean was a blueprint for redesigning its healthcare processes in accordance to IOM Recommended Rules.

The following has been taken from Park Nicollet's AMGA Acclaim Award winning submission.^[39]

IOM Rule #1: *Care based on continuous healing relationships*. Patients should receive care whenever they need it and in many forms, not just face-to-face visits.

PNHS adapted Lean principle(s): *Increased capacity for healing relationships is created by eliminating waste and by creating standard work. Standard work adds predictability and allows for more time to be spent developing professional competencies, including healing relationships with patients.*

IOM Rule #2: *Customization based on patient needs and values*. The system of care should be designed to meet the most common types of needs, but have the capability to respond to individual patient choices and preferences.

PNHS adapted Lean principle(s): *"Single-piece flow" and rapid changeover of "set-ups" promote customization. "Value stream mapping" looks at activities that are of value to the customer—all else is waste."* (These principles together enable customization based on patient needs and values.)

IOM Rule #3: *The patient as the source of control*. Patients should be given the necessary information and the opportunity to exercise the degree of control they choose over health care decisions that affect them. The health system should be able to accommodate differences in patient preferences and encourage shared decision making.

PNHS adapted Lean principle(s): *Based on value stream mapping, the patient is the only customer. An example of this is hand hygiene. In every patient room there are signs stating that patients should expect staff to use alcohol rub before and after interacting with them. If patients do not see hand hygiene they are encouraged to ask staff to comply.*

IOM Rule #4: *Shared knowledge and the free flow of information*. Patients should have unfettered access to their own medical information and to clinical knowledge. Clinicians and patients should communicate effectively and share information.

PNHS adapted Lean principle(s): *Visual controls make processes readily visible to everyone. "Just in time" care requires free flow of information. PNHS spent \$60 million to implement a clinical information system spanning the continuum of care. The system allows clinical information to flow freely across hospital, clinic and home-care. It also includes patient access to their medical record via the secured Web.*

IOM Rule #5: *Evidence-based decision making*. Patients should receive care based on the best available scientific knowledge. Care should not vary illogically from clinician to clinician or from place to place.

PNHS adapted Lean principle(s): *Lean is metric-driven and decisions are based on data. Rapid process improvement workshops (RPIW) use an evidence-based approach. For example, the wound infection RPIW directed attention to defects related to best practices for preventing post-operative wound infections, including shaving technique, normal*

blood sugars, adequate tissue oxygenation and normal body temperature during surgery. The hand hygiene RPIW emphasized new CDC guidelines for using alcohol rub.

IOM Rule #6: *Safety as a system property.* Patients should be safe from injury caused by the care system. Reducing risk and ensuring safety require greater attention to systems that help prevent and mitigate errors.

PNHS adapted Lean principle(s): *Error-proof processes are used. "Jidoka" is one-by-one confirmation to detect abnormalities. This process does not allow for passing on defects—every abnormality must be responded to immediately. Lean Production includes a "visibility room" containing all significant organizational metrics, including the category of safety. The organization included elimination of post-operative infections and preventable adverse drug events as priorities for 2004.*

IOM Rule #7: *The need for transparency.* The health care system should make information available to patients and their families that allows them to make informed decisions when selecting a health plan, hospital, or clinical practice, or choosing among alternative treatments. This should include information describing the system's performance on safety, evidence-based practice, and patient satisfaction.

PNHS adapted Lean principle(s): *Visual controls make the process readily visible to everyone. Kanban and Andon are examples of visual controls. Hand hygiene improvement included signs in every patient room stating that patients should expect staff to use alcohol rub before and after interacting with them, and requesting patients to ask staff if they do not see hand hygiene.*

IOM Rule #8: *Anticipation of needs.* The health system should anticipate patient needs, rather than simply reacting to events.

PNHS adapted Lean principle(s): *Calculate takt time (production time divided by customer demand) to deliver services or supplies just in time. In other words, anticipate need (as measured by takt time) and build processes to meet need with "single flow" with no queues.*

IOM Rule #9: *Continuous decrease in waste.* The health system should not waste resources or patient time.

PNHS adapted Lean principle(s): *Eliminate the seven types of Muda (waste)—time, inventory, motion, defects, transportation, motion, over-processing.*

IOM Rule #10: *Cooperation among clinicians.* Clinicians and institutions should actively collaborate and communicate to ensure an appropriate exchange of information and coordination of care.

PNHS adapted Lean principles(s): *Lean Production assumes shared flow of knowledge and free flow of information for all roles involved in a process in order to meet demands—just in time with no defects.*

Addressing the IOM Rules was only the beginning but opened the eyes of senior leadership to embrace what Lean had to offer.

In 2007, the Kaizen Promotion Office at PNHS conducted 37 RPIWs and claimed the following improvements.

- 76 miles less walking distance for staff per day
- 4,328 feet less walking distance for patients per day
- 2,924 fewer surgical instruments processed per month
- 1,431 excess inventory items eliminated (\$143,000 reduction from Cardiac Cath Lab)
- 312 miles less travel distance for lab letters, specimens, and Radiology reports per day.
- 76 hours cycle time reduction per day
- 1,111 hours lead time reduction per day for the following processes: Radiation Ordering & Results Reconciliation, Quick Check, Hospital Pharmacy Distribution, GI Outcomes, and EC Cardiac Observation Unit.
- 6 FTEs redeployed
- 60% average % change of output per FTE (impacted by 7 RPIW teams with productivity gains ranging between 15 and 113%.
- 3,069 square feet space freed up for alternate use (5S effort)
- 3,977 defects eliminated per day

David Wessner CEO of PNHS addressed employees at a Lean workshop five years after embarking on the Lean journey. In August of 2008, he reported that PNHS had completed a total of 458 RPIWs, had 124 Certified Kaizen Leaders, 96 other in process and over 1,000 employees exposed to the Lean philosophy through training and participation.

Leading Institutions Choosing Lean

It is not surprising that many healthcare organizations have recently been discussing a systems approach with a customer focus (Lean) to solving their healthcare issues. Among them is the world renowned Mayo Clinic in Rochester, Minnesota. In February 2008, Kare11 Minneapolis News reporter Rick Kupchella interviewed then current Dr. Denis Cortese MD, CEO of the Mayo Clinic.^[32] In the interview, Dr. Cortese alluded to several Lean principles including: *listening to the voice of the customer*. Dr. Cortese states,

“We’ve also become in the last 7 or 8 years much more aware of the fact that the outputs of healthcare: the outcomes, safety, the service, and the costs are not as good as they ought to be. Mayo Clinic has gotten engaged specifically to bring a voice to the table that focuses on ‘If you were a patient what would you want in a future healthcare system?’ That’s how we got started and [what] we’ve tried to do is create a conversation with people who are broadly based in the healthcare system. We got people who are involved from 9 different sectors including patients for doing focal surveys now around the country

to sort [of] get a sense of what needs to be done in the United States to improve the value of the care that our patients would get or we will all get because we are all going to be patients at some point."

The second principle that Dr. Cortese talks about relates to another key Lean principle: *creating value*. Dr. Cortese begins,

"How do we create value in healthcare? How do we improve outcomes, improve safety, improve service all the way across the board? [The] Institute of Medicine has worked on this. Many groups have asked this question and how do we reduce the cost over time for patients... And the idea of system engineering and the way we deliver care can improve outcomes, improve safety for sure, improve services, reduce costs. Those concepts are all created under this idea of creating value."

In healthcare, Lean defines value as delivering the right care at the right time, in the right amount, at an affordable price, as defined in each case by the provider and patient. It teaches us to study and improve these value streams. As mentioned, the value stream represents the specific activities required to provide the care or service throughout the episode of care. Lean Healthcare utilizes value stream mapping to optimize the entire process from the standpoint of the patient. By doing this, staff can create "flow" which ultimately reduces lead time (or waiting), work-in-process, and staff frustrations while providing opportunities to learn and/or focus on the root causes of poor quality.

Dr. Cortese also cited Intermountain Healthcare (IM) in Utah as an example of "integrated and coordinated care." Among its other services, Intermountain Healthcare provides care for 25,000 diabetics. They are nationally recognized for having the best diabetes outcomes with the lowest cost per patient. IM makes use of only 4 endocrinologists who support a care delivery system that is tailored to each individual patient using system engineering principles. While referring to Intermountain Healthcare's diabetic care system, Dr. Cortese states,

"The result of focusing at the individual and using engineering principles in caring for them results that [the] whole population has the best outcomes in the country. So by focusing on individuals you can actually improve the outcomes. So the idea of integrated, coordinated care using engineering principles to improve wellness and healthcare services is the really the third common principle that's floating around out there (Referring to principles to improve healthcare that are currently being discussed in healthcare today).

A week after interviewing Dr. Cortese, Rick Kupchella reported on Intermountain Healthcare. Kupchella interviewed IM Research Director, Dr. Brent James. Dr. James said his group literally borrowed a page from quality improvement at Toyota because Toyota figured out that improving quality could reduce costs. Dr. James also stated, "...more and more people are coming to understand the key issue is controlling the cost of care through better care" and from

Intermountain's efforts they have "extracted literally hundreds of millions of dollars out of the cost of care." According to the report, the cost of healthcare in Utah has grown only half as fast as the rest of the nation.

The interview with Intermountain Healthcare revealed the benefits of applying "standard work" to clinical practice. When Intermountain Healthcare "standardized" its drug therapy for their heart patients, more doctors began to using the right drugs. Intermountain Healthcare claims this resulted in 455 lives saved per year and a 900 per year reduction in patient re-admissions for complications. This statistic was an unexpected surprise for Intermountain Healthcare because Medicare had warned at the beginning in 2008 that Medicare will begin refusing to pay for preventable complications.

The following was taken from the Park Nicollet Intranet webpage on March 31, 2009:

Lean attracts international visitors.

At the suggestion of former Park Nicollet CEO, Jim Reinertsen, MD, the executives spent two days at Park Nicollet touring the hospital and clinic

Seven senior executives representing the United Kingdom's National Health Service (NHS) visited Park Nicollet to learn how we are applying Lean tools. The executives represented hospitals that are part of the NHS's Institute for Innovation and Improvement. They wanted to learn more about U.S. health care organizations using Lean tools.

The executives said they were impressed with our commitment to using the Kaizen tools in so many different areas of our operations. One executive noted, "It was great being able to see the real operations and improvements you've made. At other facilities, we spent the whole time in the board room." Another executive commented after attending a Friday morning RPIW report out session, "It was exceptional. I've never seen anything like it."

A second group of UK executives will be arriving in the next month. "Hosting other health care groups is a way for Park Nicollet to earn some consulting dollars ourselves," says Dolezal. "And it's also a great way to share our learning."

Lean Case Study 1: Honesty and Relentless Reflection

Despite all the mistake proofing and standard work we follow medical mistakes will still occur. The goal is to eliminate the same mistakes and be proactive by identifying potential mistakes. In March 2008, a cancer patient came to Methodist Hospital for pain on his right side. An intravenous pyelogram (a special X-ray procedure), showed the problem on the right kidney. The Radiologist dictated the tumor on the right side and ordered a follow-up CT. The follow-up CT was dictated and the Radiologist again dictated the tumor in the right kidney. The patient followed up with his nephrologist and his nephrologist dictates that the tumor is in the left kidney. The surgeon read the nephrologist's report citing the left kidney needing to be removed. Once in OR, everyone had accepted that the left kidney was impaired and as a result the healthy kidney was removed.

The removal of the wrong kidney was a horrific event. But what makes this tragedy hopeful for future patients is that PNHS chose to study it and to understand exactly what caused it in order to address it and prevent it from happening again in the future. Following Lean's philosophy, PNHS invited everyone in the organization to several reflection meetings to discuss the incident. The meetings were lead by former CEO, David Wessner and current CEO, Dr. David Abelson, MD. Employees expressed their sorrow and frustration and asked why this happened. Dr. Abelson explained how *cognitive lock* contributed this mistake. Both Mr. Wessner and Dr. Abelson called on all staff to be interdependent thinkers and "stop the line" if anyone suspects a defect. From these reflection meetings, many came away with a better understanding of the incident and a renewed sense of responsibility for their patients and their safety.

After these reflection meetings, many proposals where developed and data mining for laterality that became part of standard work. Patient data for all surgery patients is now analyzed from different perspectives and summarized into useful information. This renewed sense of responsibility and new mistake proofing tools will help prevent this problem from happening again. Lean brought everyone together to reflect in this time of failure so that it can be better understood; people can learn from it, develop a personal connection and shared purpose in order to prevent mishaps from occurring again in the future. This is a very important concept when most of our care is coordinated among so many different people from front desk, to triage nurse, to x-ray and lab techs to primary care physician, to specialist, to surgeon, to ICU nurse. As patients, we all depend on this coordinated care.

PNHS knew they had to address the mistake and immediately focused its next month's RPIW in Surgical Services (April 11, 2008 – RPIW 12). PNHS learned a hard lesson that laterality identification is paramount to patient safety at every point along the continuum from source imaging to surgical intervention. The March RPIW team examined the current quality check points along this process (the opportunities to catch an error before it is passed downstream), and made recommendations to enhance the efficacy of these check points. The team developed standard work, including sending the radiology and/or pathology report(s) along with the surgery consent form, asking patients open-ended questions regarding their procedure type and side, and updated standard work for the surgical 'Pause for the Cause.'

In the April/May 2008 monthly patient safety newsletter for staff at Park Nicollet, Tom Schmidt MD, Chief of Patient Safety writes the following:

"In the kidney case, a phenomenon called "diagnostic momentum" occurred. In this case, the electronic record citing the diagnosis was passed on from one provider to the next, without the original "source document" being reviewed prior to surgery. Once diagnostic labels are applied to a patient, they become very "sticky" and increasingly difficult to remove.

Tip:

Human error will be an ever-present risk as we care for our patients. One error-proofing approach is to establish "traps" as close as possible to the potential source of error to catch those errors before they reach the patient and cause harm. As we move forward with surgery planning, we will establish various points in the process where the "source document" (either a radiology or lab report) will be reviewed for correlation with the consent and planned procedure prior to the actual planned surgery.

***While there are opportunities for cognitive error with each patient encounter, the challenge is to design processes that "catch" and reverse those errors before they reach the patient.*

Tip:

STOP THE LINE!

If at any point in the process of caring for our patients you feel the safety of the patient is at risk, you have an obligation to speak up, and stop the line."

In the winter of 2009, one year after the incident, PNHS received the 2009 Minnesota Business Ethics Award. Its purpose is to raise the standards for business ethics in Minnesota and to honor companies that exhibit the highest standards of ethics.

Lean Case Study 2: Relentless Reflection

Another example of relentless reflection came in 2008 during a two week RPIW directed at cognitive errors in primary care and surgery. Clinicians from both areas participated. The reflection came from an OB/GYN physician during the *Report Out*. She told a story of how cognitive errors lead her to the wrong diagnosis. The case she presented was a pregnant Somali woman with her fourth child. The pregnant mother came to her clinic with nausea and was treated for nausea on 3 occasions over course 3 weeks before coming to the Emergency room with a ruptured appendix. After the event, the physician understood the missed diagnosis came from the Framing Effect and Diagnostic Momentum. This Lean forum will help other physicians from falling in the same trap. Lean teaches that sharing experiences is important for preventing mistakes.

As part of their quality tracking system, Park Nicollet has a Near Miss Category that is reported as well as a Cognitive Error Category that is used as a learning tool. The participants in the Report Out mentioned above suggested that Park Staff develop a lexicon for these types of errors so they can be easily identified and categorized for different specialties. The Lean Department helps develop these “habits” of learning through forums so staff and clinicians can improve on rule-based decision-making and best practices. Lean tells us to be accountable, not blame and continuously improve.

Reflection is the key to learning and preventing cognitive errors. The only blame is blame for not learning from our mistakes and not trying to improve the healthcare system in which we work.

Conclusion

Lean Healthcare promotes a systems approach that focuses on the patient’s needs. Work performed that does not add value is considered waste¹. This is a new concept for most organizations because it is not only an improvement methodology but it also teaches how to perform the work. It also teaches how to sustain these improvements through continuous checks. Lean has been called the enabler for Six Sigma because it lays the groundwork so that measures can be easily collected and understood.

Lean requires little initial training and is an extension of current work. Other methodologies take people out of the work situation to solve a problem. Lean brings people together doing the work to solve it. It is a way for workers to become more efficient by maintaining the gains that they and others have made doing the same tasks. It also makes work visible by instituting “standard work.” These gains and ideas are instituted by a powerful Lean Department with the authority and support of the CMO and CEO and other Service Line Leaders. The Lean Department promotes and empowers individuals to find and eliminate the 7 wastes found in healthcare. Lean also tries to create an environment in which countermeasures are in place to minimize the risk of potential mistakes. Lean is not only a methodology but it is also a discipline. It is generally accepted that in order to be successful you must be disciplined. Lean prevents complacency by creating a learning culture. Most successful people subconsciously follow Lean principles every day. We call them efficient, innovative, and productive.

The situation is that healthcare is in a precarious position. There is no doubt that healthcare as we know it today will change. In order to adjust we must find a way to bridge the divide we have between the cost of care and providing everyone quality care. Lean Healthcare Institutions like Park Nicollet and Intermountain Health have proven that Lean will improve quality and patient safety while lowering the cost of care. These institutions have gained national and international recognition for their approach and achievements. Therefore, until another approach proves more successful, all US Healthcare Systems should become Lean Organizations. The sooner our healthcare systems commit to Lean the more they will save in money and lives but also become prepared to “do more with less”. If we start the transformation now it will benefit all of us, the soon-to-be patients.

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Appendix A

Dr. W. Edward Deming's 14 for management

Deming's fourteen key principles for management for transforming business effectiveness. The points were first presented in his book *Out of the Crisis*. (p. 23-24)

1. *Create constancy of purpose toward improvement of product and service, with the aim to become competitive and stay in business, and to provide jobs.*
2. *Adopt the new philosophy. We are in a new economic age. Western management must awaken to the challenge, must learn their responsibilities, and take on leadership for change.*
3. *Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place.*
4. *End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move towards a single supplier for any one item, on a long-term relationship of loyalty and trust.*
5. *Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease cost.*
6. *Institute training on the job.*
7. *Institute leadership (see Point 12 and Ch. 8 of "Out of the Crisis"). The aim of supervision should be to help people and machines and gadgets to do a better job. Supervision of management is in need of overhaul, as well as supervision of production workers.*
8. *Drive out fear, so that everyone may work effectively for the company. (See Ch. 3 of "Out of the Crisis")*
9. *Break down barriers between departments. People in research, design, sales, and production must work as a team, to foresee problems of production and in use that may be encountered with the product or service.*
10. *Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the work force.*
11.
 - a. *Eliminate work standards (quotas) on the factory floor. Substitute leadership.*
 - b. *Eliminate management by objective. Eliminate management by numbers, numerical goals. Substitute workmanship.*
12.
 - a. *Remove barriers that rob the hourly worker of his right to pride of workmanship. The responsibility of supervisors must be changed from sheer numbers to quality.*
 - b. *Remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means, inter alia, abolishment of the annual or merit rating and of management by objective (See Ch. 3 of "Out of the Crisis").*
13. *Institute a vigorous program of education and self-improvement.*
14. *Put everyone in the company to work to accomplish the transformation. The transformation is everyone's work. "Massive training is required to instill the courage to break with tradition. Every activity and every job is a part of the process."^[22]*

Appendix B

AWARDS

YEAR

2011	Accountable Care Organization Status from Centers for Medicare & Medicaid Services	
	Good Catch for Patient Safety Award from Minnesota Hospital Association	
	50 Top Cardiovascular Hospitals® from Thomson Reuters	
	Distinguished Hospital Award for Patient Safety™	HealthGrades
	Cardiac Excellence Award™	HealthGrades
	Stroke Care Excellence Award™	HealthGrades
	Critical Care Excellence Award™	HealthGrades
	Pulmonary Care Excellence Award™	HealthGrades
	G.I. Medical Treatment Excellence Award™	HealthGrades
	Women's Health Excellence Award™	HealthGrades
	Innovation in Health Care Award™	HealthPartners
2010	Stroke Care Excellence Award™	HealthGrades
	100 Top Hospitals®: Cardiovascular Benchmarks for Success	Thomson Reuters
	Pulmonary Care Excellence Award™	HealthGrades
	Cardiac Care Excellence Award™	HealthGrades
	Cardiac Surgery Excellence Award™	HealthGrades
	Critical Care Excellence Award™	HealthGrades
2009	Patient Safety Improvement: Calls to Action	Minnesota Hospital Association
	Critical Care Excellence Award	HealthGrades
	Gastrointestinal Care Excellence Award	HealthGrades
	Pulmonary Care Excellence Award	HealthGrades
	Stroke Care Excellence Award	HealthGrades
	Coronary Intervention Excellence Award	HealthGrades
	Cardiac Care Excellence Award	HealthGrades
	Distinguished Hospital Award for Patient Safety	HealthGrades
	Cancer Program Outstanding Achievement Award	Commission on Cancer
	Distinguished Hospital Award for Clinical Excellence	HealthGrades
	Cancer program Three Year Approval with Commendation	Commission on Cancer
2008	Highest Value Hospital	Leapfrog Group
	100 Top Hospitals: Cardiovascular Benchmarks for Success	Thomson Reuters
	Patient Safety Excellence Award: Safe Count	Minnesota Hospital Association
	100 Most Wired Hospitals	Hospitals & Health Networks Magazine

Appendix B (Continued)

- Patient Safety Excellence Award: Safe Skin; Safe from Falls Minnesota Hospital Association
- 2007 Patient Safety Improvement: Pressure Ulcers Minnesota Hospital Association
- Patient Safety Improvement: Falls Prevention Minnesota Hospital Association
- Methodist Hospital recognized on national Top Hospitals Quality and Safety Survey
The Leapfrog Group
- Highest "three star" rankings in 11 of 12 quality measures
Minnesota Community Measurement 2007 Health Care Quality Report
- Highest quality "three star" rankings for coronary artery bypass graft operations Society
of Thoracic Surgeons
- 100 Top Heart Hospitals Modern Healthcare Magazine
- 100 Top Cardiovascular Hospitals Thomson Healthcare
- Top 100 Integrated Healthcare Networks Verispan
- Park Nicollet Heart and Vascular Center in top 10% of hospitals nationwide for cardiac
care and heart surgery Medicare
- Certified program - International Diabetes Center American Diabetes Center
- 100 Top Cardiovascular Hospitals Solucient
- Blue Distinction Center for Cardiac Care Blue Cross and Blue Shield
- 2006 Gold Award - Excellence in Comprehensive Disease Management - Asthma, Coronary
Artery Disease, Diabetes HealthFront
- Primary Stroke Center Certification Joint Commission on Accreditation of Healthcare
Organizations
- Park Nicollet Cancer Center, Highest Accreditation Rating Commission on Cancer
- Park Nicollet Heart and Vascular Center and Methodist Hospital, named one of the 100
Top Cardiovascular Hospitals in America Solucient
- "Most Wired" and "Most Wireless" Award 2006 Most Wired Survey and
Benchmarking Study
- Bariatric Surgery Center of Excellence American Society of Bariatric Surgery
- 2005 Park Nicollet Methodist Hospital named one of the 50 Exceptional U.S. Hospitals for
Outstanding Quality and Safety Practices Consumer Digest
- Park Nicollet Methodist Hospital named one of the nations 100 Top Hospitals
Solucient
- Premier Award for Quality in Acute Myocardial Infarction Premier Group Purchasing
Association
- Gold Award - Excellence in Comprehensive Disease Management - Diabetes, Coronary
Artery Disease, HealthFront
- 2004 Park Nicollet received the Acclaim Award from the American Medical Group Association
(AMGA) for the project "Applying Production Principles from Toyota to Improve Patient
Care."

Appendix B (Continued)

Park Nicollet received the Gold Award for Excellence in Disease Management and Innovations in Health Care Quality from HealthFront on behalf of BHCAG employers

Struthers Parkinson's Center receives 2004 "Award of Excellence" from the Minnesota Council on Physical Activity and Sports

- 2003 Park Nicollet/Methodist Care System received the 2003 Gold Award for "Excellence in Comprehensive Disease Management." The Care System also received a Silver Award for "Innovation in Clinical Quality" for its development of an integrated clinical information system.

David Wessner, president and chief executive officer was awarded the 2003 Stephen Rogness Distinguished Service Award for his demonstrated history of significant leadership.

Park Nicollet Foundation was the 2003 co-winner of the Community Health Commitment Award for its work as a founding partner of "No Shots, No School."

Park Nicollet won 2 awards from the American Medical Group Association (AMGA)

AMGA High Risk Patient Management Award for the project "creating a chronic disease model for patients with diabetes"

Medical Preeminence Award to David Wessner. Chief Executive Officer of Park Nicollet

Park Nicollet was named 2003 Acclaim Award honoree for the project "changing an organization to improve patient safety."

The Minnesota Hospital Association, (formerly known as the Minnesota Hospital and Healthcare Partnership, MHHP), recognized Park Nicollet Health Services for its efforts in patient safety. Other patient safety recognitions came from the Minnesota Alliance for Patient Safety (MAPS) and the American Medical Group Association.

International Diabetes Center (IDC) received a four-year extension of its designation with the Pan American Health Organization/World Health Organization Collaborating Center for Diabetes Education, Translation and Computer Technology. IDC's designation has been renewed many times since 1985. IDC is one of 32 expert centers worldwide.

