LEAN IMPLEMENTATION AT A COMMUNITY HOSPITAL

by

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ABSTRACT

Lean is a systematic method of reducing waste in order to meet the needs of the customers. Lean has been used in the automotive and manufacturing industries for decades to improve production efficiency, reduce operating costs, and ensure workplace safety. Eventually, Lean found its way into the healthcare industry during the 90s. This essay will first explain the origins of Lean Thinking, the five principles of Lean, and early adopters of Lean in the healthcare industry. Then, this essay will introduce Washington Health System (WHS) and describe how this community hospital has implemented Lean throughout its system. Using different Lean tools, WHS established standard protocols for employees and processes, prevented further patient falls, and created a new care plan for patients with special needs. Lean is relevant to public health because it ensures patient safety in the healthcare environment through the use of root cause analysis and standard work. With Lean, healthcare processes are more efficient, employees are more productive, and patients are safer and more satisfied.

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1.0 LEAN THINKING

1.1 DEFINITION OF LEAN

Every process has its flaws and hindering factors. A missing part hinders the production of a car. A delay in materials delivery deters food production. A reduction in staff slows down restaurant business. Businesses aim to reduce nonvalue-added activities in order to maximize production, boost profits, and satisfy customers. Unbeknownst to many successful businesses, they are using Lean (or Lean Thinking) in their daily operations. Lean is defined as "to maximize customer value while minimizing waste. The ultimate goal is to provide perfect value to the customer through a perfect value creation process that has zero waste." (Lean Enterprise Institute, 2018)

Lean aims to eliminate all types of waste, (or *muda* in Japanese) during a process or event. To be more specific, *muda* means any human activity which absorbs resources but creates no value. (Womack & Jones, 2003, p. 19) Some examples of *muda* are unnecessary processing, long wait time, extra inventory, and defected products. Taiichi Ohno, the Toyota executive that pioneered the Toyota Production System, identified seven types of *muda* in any process – transportation, inventory, motion, waiting, overproduction, over-processing, and defects. In later years, many Lean practitioners have added an eighth *muda* – under-utilizing employee talent.

1.2 THE ORIGINS OF LEAN THINKING

Sakichi Toyoda was a famous Japanese inventor who invented many machines and founded the Toyota Industries Corporation. In 1924, he invented the "Type-G Toyoda Automatic Loom", a machine that spins thread and weaves textiles automatically. This machine has a stopping device that automatically stops the loom when a thread breaks, and it automatically changes the shuttle (thread holder) without stopping operation. (Toyota Motor Corporation**,** 2018) Sakichi Toyoda coined the term *jidoka*, which means "automation with a human touch". He advocated all machines to have a built-in device that automatically stops during abnormal situations to improve product quality and workplace safety.

Sakichi Toyoda's son, Kiichiro Toyoda, founded Toyota Motor Company in 1937. Inspired by his father, he set out to improve the efficiency and quality of auto manufacturing. Kiichiro Toyoda collaborated with Tachii Ohno, an executive at his company, to develop the "Just-in-Time" concept, which means "produce only what is needed, when it is needed, and in the amount needed." (Toyota Motor Company, 2018). Later, Tachii Ohno created the "Kanban System", a production control method that regulates supply chain by stocking and restocking only what is needed. After many years of trial and error, the Toyota Production System (TPS) was implemented in 1945 and became Toyota's standard way of automotive manufacturing.

In 1990, James P. Womack, then research director of MIT's International Motor Vehicle Program, described Toyota's manufacturing success in his book *The Machine that Changed the World*. This book first coined the term "Lean Production". Later in 1996, Womack's landmark book *Lean Thinking* described the philosophies and tools in Lean Production. (Teich & Faddoul, 2013) His efforts helped spread Lean philosophy across the United States and the western world.

1.3 THE FIVE PRINCIPLES OF LEAN

According to the book *Lean Thinking*, there are five core principles of Lean – value, value stream, flow, pull, and perfection. These principles help businesses jump start their "Lean Thinking" by specifying value, lining up value-creating actions in the best sequence, conducting production activities without interruption, and performing them more and more effectively. (Womack & Jones, 2003, p. 20)

1. **Value** – Producers must have open and constant communication with their customers to determine what they want, when they want it, and how they want it.
2. **Value Stream** – Identify all the steps in the inception, production, and delivery process
3. **Flow** – Allow the product to "flow" through the value stream steps without barriers. For example, supermarkets should create an easy and convenient shopping experience for their customers. They should put like-products in the same aisle, hang signs to direct customers, and create quicker checkout lanes.
4. **Pull** – Businesses should allow customers to *pull* the product from them as needed, rather than *push* the products to them. Businesses won't be successful if they push too many products or the wrong products to their customers.
5. **Perfection -** After accomplishing the first four principles, repeat the process again, seek ways to improve the process, until a state of perfection is reached in which perfect value is created with no waste. (Lean Enterprise Institute, 2018)

2.0 LEAN TOOLS USED IN HEALTHCARE

With Lean principles comes with Lean tools – practical methods for improving production speed, efficiency, quality, and safety. There are more than 25 tools used in Lean management, but each tool is appropriate for specific processes, situations, and patients. This section will highlight seven Lean tools that are commonly used in the healthcare industry. For visual examples of each Lean tool, visit Appendix A.

2.1 PDCA CYCLE

The PDCA Cycle is a four-stage model that focuses on improving the quality and effectiveness of any process or event. (Colin McArdle, 2018) First envisioned by physicist and engineer Walter Shewhart, then later promoted by his colleague W. Edwards Deming, the PDCA model is probably the most popular Lean tool due to its simplicity and practicality.

1. **Plan** – establish the plan and process necessary to deliver the desired results
2. **Do** – implement the plan
3. **Check** – monitor and evaluate the results against the initial objective
4. **Act** – review all steps above and modify the process as required, then repeat it again

(Colin McArdle, 2018)

2.2 A3 REPORT

The **A3 report** is a one-page document named after the A3 sized paper, which records the results of an improved process following the logic of PDCA. A3 is essentially a "storyboard" version of PDCA for identifying and resolving the root causes of a problem. There are seven sections to the report: background, current condition, goal statement, root-cause analysis, countermeasures, implementation plan, and follow-up plan. (Sobek II & Smalley, 2008, p. 94) An A3 is most effective when team members outline it together, post it at a visible location, and regularly update the progress of improvement on the report. See Appendix A.1 for a template.

2.3 STANDARD WORK AND KAIZEN

Standard work is the documentation and implementation of best practices. Usually, in the form of a checklist or chart, standard work establishes standard protocols for processes and promotes unity and safety in the workplace. Standard work helps created a culture of process improvement because, as a standard, employees must look for ways to improve and streamline every process. The PDCA Cycle and A3 report are Lean tools used to create standard work in the workplace and processes. ***Kaizen*** is a Japanese philosophy that means "continuous improvement". It is a strategy in which all employees, from the CEO to frontline staff, work together to achieve regular improvements, and it combines the collective talents of a company to create an engine for continually eliminating waste. (Vorne Industries, Inc., 2018) Kaizen works hand-in-hand with Standard Work. Kaizen is the force that drives employees together, and Standard Work is the "drawing board" that allows employees to develop best practices for a process.

2.4 ROOT CAUSE ANALYSIS

Root Cause Analysis (RCA) is a technique that helps people investigate why the problem occurred in the first place. It seeks to identify what happened, why it happened, and a solution that will prevent it from happening again. The **5 Whys** technique is a type of root cause analysis developed in the 1930s. To start this process, identify the problem, ask the first "why" as to why the problem is occurring, then ask at least four more "whys" in succession, with each successive "why" digging deeper into the problem and building on the previous answer. Do this until you cannot produce any more useful responses to the problem. The last "why" is the root cause of the original problem, and appropriate countermeasures should be developed to prevent it. See Appendix A.2 for a sample 5 Whys scenario.

A **Cause and Effect Diagram**, also known as fishbone diagram or Ishikawa diagram, is another type of root cause analysis. It is a visual way of looking at the root causes of a problem, and it sorts ideas into useful categories. To start the process, identify the problem and write it at the "head" of the fishbone. Then draw a long horizontal line and several vertical lines (the bones) coming out of the horizontal line. These branches are labeled with different categories that would help identify the root causes of the problem. There are two popular choices as categories: the 6 Ms (machines, methods, materials, measurements, mother nature, and manpower), and the 4 Ps (policies, procedures, people, and plant/place). Once you have chosen the categories, brainstorm possible causes under each category. See Appendix A.3 for a sample cause and effect diagram.

2.5 FLOW CHART

Process mapping is a visual tool that lays out all the steps in a process and points out areas that add value or don't add value. It helps identify specific areas required for improvement within a process and helps eliminate *muda*. Process mapping is inspired by the second Lean principle *value stream*, which is the set of all specific actions required to bring a specific product (a good or service) from the beginning to the end. A **flowchart** is a straightforward process map that highlights individual steps in a process. A flowchart is a quick and easy way to map out all the steps to a process, and it is often created to define standard work for the workplace. Standard symbols are used to notate each part of the process. For example, the start and end points are notated by a "rectangle with rounded ends", a step in the process is notated by a "regular rectangle", and a decision step is notated by a "diamond". See A.4 for a sample flowchart.

2.6 PICK CHART

A PICK chart is a chart used to prioritize projects or solutions by considering their level of difficulty and their level of payoff. It is a great visual tool for organizing ideas and making consensus decisions on which are the best solutions to solve a problem. (Public Health Foundation, 2018) It consists of a two-by-two matrix with four categories: possible, implement, challenge, and kill. The horizontal axis shows the level of payoff from low to high, and the vertical axis shows the ease of implementation from easy to difficult. Ideas that fall in the quadrant "implement" are easy to do and provide the highest payoff. Ideas that fall into the quadrant "kill" may not be the best to pursue. See Appendix A.5 for a PICK chart template.

3.0 EARLY ADOPTION OF LEAN IN HEALTH CARE

How did Lean, a philosophy originated from the auto industry, find its way to healthcare? Joseph Juran, an engineer and philosopher, encouraged healthcare organizations to learn from other industries. In the 1990 book *Curing Health Care*, Juran wrote, "It is well advised to take into account the experience of other industries in order to understand what has worked and what has not. The decisive factors lie in the managerial processes, which are alike for all industries." (Berwick, Godfrey, & Roessner, 1990, forward) 10 years later, two hospitals followed Juran's advice and sought counsel from the auto industry to improve their healthcare delivery system.

3.1 VIRGINIA MASON

Virginia Mason Health System in Seattle, WA was the first healthcare system in America to integrate Lean throughout its entire system. To improve profit margins and change organizational culture, Virginia Mason developed a new strategic plan in 2000 using a pyramid. It puts the customer (the patient) at the top, supporting equally by four pillars: staff members, quality, service, and innovation. Executives at Virginia Mason realized Lean complements their strategic plan, so all senior leaders flew to Japan for two weeks to see Lean in action at Toyota Motor Company. After their return, they established the Virginia Mason Production System (VMPS) in 2002 based on the principles of the Toyota Production System.

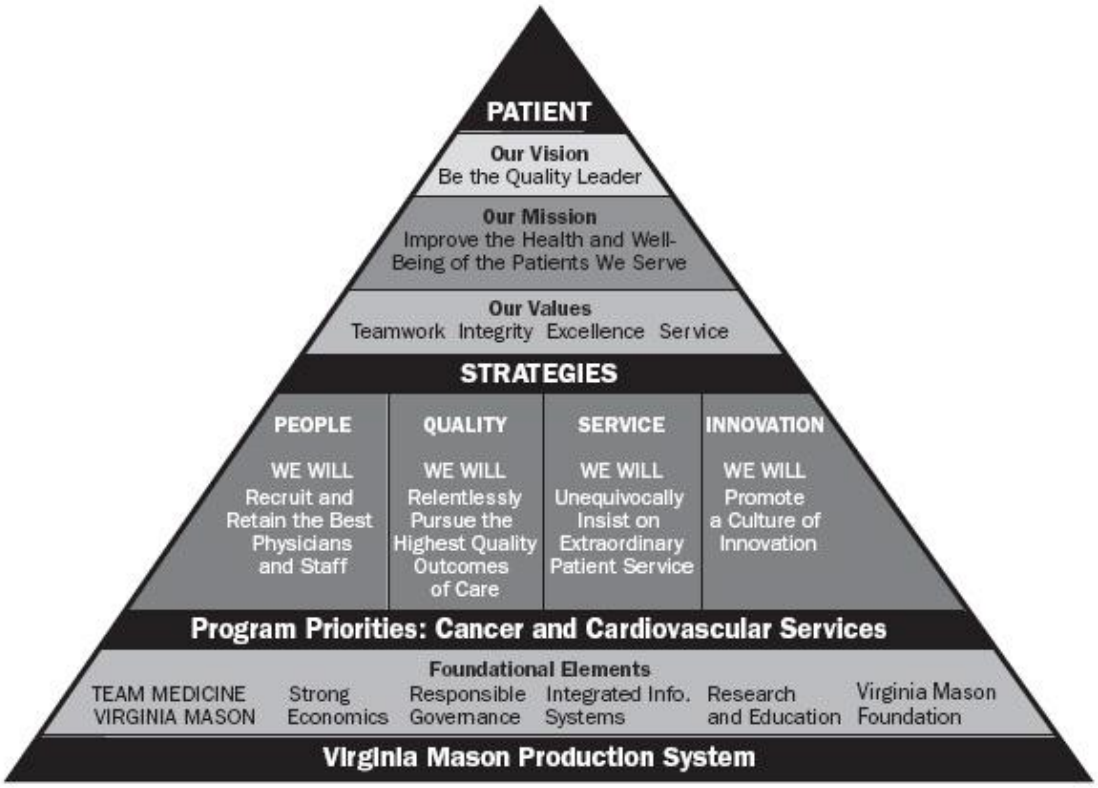


Figure 1: The Virginia Mason Production System

Implementing VMPS took many years and effort. All Virginia Mason employees are required to attend an "Introduction to Lean" course and participate in Rapid Process Improvement Weeks (RPIW), which are week-long sessions about analyzing processes and proposing, testing, and implementing improvements. (Institute for Healthcare Improvement, 2005) During the first two years of VMPS implementation, Virginia Mason conducted 175 RPIWs and has since held 850 continuous improvement activities. (Virginia Mason Medical Center, 2018) To further engage employees, Virginia Mason created the "No-Layoff Policy", which assured that employees won't lose their job as a result of process improvement and encourage employees to suggest ideas for improvement.

Lean has made a positive impact at Virginia Mason in several ways. Patient safety and quality of care have increased as a result of Lean management. Virginia Mason created the Patient Safety Alert System (PSA) in 2002 based on the philosophy *jidoka* from the Toyota Production System. PSA allows any person to activate an alarm that stops a care process if they feel patient's safety is at risk, and that alarm will alert the patient safety department and an administrator to investigate the situation immediately. From 2002 to 2009, 14,604 PSAs were reported, predominately identifying system issues, medication errors, and problems with equipment and/or facilities. (Institute for Healthcare Improvement, 2005) Lean management also helped lower disease incidence and decrease associated costs. In one particular instance, Virginia Mason faced a high incidence of ventilator-associated pneumonia (VAP). In 2002, there were 32 cases of VAP at an estimated cost of $500,000. But after implementing Lean practices, Virginia Mason only had four cases of VAP at an estimated cost of $60,000. (Institute for Healthcare Improvement, 2005)

Primary Care at Virginia Mason became a money-generating section of health care thanks to Lean practices. Primary care offices implemented the Kanban System to regulate the flow of medical supplies, and needed supplies were placed in all patient rooms to reduce "search times". Non-direct patient care, such as reviewing lab results and calling the pharmacy, were done between patient visits instead of during the patient appointment. This allowed providers to see more patients in shorter work days, and they could finish paperwork by 6 p.m. Today, these clinics consistently achieve positive net margins and see more patients without sacrificing time spent with each patient. (Virginia Mason Medical Center, 2018)

3.2 THEDACARE

Another healthcare system that has successfully implemented Lean management is ThedaCare, a community health system in Wisconsin consisting of seven hospitals, 35 clinics, and 6,800 employees. In 2002, John Toussaint, then CEO of ThedaCare, paid a visit to Ariens Outdoor Power Equipment Company, a nearby business that has used Lean principles for several years. He became inspired to apply Lean practices in health care, thus he and other ThedaCare leaders established the ThedaCare Improvement System in 2004. (ThedaCare, 2018) Ambitious goals and metrics were set to measure the success of Lean management: improve quality to 95th percentile or greater, become the healthcare employer of choice, make the *Fortune 100* list of best employers, lower service costs, and gain $10 million a year through cost savings and increased productivity. (Institute for Healthcare Improvement, 2005)

In order to immerse Lean into the culture of ThedaCare, Rapid Improvement Event Weeks (Event Weeks) were created. They are four-day intensive process improvement workshops that teach hospital employees how to apply Lean to their workflow, and on the fifth day, teams present their achievements and results at an employee gathering called “Report Out”. (Toussaint & Berry, 2013) All staff members are required to attend Event Weeks. ThedaCare uses the “True North” triangle framework to communicate and reinforce process improvement priorities to all hospital employees. The patient is in the middle the triangle, and the strategic goal categories are at the tips of the triangle. This framework reinforces the importance of process improvement and patient satisfaction, and it is posted in every department and unit through ThedaCare Health System. (Toussaint & Berry, 2013)

Figure 2: ThedaCare's True North Framework

One year after implementing the ThedaCare Improvement System, the health system already witnessed dramatic results. In terms of finances, Days in Account Receivable reduced from 64 to 44 days, which equaled to about $12 million in cash flow, and the health system as a whole saved $3.3 million in 2004. At the hospital, phone hold time was reduced from 89 seconds to 58 seconds, the time it takes to complete admission documentation was reduced 50 percent, and medication distribution time decreased from 15 minutes to eight minutes. (Institute for Healthcare Improvement, 2005) A notable achievement at ThedaCare was using Lean to speed up heart attack response rate. ThedaCare launched Code STEMI, an event that is called when a patient suffers a heart attack. With Code STEMI, ThedaCare created Standard Work for treating a heart attack patient. If the patient is at a rural hospital, ThedaStar Air Medical or an ambulance company is called to transport the patient to Appleton Medical Center, ThedaCare's main hospital. Thanks to Code STEMI, the time it took for rural heart-attack patients to get life-saving treatment decreased from 212 minutes to 91 minutes. (ThedaCare, 2018)

4.0 WASHINGTON HEALTH SYSTEM

Washington Health System (WHS) is a small community hospital system that provides health care services in Washington, Greene, and Allegheny counties in southwestern Pennsylvania. Established in 1897, WHS started as a small hospital in Washington, PA. Now, WHS comprises Washington Hospital (main campus), Washington Hospital at Greene, 20 physician offices, School of Nursing, Family Medicine Residency Program, Children's Therapy Center, the Wilfred R. Cameron Wellness Center, Greenbriar Treatment Center, and several diagnostic centers. WHS also has joint ventures or affiliations with other organizations in Hospice, Children's Express Care, and Cancer Care. WHS has almost 2000 employees, and about 400 volunteers serve at the Washington and Greene hospitals.

4.1 LEAN JOURNEY

In 2011, senior executives realized WHS did not have a standardized method for process improvement. Hospital staff did not have resources or guidelines on how to improve quality of care, decrease process time, increase patient satisfaction, and reduce expenditures. Senior executives decided to invite Lean consultants to the hospital and host a Leadership Development Institute (LDI) seminar for all managers in the hospital system. The event was well received by managers, and senior executives became interested in adopting Lean across the hospital system.

After the LDI, the Lean consultants trained 100 managers on the Toyota Production System (TPS), then they introduced Lean to all hospital employees at the Employee Development Institute (EDI). In 2013, WHS hired a manager of performance improvement, who oversaw the promotion and execution of Lean practices throughout the hospital. Later, senior executives traveled to Virginia Mason in December 2014 and ThedaCare in January 2015 to observe and learn about their Lean journeys. To fully invest in Lean, senior executives created the Performance Improvement (PI) team, who would be the champion of Lean Thinking and help immerse Lean into the hospital culture. A director of performance improvement and four coaches/facilitators were hired to join the existing manager of performance improvement.

Similar to Virginia Mason and ThedaCare, WHS created a Lean philosophy that is inspired by the Toyota Production System – the Washington Performance System (WPS). Displayed in Figure Three, this philosophy helps all WHS employees to see how Lean ultimately focuses on the satisfaction of patients and families. We start with the simple yet powerful mission of WHS: Great Patient Care. From that, we create the vision of WHS: to be a leader in healthcare quality, safety, and value. There are seven core values at WHS: patient and family focus, continuous improvement, compassion, communication, respect, integrity, and community commitment. These values guide hospital staff to make changes to patient care, improve system processes, promote teamwork, and reduce healthcare expenditure. At the tip of the arrow lies the purpose of WPS – meeting the needs of patients and families.

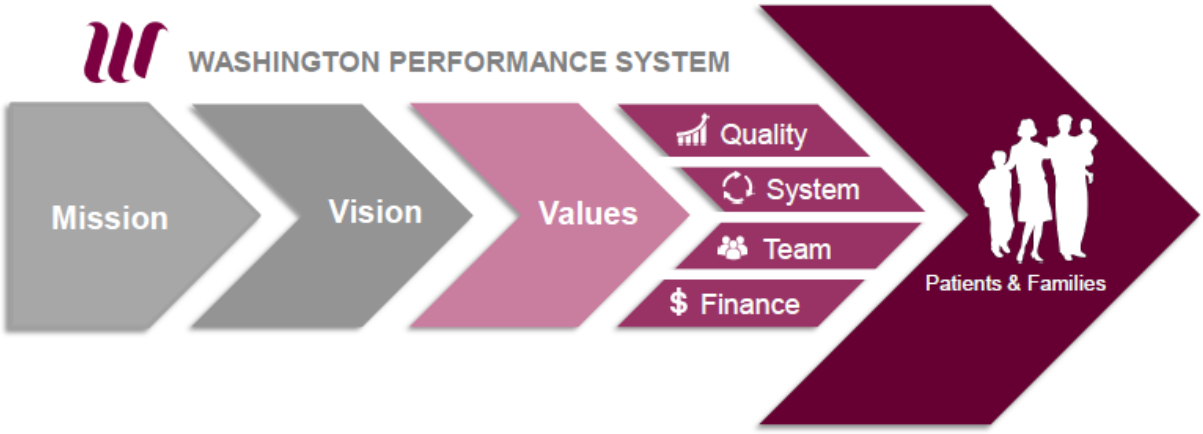


Figure 3: Graphic Representation of Washington Performance System

After introducing Lean thinking to hospital employees, the performance improvement team has trialed different Lean training sessions. The first education program on Lean was the Master Coaches program, which was established in 2013 and met 2.5 hours a week for 10 weeks. The following year, the format of the Master Coach program changed to eight hours a day, once a week, for three weeks. The program received a lot of criticism. Participants complained they had little time to work on process improvement, and their managers were not engaged in ensuring their success. Also, managers complained the absence of staff members led to short staffing and disruption of patient care.

The PI team eliminated Master Coaches and created Rapid Improvement (RI) workshops in 2014. Two RI workshops were held, one for housekeepers to address bed cleaning, and one for nursing and support staff to address hand hygiene. These workshops were held for four days, with a senior leader attending the workshop on day five to see the results. Although the workshops were short and participants were highly engaged, the culture at Washington Hospital

did not permit frontline staff to make process improvements without manager involvement. This discouraged participants from using Lean tools in their job flow.

The "Earning Our Stripes" Program (Stripes) was created in 2016 to address the shortcomings of Master Coaches and Rapid Improvement Workshops. Inspired by the Washington Performance System, Stripes stressed the importance of meeting the needs of the patients and families, assigned a mentor to every participant, and helped participants make long-lasting process improvements in their department. The first two groups of participants attended class four hours each month for 12 months. Participants and their managers were required to sign a pledge to be engaged in this process, which reinforced management involvement. For the third group of participants joining in May 2017, the PI team shortened the length of Stripes – one month of intense coursework and three to four months of project execution. This new format allowed participants to finish their classes in one month, then spend the next few months improving workflow processes in their department. For the fourth group of participants joining in September 2017, participants started working on their projects on day one. At this stage of Stripes, participants were able to make radical progress on their Lean project, their managers supported their efforts, and their department benefited from the process improvements.

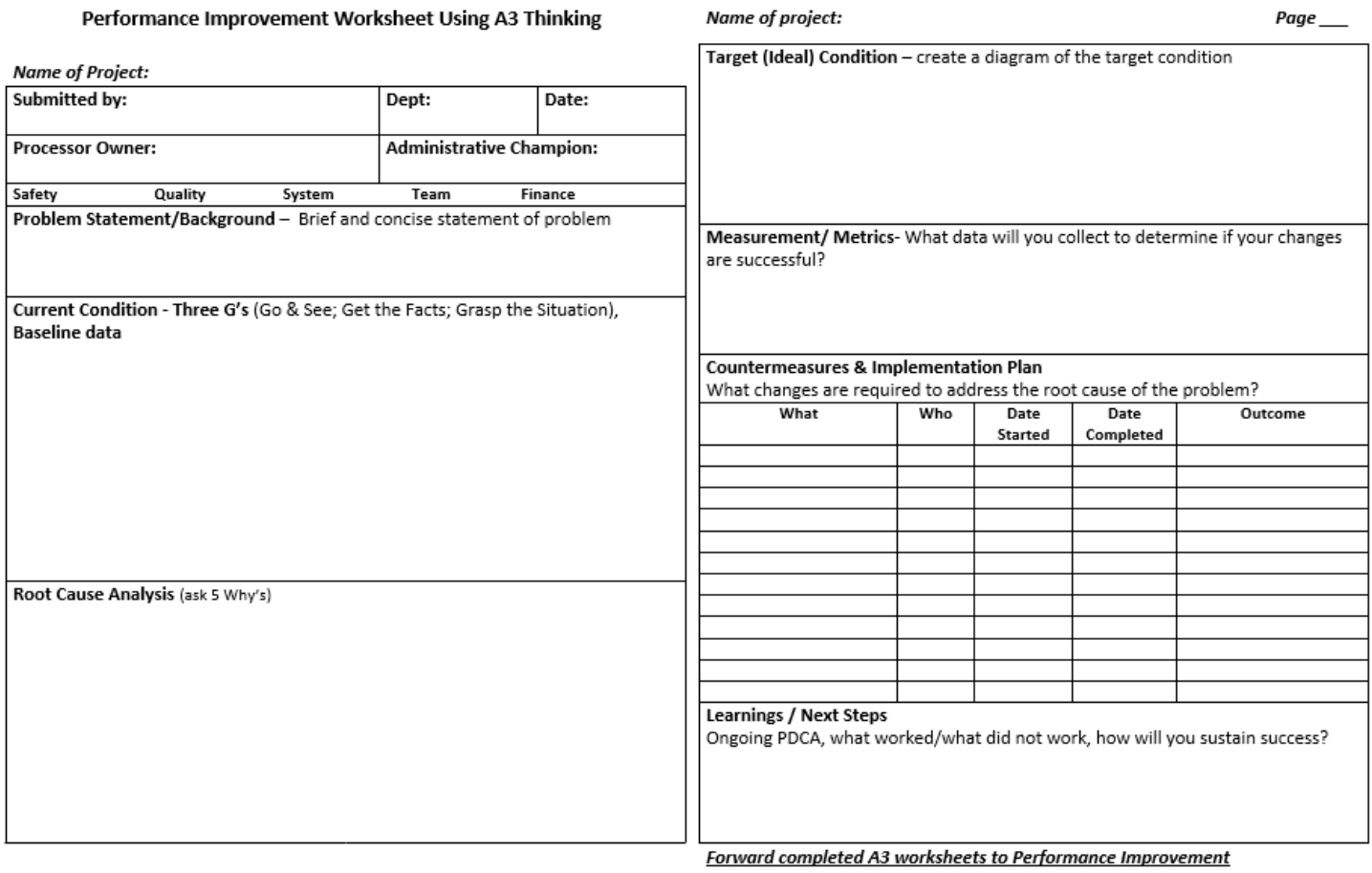
5.0 LEAN PRACTICES AT WHS

5.1 STANDARD WORK

The Washington Performance System uses standard work to encourage problem solving, teamwork, and daily continuous improvement. Staff huddle is the most visible and interactive type of standard work. Huddles occur in every patient unit and every department of the hospital, either on a daily or weekly basis. When it's time for a huddle, everybody involved gather at the huddle board for 10 to 15 minutes to discuss eight items: safety issues, new concerns, new improvement projects, current improvement projects, current A3 reports, any celebrations (such as birthdays and graduations), quality and performance metrics, and news from administration. A huddle board displays all relevant information for huddles, such as A3 reports, Just Do It forms, quality and performance goals, PICK charts, thank-you cards, and celebration notes. Staff huddles helped create a culture of open communication, teamwork, and innovation across Washington Health System.

The Performance Improvement team established standard documents for process improvement across the health system. The team created a standard template for the A3 problem-solving report, Just-Do-It form, waste walk form, and action plan report. The A3 is a comprehensive one-page document that highlights the entire process improvement process from start to finish following the logic of the PDCA format. The Just-Do-It form encourages

individuals to take initiative on small improvement tasks and make positive changes to their daily job flow. The waste walk form helps teams identify *muda* in their workplace or in a process. Teams use this form to describe the type of wastes identified and list ways to eliminate them. The action plan report is part of the countermeasure plan of the A3 report. It reports a list of tasks that are instrumental in improving the process in question.



Performance Improvement Worksheet Using A3 Thinking

Name of Project:

Submitted by:	**Dept:**	**Date:**
Processor Owner:	**Administrative Champion:**	

Safety **Quality** **System** **Team** **Finance**

Problem Statement/Background – Brief and concise statement of problem

Current Condition - Three G's (Go & See; Get the Facts; Grasp the Situation), **Baseline data**

Root Cause Analysis (ask 5 Why's)

Name of project: *Page ___*

Target (Ideal) Condition – create a diagram of the target condition

Measurement/ Metrics- What data will you collect to determine if your changes are successful?

Countermeasures & Implementation Plan
What changes are required to address the root cause of the problem?

What	Who	Date Started	Date Completed	Outcome

Learnings / Next Steps
Ongoing PDCA, what worked/what did not work, how will you sustain success?

Forward completed A3 worksheets to Performance Improvement

Figure 4: A3 Template

Just Do It Improvement

Submitted by			Dept	Date
Safety	Finance	System	Quality	Team
What is the problem, why is it happening and how often?				
What is your proposed solution?				
What is the final outcome of the improvement? (include measurements)				
Date Completed:				

Figure 5: Just-Do-It Form

Waste Walk		
Area/Process Observed: Date: Time:		
Type of Waste	Description of Waste	Improvement Idea
Transportation		
Inventory		
Motion		
Waiting		
Overproduction		
Over Processing		
Defects		
Skills		

Figure 6: Waste Walk Form

PROJECT NAME

Action Plan

Action Item	Owner	Due Date	Status

Figure 7: Action Plan Report

Standard work is important for three reasons. First, it focuses on the employee. Frontline staff is encouraged to offer improvement ideas and take initiative in improving their job flow. This makes their job more meaningful, and they feel valued by the organization. Second, patients' needs are met as a result of standard work. When processes are standardized, patient safety is ensured and quality of care increases. Finally, standard work creates the foundation of *kaizen*, in which all employees in an organization work together to achieve regular improvements. Regular staff huddles are effective in reinforcing *kaizen* across the organization.

5.2 PREVENTING PATIENT FALLS

In March and April of 2017, two patients fell off their stretcher in the radiology department's CT holding area at Washington Hospital. Both patients were transported from the emergency department to the radiology department to get a CT scan, and for unknown reasons, they fell out of their stretcher in the waiting area. This created a patient safety concern, so a process improvement team was created to investigate the root causes and develop prevention strategies. Staff members from the radiology department, emergency department, and transport services collaborated on this project to improve the patient transport process between the emergency department and CT holding area. Afterward, the next step was to implement the new process to all areas of radiology and eventually throughout Washington Hospital.

The first task of the process improvement team was to create an A3, which guided the team throughout the process improvement process following the logic of PDCA. For root cause analysis, the team used 5 Whys to discover the root cause patients falling out of the stretcher. Eight root causes were identified, and 15 possible countermeasures were developed to tackle the root causes. Because there were so many countermeasures, they were ranked on a PICK Chart to determine the most plausible ones. According to Table 1, seven countermeasures landed in the upper-left quadrant. They were deemed the most effective and easiest to implement for this project, and an action plan was created to implement the countermeasures. The author of this essay joined the process improvement team in July of 2017 and assisted in identifying the countermeasures, creating the PICK Chart, and making an action plan for this project.

Table 1: Eight Root Causes of Patient Falls in CT Holding Area

	Root Causes of Patient Falls	Countermeasures (Referenced in Table 2)
1	The patient was left unattended and without a call bell device	1,4,5, 14
2	The stretcher was in the raised position	2
3	Patient wanted to leave stretcher – one possible reason was to use the bathroom	1,2,4,12
4	There were no foot boards or restraints on the stretcher	1,2
5	Communication of Fall Risk was poor or nonexistent during handoff between Emergency Department and Radiology	5,7,8,9, 15
6	CT Techs have difficulty observing CT holding area – there are only two monitors	3, 14
7	The length of time in CT holding area can increase the risk of falling	6,10,11
8	There is no interface between Sunrise (hospital's electronic medical record) and Fuji (diagnostic imaging system) to communicate Fall Risk	5,7, 15

Table 2: 15 Possible Countermeasures to Patient Falls

15 Possible CT Falls Countermeasures	
1	Ensure that patient has a companion (family or staff) to watch them
2	Have the transporter lower the stretcher and provide patient with the pull-pin alarm and knee gatch (lower half of the stretcher that raises the knees)
3	Add additional monitors to observe patients in the holding area
4	Equip stretchers with alarms to detect patient movement
5	Define effective "handoff" procedures to ensure that fall-risk patients are identified to receiving staff
6	Develop procedures to improve patient flow between CT and ED
7	Develop clear messaging in current systems to provide fall risk warnings
8	Define clear and comprehensive procedures for transport/escort to follow for picking up and dropping off patients
9	Have dedicated escorts for CT and Ultrasound patients
10	Purchase a CT machine for the Emergency Room
11	Develop a single point-of-contact for controlling patient flow in CT
12	Close bathroom door to discourage patients from thinking of toileting
13	Remove sign from the bathroom door to discourage patients from thinking of toileting
14	Place a Medical Assistant in the CT area during peak usage periods to monitor patients
15	Use the "notes" section of the electronic transport request form to identify patients with fall risk

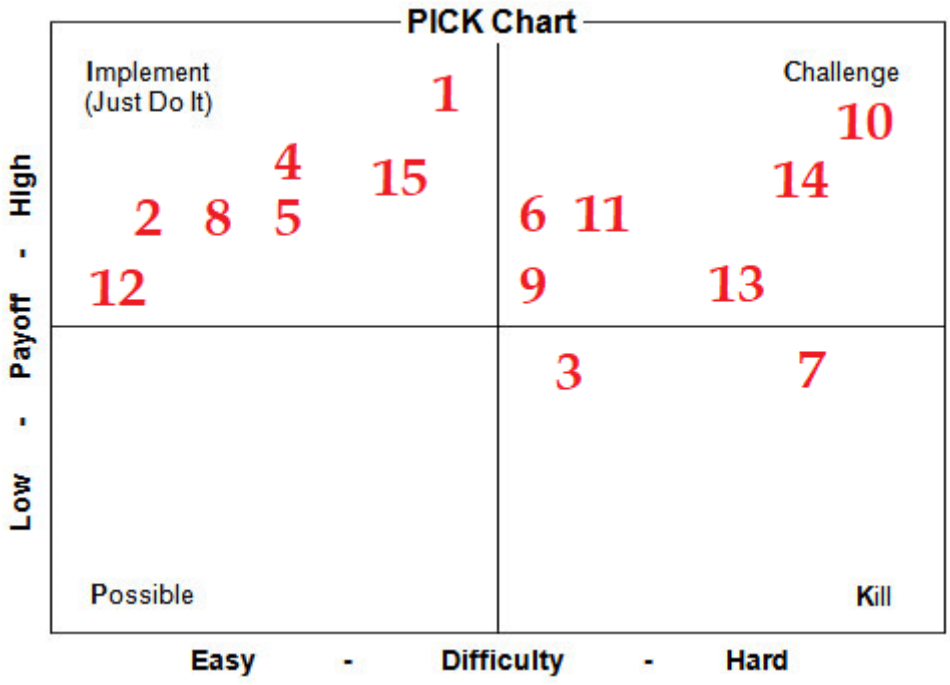


Figure 8: PICK Chart Ranking the 15 Possible Countermeasures

Standard work was established to identify fall-risk patients. In the emergency department, nurses must assess every patient before they are transported to CT scan to determine if their risk of falling is high. Patients are considered high for fall risk if they are confused, agitated, has altered mental status, or if the nurse believes the patient cannot safely be left alone. If a patient has a high risk of falling, the nurse must put a yellow band on the patient's wrist and inform CT staff about the falls risk. A family member must accompany the patient to CT holding area. Once there, the family member will be given a call bell device, and they are instructed to activate it if they need help. If no family member is available or if family choose not to accompany the patient, the patient will be transported to CT scan only when the exam can be performed immediately. The nurse, transporter, or CT staff will monitor the patient in the exam room.

Standard work was also established for transporters who move patients between the ED and CT scan. Before moving the patient, transporters must ask the patient's nurse if the patient

has a high risk of falling. If so, the transporter notes “high risk” in the electronic transport request form. Once the patient is moved to the CT holding area, the transporter must lower the stretcher, put a knee gatch under the patient’s knee, and give the patient a call bell. If the patient is at risk of falling, and there isn’t a family member accompanying the patient, the transporter must stay with the patient until a CT tech comes to get the patient.

After establishing Standard Work, the process improvement team ordered pull-pin alarms to fulfill countermeasure #2. This type of alarm is commonly used to signal staff that a patient has wandered off. The alarm has an activation cord attached to it, and a clip at the end of the cord. Once a patient is moved into the CT holding area, the transporter or CT staff would clip the alarm unit to the railing of the stretcher, then clip the cord onto the patient’s clothing. If the patient gets up and moves away from the alarm, the activation cord is pulled out of the alarm, which causes the alarm to make a loud siren. Pull-pin alarms are very affordable and easy to use by any staff member.

Following the PDCA cycle, the countermeasures were implemented, and patient flow between ED and CT scan is regularly monitored. The new patient flow process has yielded positive results. First and foremost, no more patients have fallen in the CT holding area since the implementation of countermeasures. Second, it standardized the patient transport process between ED and CT scan. Third, it fostered more collaboration and communication between the emergency department, radiology department, and transport services. In August of 2017, the author spent an hour observing patients in the CT holding area. With the new process, the author noticed patients were safe and secured on their stretcher, CT staff quickly attended to their needs, and transporters stayed a few extra minutes to exchange important patient information with CT staff. This is a testimony that the new process is effectively preventing further patient falls.

5.3 PROVIDING CARE TO PATIENTS WITH SPECIAL NEEDS

In 2016, a patient with disability was admitted to Washington Hospital for three days. The patient, whom we will name "Alex", was very unsatisfied with his/her hospital stay. In Alex's letter to Gary Weinstein, the President and CEO of WHS, Alex described, "The entire time I was in the hospital, I felt like a highly frustrated turtle on its back. I felt helpless and unnecessarily stressed out, which is certainly no mindset for healing." When Alex was admitted, he/she was placed in a room far away from the nurse's station, and he/she couldn't press the call button due to his/her disability. Eventually, Alex was moved directly in front of the nurse's station, but due to not being able to hit the call button, Alex had to shout for a nurse, which made him/her uncomfortable and vulnerable. Later, nursing staff promised Alex they would get an EZ Call pillow speaker so Alex could easily touch the button with his/her face to call for a nurse. However, they didn't bring the pillow speaker until a few hours before discharge, and they didn't have the proper adaptor or plug for the button, so it was useless anyway. (See Appendix B for Alex's letter to Gary Weinstein)

Gary Weinstein read the letter and immediately contacted the director of patient experience, who quickly established a process improvement team to tackle this problem. The team consisted of 13 staff members from inpatient services, emergency department, case management, physical therapy and occupational therapy department. A Lean facilitator served as a mentor, and Alex was asked to join team meetings to offer additional insight. The author of this essay was not involved in this project. All information and charts from this project were provided by the director of patient experience and studied retrospectively by the author.

To kickstart the project, the process improvement team did a "Go & See" – tracking patient flow from admission to discharge to mimic the experience of a special-needs patient. This

method allowed the team to track down all the steps Alex went through and have a better understanding of Alex's frustration. The data collected during the Go & See were placed in the "Current Condition" section of the A3 report, and a flowchart was created to map out the patient flow from admission to discharge.

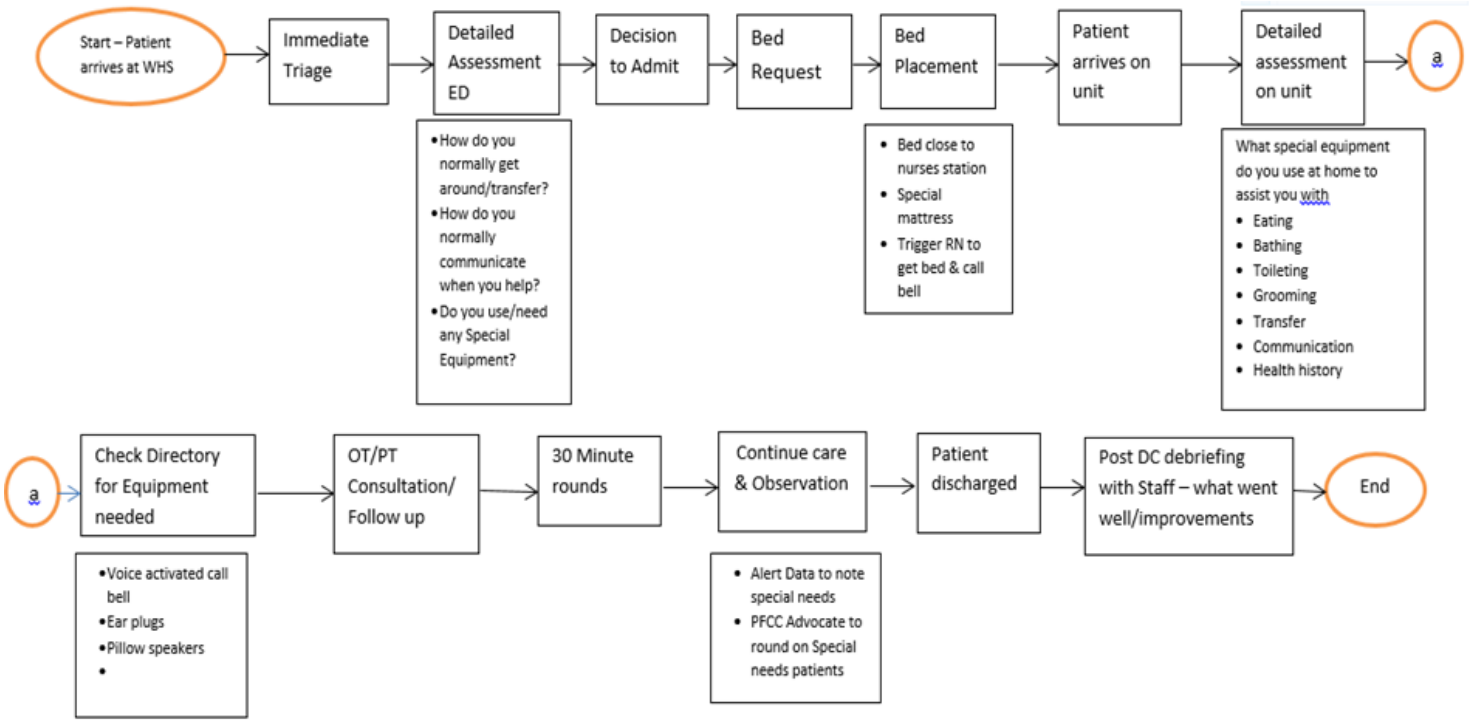


Figure 9: FlowChart Showing the Journey of a Disabled Patient at Washington Hospital

The team's next task was to investigate the root causes of Alex's dissatisfying hospital experience. The team agreed on five concerns to Alex's hospitalization: lack of assessment, lack of equipment, equipment was lost, staff couldn't use equipment, and staff didn't know what was available. For each concern, the 5 Whys exercise was used to determine its root cause. To have the best understanding of these root causes, a Cause and Effect Diagram was created with the following categories – Methods, Materials, Machine, Measurements, and People (Manpower).

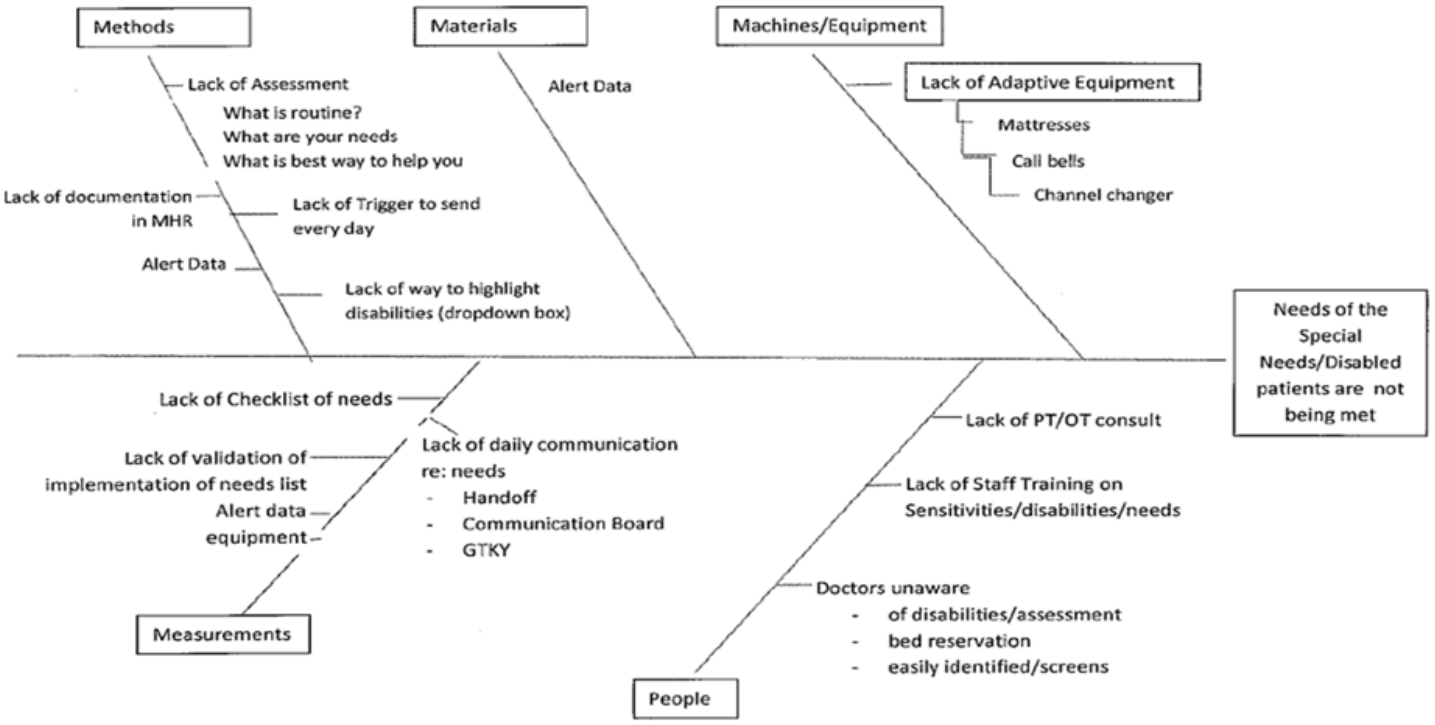


Figure 10: Cause and Effect Diagram for "The Needs of Disabled Patients Are Not Met"

An action plan was created to highlight countermeasures to these root causes. The most immediate countermeasure was creating a special needs assessment in the emergency department. The process improvement team collaborated with the hospital's information systems team to create a survey on Sunrise, the hospital's electric medical record, which would help determine patient's level of mobility and level of assistance. The three questions are – the type of mobility-assistant device being used, the presence of a medical condition that impacts mobility, and the type of medical condition that impacts mobility. Filling out these questions would notify medical staff across the hospital that a certain patient is mobility impaired and needs special care during his/her hospital stay.

A standardized care plan for patients with special needs was established. In the emergency department, nurses are instructed to identify special-needs patients using the special needs assessment. If a special-needs patient is admitted, the patient placement team was instructed to place the patient in the room closest to the nurse's station. One of Alex's main concerns was not having what he/she needed during hospitalization. He/she needed the EZ Call pillow speaker to communicate with nursing staff, and he/she needed an air mattress to support his/her back. New inventory standards were created to address these concerns: every patient unit must carry pillow speakers, and air mattresses are kept in the seventh-floor storeroom for easy checkout and return. Nurses were also educated on the use of EZ Call pillow speakers. Another concern that Alex had was poor communication between him/her and the nursing staff. To address this concern, nursing staff are instructed to offer pillow speakers to all disabled patients, and they are instructed to visit disabled patients every 30 minutes. After discharge, a member of the patient experience team should call the patient within 24 hours to receive feedback on his/her hospital experience.

Two positive changes have since occurred. First, there is increased awareness of special-needs patients across Washington Hospital. Prior to the existence of standard work, nursing staff was unprepared when they received a special-needs patient and they didn't understand their needs during hospitalization. Now that standard work is established, nursing staff has a checklist and action plan for special-needs patients and they are more engaged with their patient care. Hospital staff can go to the special needs resource directory on the employee portal to download standard documents. See Appendix C for the special needs resource directory.

The second positive change is the gathering and placement of resources for special-needs patients. Previously, most nurses didn't know the type of special-needs equipment available in

the hospital, and even if nurses know they exist, they wouldn't know where to find them. The process improvement team worked with the physical therapy and occupational therapy departments to establish an accurate list of available equipment for special-needs patients, have equipment placed in a convenient or centralized location, and posted a list of equipment and their location on the online employee portal. In Alex's case, EZ pillow speakers are conveniently stored in the medication room of all units, and air mattresses are placed on the seventh floor. In the event a special-needs patient is admitted, nurses are now knowledgeable of available equipment in the hospital and where to find them.

A nursing supervisor on the process improvement team performed an internal audit on special-needs patients between August 1, 2017 and October 14, 2017. The audit assessed appropriate bed placement and necessary equipment received by special-needs patients, and it showed six out of eight patients during the audit period (or 75 percent of patients) received both needs. The sample size for the audit is very small; however, the next steps could be increasing the percentage of special-needs patients having appropriate bed placement and equipment to 95 percent. Other challenges also persist. Nursing staff inappropriately marked many patients with special needs, and many patients felt sensitive to being labeled "paraplegic" or "quadriplegic" on the assessment. Currently, the patient experience team is working on adjusting the assessment questions and gathering feedback on the most appropriate terminology for the assessment.

6.0 PUBLIC HEALTH RELEVANCE

In the context of health care, Lean aims to eliminate waste in complex processes in order to provide value to patients. At the hospital, patients receive testing and treatment with the hopes of being cured of disease or injury. Hence, the value that patients are seeking is "improved health". Lean is relevant to public health because it helps create a safer hospital environment for patients and gives them the best chance of recovery and survival.

Patient safety is a public health concern in the healthcare environment. If healthcare teams don't work together and hold everyone accountable, a small mistake can cause dangerous complications to the health of patients. As many as 440,000 people die every year from hospital errors, injuries, accidents, and infections. (The Leapfrog Group, 2017) Root Cause Analysis helps hospital staff investigate why a patient was harmed and establish countermeasures that will prevent the event from happening again. The countermeasures are made into standard work, and when hospital staff follows standard procedures, the chance of patient harm is decreased. If a mistake occurs, standard procedures can help reduce the damages caused by the mistake. At Washington Health System, root cause analysis and standard work helped prevent patient falls in the CT holding area, and offer assistive equipment to special-needs patients so they can alert nursing staff immediately of any concern.

7.0 CONCLUSION

Lean thinking has proven to be a useful and life-saving methodology, not only in the manufacturing industry but also in the healthcare industry. Lean organizations enjoy production efficiency, cost savings, employee safety, and customer satisfaction. Virginia Mason and ThedaCare were early Lean adopters in the healthcare industry, and they paved the Lean way for other hospitals. Washington Health System is a community hospital system that recently adopted Lean six year ago and has immersed process improvement into the hospital culture. With the implementation of standard work, patient care processes were standardized, and *kaizen* bonded employees together to achieve continuous improvements. When two patients fell in the Radiology Department, Lean tools helped identify the root causes, created countermeasures, and established new processes to prevent further patient harm. When a special-needs patient was not satisfied with his/her hospital stay, Lean tools helped identify the root causes and established a new care plan to meet the needs of future disabled patients. Other community hospitals across the country can learn from current practices at Washington Health System and consider using Lean to improve their healthcare delivery processes.

APPENDIX A: SAMPLE LEAN TOOLS

A.1 SAMPLE A3 REPORT

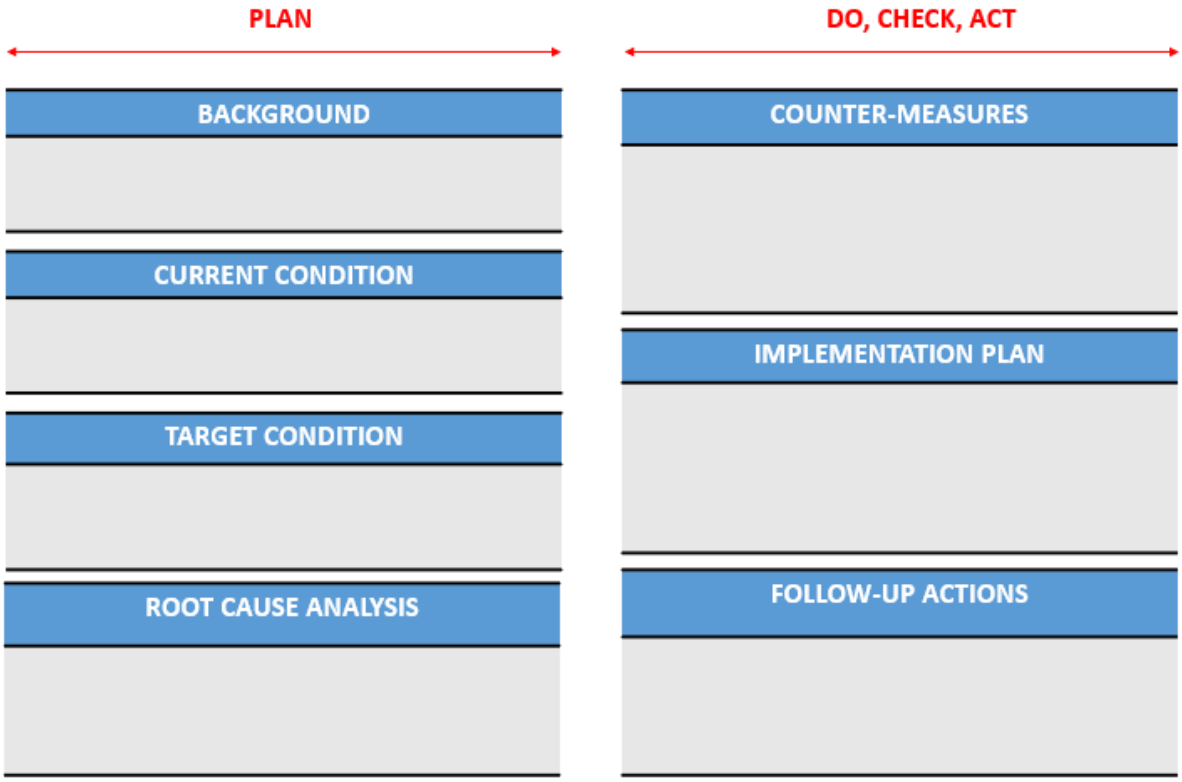


Figure 11: Sample A3 Template

A.2 SAMPLE 5 WHY SCENARIO

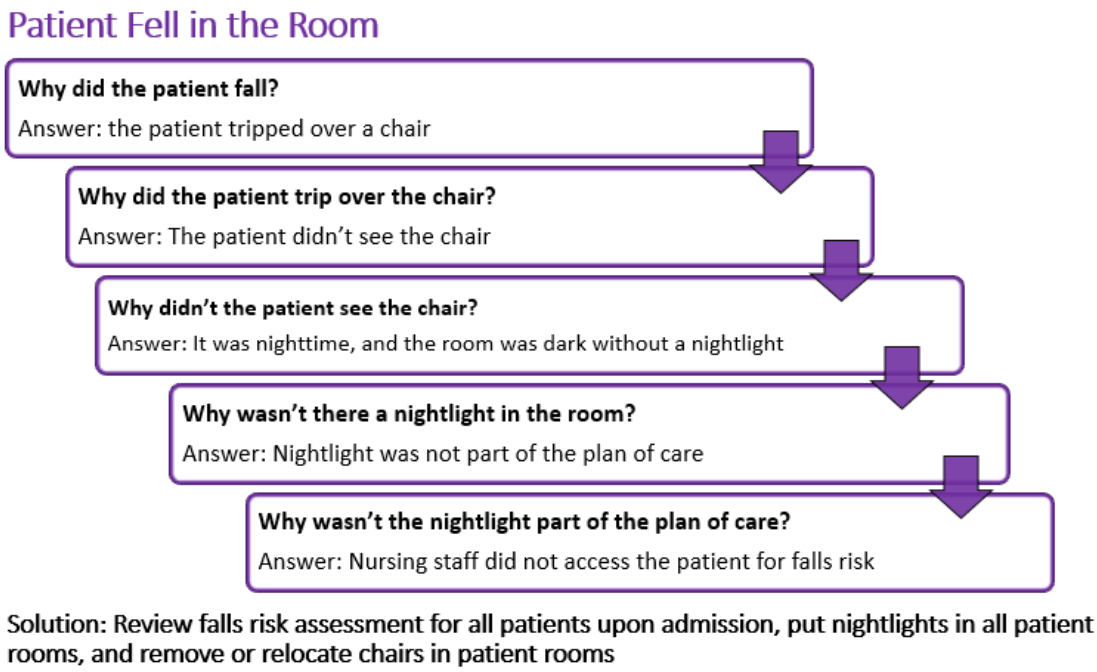


Figure 12: Sample 5 Whys Scenario

A.3 SAMPLE CAUSE AND EFFECT DIAGRAM

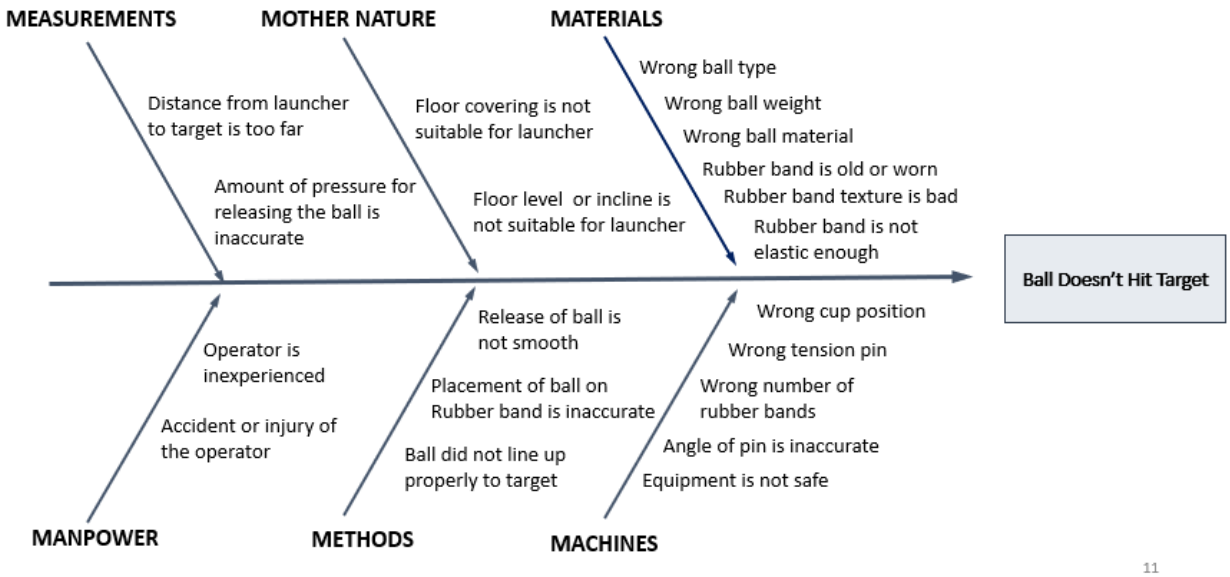


Figure 13: Sample Cause and Effect Diagram

A.4 SAMPLE FLOW CHART

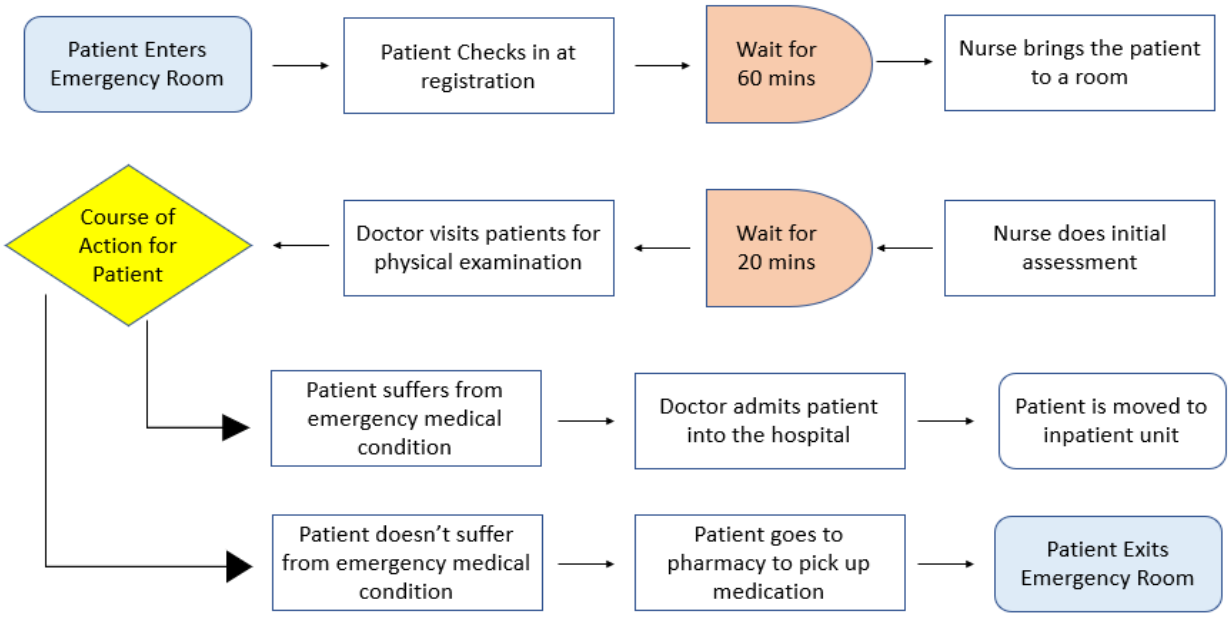


Figure 14: Sample FlowChart

A.5 PICK CHART TEMPLATE

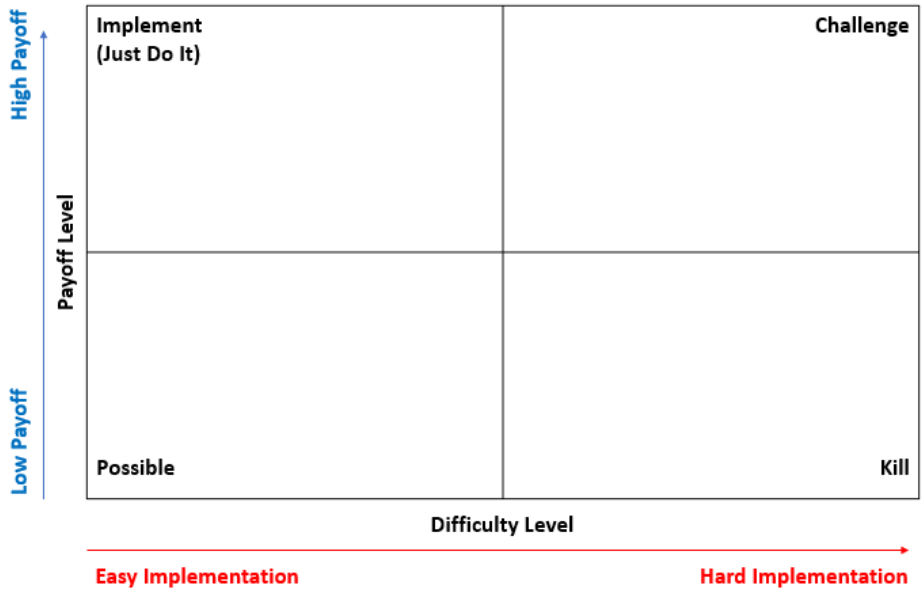


Figure 15: PICK Chart Template

APPENDIX B: PATIENT LETTER TO GARY WEINSTEIN

Dear Gary.

You may recall that we've met several times at meetings for the Washington County Hospital Authority. I happen to be a community member who uses a wheelchair. I was recently admitted to the Washington Hospital and I feel compelled to share my experience with what was. by all accounts. a completely unacceptable and avoidable situation.

While I was admitted. from August 24th through August 27th. for treatment for an advanced UTI. elevated heart rate and high blood pressure. I did not have my basic needs met as someone who has Becker's Muscular Dystrophy.

The entire time I was in the hospital. I felt like a highly frustrated turtle on its back. I got minimal sleep. I couldn't easily communicate with the staff. I couldn't control my bed or the TV. I couldn't make a phone call or take a phone call. I couldn't even take a drink of water at will.

To be perfectly honest. I felt helpless and unnecessarily stressed out. which is certainly no mindset for healing.

When I was first admitted. I was placed in a room that was not within earshot of a Nurse's Station. which was a critical problem because I lack the strength to press the provided bed button. This made communicating with nurses virtually impossible. I spoke up about the issue and was moved to another room across from the Nurse's Station. While that helped to get me within shouting distance of staff. I still was left feeling vulnerable. especially since I didn't know if a staff member had heard me or not. I was left with no choice. but to yell whenever I needed help doing anything. which was both humiliating and demoralizing.

The night I was admitted. for example. staff told me they could get me a pillow button so I could more easily call nurses if I needed anything. This did not materialize until a few hours before I was getting ready to be released from the hospital days later. And they didn't have the proper adapter or plug for it anyway. so it was rendered useless.

It was an exceedingly frustrating situation. to say the least. however I do want to note that throughout my stay the staff were well-meaning and helpful to the extent that they were able to help. It was clear to me that they had little time to devote to each patient.

It is a sad statement on our healthcare system that I was more worried about having to be admitted to the hospital than I was about my diagnosis -- what was the level of care I was likely to receive? And I was right to be worried.

I feel that I need to bring this all to your attention because I don't want anyone else to experience this -- and I certainly don't want to experience it again. It seems to me there has to be another level of support for high-need patients. like myself.

Figure 16: Patient's Letter to Gary Weinstein

APPENDIX C: SPECIAL NEEDS RESOURCE DIRECTORY

Special Needs/Disabilities Resource Directory

Special Need/ Disability	Equipment	Location	Extension
Hearing Impaired or Deaf Patients *Suggestion – order an amplifier and individual earbuds - Williams Sound PKT D1 Pocket Talker Ultra Duo Pack Amplifier with Single mini earbuds and folding headphone*	A telephone device for the deaf (TTD) and amplified receivers Both pieces of equipment must be used with the Analog Model 2500 telephones that can also be borrowed from Switchboard.	Switchboard	
	ITY Sign Language Interpreter and the Sign Language Phones	Switchboard	
	There is a closed caption (cc) button on the pillow speaker/TV remote.	See remotes	
	Special amplifying devices to assist the hearing impaired are available	Speech Therapy Switchboard	
	Sign language interpretation services are available 24 hours daily from	☐ Hila Saxer at 724-986-9029 ☒ Pittsburgh Hearing, Speech and Deaf Services at 412-281-1375	
Physical Limitations	**OT Equipment** **Long Handled Shoe Horn** **Reacher** **Sock Aide** **Long Handled Sponge** **Elastic Shoelaces** **Weighted Utensils** **Scoop Dish** **Toilet Aide (personal hygiene)** **Arthritic scissors** **Walker bag** **Button Hook** **Wash Mitt** **Long handled Comb** **Dycem** **Foam Buildup for Pens/Pencils/Toothbrush/Utensils etc.** **Swivel Seat** **Sliding/Transfer Board**	**To obtain equipment:** • **Need an evaluation for OT and/or PT** • **OT/PT recommends specific equipment to order for patient** • **Decision needed for patient to have for home use and informed where to get it (some available in gift shop)** • **Does patient need it in hospital – order and keep on the floor**	**724-229-2607** **724-223-3279**

Special Need/ Disability	Equipment	Location	Extension
Speech Impaired Patients	Communication boards are available to assist patients with impaired speech to communicate their needs.	Speech Therapy, Emergency Department, Critical Care Staffing Office.	724-223-3290 724-223-3085 724-229-2334 724-2233029
Pillow Speakers	EZ Call Nurse Call Pillow Speaker (Executone)	5E 7E	
	EZ Call Nurse Call Pillow Speaker (Hillrom)	Main Hospital – 2B Facilities Mgmt 4A 4C 5A 6S	
	EZ Call Nurse Call Pillow Speaker (Responder IV)	1E-OOU 1H-ED 2B – Facilities Mgmt 3H- OPSU 5H- CCU	
	EZ Call Nurse Call Pillow Speaker (Responder V)	4S 5S 6E 7S	

Figure 17: Special Needs Resource Directory

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