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REDUCING INEFFICIENCIES IN THE HEALTHCARE SECTOR BY USING LEAN PRINCIPLES: A SOUTH AFRICAN CASE STUDY

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Declaration

I, Steven Kazadi declare that this dissertation is my own work and any published work used from another person has been duly referenced and acknowledged. This material has not been submitted previously for the awarding degree at the Durban University of Technology or any other educational institution.

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Abstract

Healthcare organizations all around the world have many wasteful activities that causes inefficiencies in their day-to-day operations which contribute to poor service delivery, rising costs, poor patient experience, medical errors, and a lackluster work environment. In this regard, there is a dire need for innovative methods for improving the efficiency and quality of healthcare services. The lean healthcare (LH) concept is a highly recommended approach in improving efficiency because it focuses on reducing non-value-added (NVA) activities, man power, waste of resources, time and money whilst ensuring safety standards and regulations are adhered to. However, LH has it its fair of challenges with regards to achieving long-term results in which there's a lack of studies that addressed this to which it has been reported that up 90% of lean projects fail long-term which goes against the concept of pursuing perfection through continuous improvement.

Hence, the aim of this research project is to propose how lean techniques will be used to solve inefficiencies but through a Quality Improvement Methodology (QIM) decision tree which is a framework that will act as a catalyst for sustaining lean improvements. The study utilized secondary data in achieving the objective of the research project through the use of a Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow chart within the context of quality and lean in healthcare organizations in South Africa (SA). The study achieved 38.33% reduction rate of non-value adding (NVA) activities and an approach on how to sustain the lean efforts through visual control charts of the waiting times which measure any deviations from the standard stability rate of 99.7%. However, the current measured stability rate is 87.5% which is a signal for further improvement to achieve the standard rate. The significance behind this is to ensure a cycle of continuous improvement through measurable indicators and visual charts.

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Chapter 1 : Introduction

There is a wide variety of health systems around the world by their function is all the same which is organization of resources, people and institutions that conveys healthcare service to meet the wellbeing needs of the target population. In context of SA their healthcare system is comprised of the public and private sector to which about 8% or more of SA's gross national product (GNP) is spent on it [1].

However, it has been reported that SA's health system has high levels of operational inefficiencies which has resulted in billions of rands being wasted due to issues such as medical negligence and irregular expenditure [2]. However, these inefficiencies will cause the quality of healthcare services to deteriorate, then this will ultimately result in a sickly population and a drop in productivity which will affect the economy negatively. In that regard it becomes imperative to strengthen the healthcare system.

1.1 Purpose of the study

The purpose of this research project is to primarily reduce inefficiencies in the healthcare sector by using lean principles. The motivation behind this is through the researcher's experiences of receiving inefficient services within the public hospitals of SA. However, merely having a keen interest to improve the healthcare sector is not enough to conduct a two-to-three-year dissertation on it but briefly reading past studies and consulting with experienced researchers on the relevancy of the problem the researcher is aiming to solve and contributing to the body of knowledge.

1.2 Research Background

The concept of lean principles has been growing throughout different industries due to its systematic approach of maximizing value whilst minimizing waste which started in the 1940's in the Automotive industries as displayed in Figure 1. Furthermore, other industries began to capitalize on the philosophy such as the manufacturing, services and healthcare industries who aimed at adopting this approach to maximize their production with minimal resources.

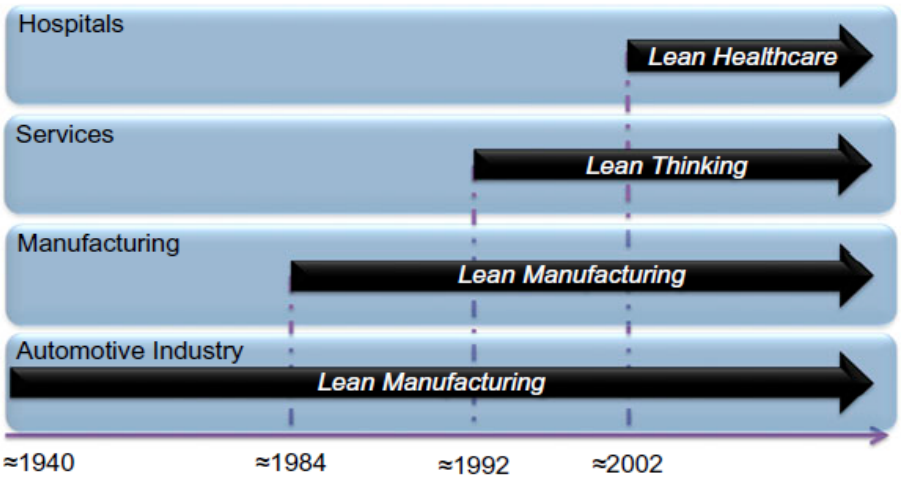


Figure 1: Evolution of lean principles [3]

LH was developed in the early 2000's is a concept with objective of eliminating all types of waste in all tasks and processes so that medical procedures, time and materials could be utilized efficiently as possible. This will eventually result in the reduction of costs for its services whilst improving patient safety, increase quality, reduce waiting, response and lead time [4]. However, when looking at the South African healthcare system which is comprised of the public and private sectors, operational inefficiencies are present in both sectors. Although, the inefficiencies are more prevalent in the public sector since it serves 80% of the patients across the country with limited resources [5]. Even though the private sector serves less patients in comparison to the public sector, this does not mean that the private sector is immune to operational inefficiencies [6]. This is because they have their own fair share of challenges such as shortage of medical practitioners, poor quality care and inefficient use of resources which will result in poor patient experience.

Furthermore, lean management is the most highly recommended approach in addressing these challenges in the South African healthcare sector, since the lean method has been used effectively across the globe to improve patient experience without the need of investing additional financial resources [2, 5]. In this regard, implementation of lean healthcare into South African healthcare institutions is still at an early stage of development and its value stands to be questioned, as a vast majority of literature highlights that indeed lean healthcare is an evidence-based approach in improving efficiencies but can

the quality method work in long-run and how will it be sustained [7]? In answering that, Naidoo [2] suggested in order to sustain lean efforts, there is need to focus on initiating LH rather than just applying the tool. However, even before attempting to initiate LH there has to be existing set of quality management systems or practices present within the healthcare environment that would enable initiation [8]. In other words, policies documents advocating for improvement of the quality of care must be present.

1.3 Problem Statement

The South African healthcare which is like any other type of organization that has a set of tasks and processes has wasteful activities to which studies that have focused on patient flow have estimated that there is about 60% of NVA activities within healthcare processes [7]. As a result of these inefficiencies are encounters such as medical errors, inappropriate processing and duplicative treatment and in the end both the patient and the hospital suffer due to the high levels of waste that is present within the system [7]. Indeed, LH is the highly recommended improvement approach in resolving the inefficiencies with scholarly articles to confirm the claims but the issues lie within sustaining the improvement and maintaining use of the lean tools in which the reported failure rate is up to 90% [9]. Which goes against one of the fundamental principles of lean management which is always pursuing perfection through continuous improvement methods [10]. In this regard, a framework will need to be developed that will incorporate the cycle of continuous improvement.

1.4 Research Questions

In the development of the research project the researcher had just two initial broad research questions which will guide in how the project will commence. However, further questions will be developed as the research project progresses after the review of literature. The initial questions go as follows:

- What are the common inefficiencies in the healthcare systems and which lean tools are frequently employed to address these inefficiencies?

- What type of framework needs to be developed to compliment lean principles and act as catalyst to sustain lean results?

1.5 Research Aims and Objects

The aim of the research project is to identify and reduce inefficiencies in the healthcare sector in SA through lean techniques and propose a quality improvement (QI) framework that will act as catalyst to sustain lean effort to promote continuous improvement. Therefore, the key objectives would go as follows:

- To conduct a comprehensive literature review on the state of lean healthcare to determine common inefficiencies and the common lean tools used to address the inefficiencies then narrow the research project down to SA.
- Propose and develop a QI framework that will assist with challenges in sustaining lean efforts of continuous improvements of projects implemented.

1.6 Significance of the study

Healthcare organizations in SA are still years behind implementing lean healthcare so more studies surround it is imperative as the healthcare system is still described to be very inefficient resulting in poor patient experience. However, what makes this study very significant is that it covers the shortfalls found in past studies regarding how to sustain the lean efforts in the long run. This is where the researcher's contribution will come into place by developing a framework that combines the lean methodology with other continuous improvement methodologies to cover the shortfalls. In other words, whether it be public or private the framework will be applicable.

1.7 Limitations

Initially the researcher aimed at collecting primary data to gather intel on the processes within the one selected public healthcare clinic in KwaZulu-Natal (KZN) in order to apply the framework developed which will ultimately lead to selecting lean techniques in identifying and reducing the wastes encountered. However, due to the researcher not foreseeing ethical violations as there are protocols required to be followed before embarking on

a journey of visiting public healthcare organizations, this was not possible. This would have prolonged the research project above the stipulated research period.

In combating the limitations, the use of secondary data which will serve the purpose of achieving the objective of the study was adopted. Furthermore, the researcher is required to set a criterion to assess its quality and the relevance of the data for its use in context of what the researcher is aiming to solve.

1.8 Delimitations

Since the researcher utilized secondary, which was taken from the study of Theunissen [6]. This entailed information of a private hospital which is a Medical Centre situated in Kempton Park, Gauteng in South Africa. The name of the hospital will not be mentioned to avoid any future negative implications concerning the use of their name but information detailing their processes may be used. In this regard, the Medical Centre has over 50 departments which has the following:

- 343 beds with 33 ICU beds and 10 neonatal ICU beds
- a 24-hour emergency department also known as casualty department and a trauma unit.
- Sees an average of 2000 patients per month therefore averaging of more or less 500 patients per week.

1.9 Dissertation format

This thesis presents five chapters in which each chapter unravels the next chapter. In other words, the format explains in summary of how the researcher will go about solving the problem identified for this research project. This goes as follows:

Chapter 1: Introduction

This chapter entails a clear outline of how the study will be conducted. This will assist the readers in understanding the background of the research followed by the problem statement, the research questions, the objectives, the reason on why this study is significant, the limitations encountered in doing the research and delimitations of the study.

Chapter 2: Literature Review

Chapter 2 presents a literature review which looks at a broad scale of what other researchers have achieved in context of lean healthcare and in answering the research questions the researcher had initially. This will guide the researcher on how to ascertain appropriate methods to solving the research problem identified in this study, based on the lessons learnt on similar literature conducted to address the research questions identified in this study. In summary it explored the common inefficiencies, lean tools used and the fundamental approach on sustaining continuous improvement projects by not starting with patient flow projects. To which a framework is required to be developed in acting as a catalyst in achieving sustenance of lean healthcare through the combination of other quality tools. In which the framework would be developed in context of the simplified three step approach developed by Radnor [11] which is assessing, improving and monitoring to achieve long-term results of lean efforts.

Chapter 3: Research Methodology

This chapter presents the research methodology which illustrates how the researcher will go about addressing the gaps identified within the previous chapter of the past literature. In which, it will explain framework developed which is the QIM decision tree which aids in guiding the research in selecting appropriate systems and tools before solving the problem or opportunity through the correct selected improvement tool based on the context of the problem. To which, in summary it asks the question of are we trying to solve a process problem which lean tools is commonly used for making processes more efficient or an output problem which six-sigma tools are commonly used for reducing variation in a process to ensure its effectiveness. However, the framework also aids in ensuring the cycle of continuous improvement by answering what happens next should a new problem by merely re-analyzing the QIM decision tree.

Now, the question of what data is required to test the framework's applicability, the researcher selected the secondary data collection approach through a Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow chart adopted from the study of Tlapa, et al. [12].

Chapter 4: Analysis, Application and Interpretation

In this chapter which is the analysis, application, and interpretations. This entails how the results of the QIM decision tree testing were analyzed by the secondary data collected, to apply the selected appropriate improvement tool and then interpret the findings through pre-determined improvement results. To which, in summary of this proves the applicability of the framework and how exactly lean or quality practitioners should approach in improving inefficiencies in the healthcare sector.

Chapter 5: Conclusion and Future Research

This chapter concludes the dissertation and unique finding by the researcher followed by recommended future research in the field of lean healthcare. In summary of this, it explains how this improvement project has a high probability of long-term success. This will be through justification of past studies by focusing on information flow of the healthcare organization and breaking down a large-scale project into kaizen projects by developing value stream maps (VSM) for each departmental area in the hospital to gain quick acceptance and avoid any resistance and applying monitoring tools ensure sustainability of the results and prompt for continuous improvement. However, the conclusion will also include recommendation of the refinement of policy on quality of healthcare in SA in regards to quality improvement.

1.9.1 Conclusion

The first chapter, which is an inductor to the research project provided the background and nature of the study. In which will enable the readers to have a brief understanding on how the research systematically went about conducting the research project from broadly investigating past literature on lean healthcare around the world to narrowing the reviews down to lean healthcare in SA to get a holistic view of what is required. This illustrates that indeed lean principles are proven to be the recommended approach in making processes more efficient but to achieve sustenance it is imperative to develop a framework that will serve as a catalyst to which this will be explained throughout the dissertation.

Chapter 2 : Literature Review

2.1 Introduction

The literature review is compiled of past research on how lean principles could assist in improving the operations of the healthcare sector as well as the potential challenges implementing lean principles. The review will highlight the common problems and how lean principles is the best option to implement reducing inefficiencies within the healthcare sector, with much emphases to South African healthcare.

2.2 Lean Principles

Lean thinking is a concept that originated in the corporate sector [5]. Henry Ford being the first to consolidate a full production process in 1913 to which in 1930 at Toyota, Taiichi Ohno was credited for developing the Toyota Production System (TPS) by simply revising and innovating Ford's original process [13]. A basic principle that looks at a process and eliminates operations that doesn't add value to the organizations service or product from the viewpoint of the customer, to which the lean concept uses a set of tools and incorporates a long-term vision aiming for continuous improvement [14]. According to De Koning, et al. [10] lean principles is set on standard solutions to common problem. In this regard, looking at five basic principles of lean outlined by Isack, et al. [13] goes as follows:

1. Defining the value whether it be the service or the product from the customers perspective.
2. Identifying all the activities in the value stream map to eliminate wasteful activities.
3. Make the value-adding activities occur in a tight sequence so that the product/service will flow smoothly towards the customer.
4. As the new flow is introduced, allow customers to pull value from the next upstream.
5. Pursuing perfection through continuous improvement methods

The five lean principles stated above were originally developed in the manufacturing sector but now through proven research it can now be applied even in the service sector [7]. The principles were designed to improve operational processes and to promote cultural changes that focus more on value creation.

2.3 Lean Healthcare

LH a concept that is not new in the healthcare environment according to Ricciardi, et al. [15]. Lean principles derived from TPS represents a fresh way to identify and improve work systems within healthcare to which this resulted in the concept of LH being introduced which dates back to the early 2000's [12]. There is an increase in the cost of medical care at an alarming and unsustainable rate worldwide [10]. This has led to healthcare services seeing the importance of improving quality and eliminating waste in order to ensure their services are safe, affordable, accessible and cost effective. In this regard, lean principles is increasingly becoming a recommended method to improve those aspects [16].

The concept of LH starts by studying the healthcare processes and determining what is of value to the patients that enter the healthcare vicinity, nonetheless there are many windows into the ideology of healthcare value. Defining value itself is defined as quality divided by the cost[12].

2.3.1 Understanding Value and Waste in Healthcare

Lean principles differentiate from other quality improvement methods due to its focus on firstly studying the process and reducing or eliminating wasteful activities. Thus, the concept of lean healthcare is broken down to value adding (VA) activities which contribute directly to meeting customer needs and non-value adding activities which takes space, resources or time and do not meet the customer's needs. According to Cohen [14] 95% of processes are NVA activities and 5% are VA activities in the healthcare environment which gives a direct conclusion that; to make the healthcare sector more efficient it is recommended that you eliminate the waste discovered in the activities than focusing on the value adding activities.

The context of understanding what is value and waste in the public healthcare sector is more difficult because value is best understood as what a customer is willing to pay for, whereas patients aren't required to pay for public healthcare. In this regard, value can be described as services that a patient is willing to wait for. An example of a VA process would be a nurse gathering imperative data about the patient while the NVA adding process would be the patient waiting for a medical practitioner to arrive at his/her room [17].

However, in the chase of reducing inefficiencies within the healthcare sector, it is important to look at the factors influencing the inefficiencies and lean techniques through research discovered the factors contributing to these inefficiencies. Arguably, cost of medical is increasing daily at an unsustainable rate, some of the reasons being due to an aging population and technological advancements. These two factors in modern day society are uncontrollable and the increase in demand. Notably, operational inefficiency increases healthcare costs[18].

Through reviewing articles on the types of waste that contribute to inefficiencies which are commonly described by lean principles; the context of identifying eight types of waste in healthcare described by Cohen [14] and Mutingi, et al. [16] which share common types of wastes are given in

Table 1 below.

Table 1: Describing healthcare wastes [14],[16]

Types of waste	Corresponding Healthcare waste
Transportation	Poor layouts resulting in needless movements of patients, specimens, materials and even staff members having to walk to the other end of the ward to collect notes.
Inventory	Inappropriate inventory control resulting such as ordering excess medications, medical supplies. Waiting lists and patients awaiting to be discharged
Motion	Unnecessary movements of staff members in their daily activities for example looking for paperwork such as drug sheets due to the sheets not being put back to its correct place.

Waiting	Idle time spent on patient waiting for admission or for a bed in a ward. Large time gaps between activities resulting in queueing.
Overproduction	Producing more then what is necessary such as making several admission files for one patient.
Overprocessing	Executing tasks that add no value to the patient such as duplicating data by asking patients information several times.
Defects	Time spent performing incorrect procedures, then fixing errors. Such as mistakes like wrong identity number on file or patient being given wrong medication.
Skills	Underutilization of doctors and nurses such as not setting time aside for improvement recommendations to which they aren't engaged, heard nor supported. Resulting in them feeling burned out and stop sharing improvement ideas.

According to James, et al. [19] millions are wasted due to clinical inefficiencies, hence the importance of identifying the inefficiencies is imperative before looking at the various methods to eliminate the clinical inefficiencies. In this regard, inefficiency can be described as using more resources than necessary to deliver a unit of beneficial patient care or service and is directly linked to lean healthcare types of waste such as overprocessing or overproduction within a clinical process. However, in the context of improving efficiencies there are five common inefficiencies within the healthcare environment researched by Henry [20] and Staff [21] with some of the key efficiencies broken down into an engineering perspective by Pepin [22].

2.3.2 Five common inefficiencies in hospital operations

- **Poorly managed patient flow:** a high influx of patients moving in and out of departments in hospitals to which a smooth patient flow is recognized as a solution to prevent overcrowding. Yet, according to Henry [20] emergency departments remain overcrowded resulting from lengthy waiting times and large duration times

between operations. Parts of this is most certainly caused by the ongoing lack of matching the resources to patient needs.

- **Lengthy hospital stays and inappropriate hospital admissions**: practitioners sometimes admit that patients are kept longer than necessary due to not having alternative places to send them. Patients are also getting sicker than ever before, coordination and planning amongst specialists is poor and the average time a patient spends in the hospital is gradually increasing. These longer stays are costly and result in fewer spots for inbound patients.
- **Inadequate medication reconciliation:** incomplete medication reconciliation can lead to medication errors which are expensive and contradicts the most basic principle in health “first do no harm” [23]. It is recorded that an estimated of up to 160 000 deaths are caused by medical errors every year [24]. One of the reasons being a lack of efficient processes for reconciling medications at each point of care and patients being poor historians when it comes to their medications.
- **Duplicate documentation requirement:** reducing inefficiencies in documentation methods will permit physicians to spend more time with patients and also assist with creating a smooth patient flow. It has also been reported that the increase in readmission rates causes the duplication of documents due to inpatient care quality and care coordination being poor.
- **Poor communication methods:** a survey conducted by Ponemon institute of more than 400 providers discovered that poor communication is costly and sums up billions of dollars industry wide. The causes are drilled down to lack of technology and inadequate wireless connectivity or pagers. Other processes like patient admissions and transfers found that more than half the amount of time required to admit one patient is wasted on inefficient communication. It’s not just poor communication between the medical staff but also poor communication between patients and providers which has shown to also lead to costly readmissions and the root of poor patient flow and lengthy stays.

2.3.3 Identifying Lean methodologies to solving inefficiencies in healthcare

According to Narayanamurthy, et al. [9] implementing lean principles begins when the healthcare organizations begins to directly attack inefficiencies which causes the wastes in a value stream by following the five tenets of lean. However, five common lean healthcare methods will be reviewed that works effectively to reduce inefficiencies in healthcare. In this regard, seeing that the healthcare sector is a matter of life and death the methods should all be focused on quick-responses and extra relevant in the healthcare environment [25].

2.3.3.1 Kaizen

Typically, an improvement process starts with a Kaizen (continuous improvement), a philosophy that focuses upon continuous improvement of processes thus reducing waste and increasing quality and efficiency through small and big scaled projects [26]. This includes the standardization and measurement of operations [13]. According to Manos, et al. [27], the acceptance of LH can grow if they start with giving quick results which kaizen is a great method for identifying low-hanging fruits to get quick wins. De Koning, et al. [10] conducted a study in Iowa Hospital that's located in the city of Iowa. In his study he included the kaizen process to eliminating waste in computerized tomography (CT) scanning process which was successfully implemented resulting in an increase of revenue per year and enhancing customer experience. Also another study conducted in one of the Namibian medical laboratories experienced an improvement of the quality of their services through the application of kaizen activities [13]. Similar to the study of Isack, et al. [13] and De Koning, et al. [10]. Kovacevic, et al. [4] achieved the same result of implementing kaizen events but also discovered that kaizen is helpful in improving the work organization, focusing on low-cost and low risk improvement and empowering employees to engaging in creative improvement ideas due to the principle of respecting all ideas no matter the size or impact in the healthcare sector.

2.3.3.2 A3 Problem-Solving, A3 report

The A3 report is a common problem-solving tool that would fall under kaizen events which should be planned and realized upon such as the PDCA cycle (Plan-do-check-Act) whereby [4]:

- Plan: after the problem has been through the eyes of the customer “patient”, then a plan is established with the current condition being displayed with the cause analysis diagram such as the 5 why’s being commonly used to get to the root of the problem. Thereafter state the expected result of conducting the A3 report. [17].
- Do: the implementation plans or conduct experiments to make the necessary changes and assigning duties to individuals with deadlines attached to their responsibilities.
- Check: verifying if the expected results are achieved or evaluate results
- Act: reviewing and assessing the results and refining the experiments through follow-ups.

Shahroudi and Aarabi [28] did a study on reducing the foot traffic in the operating room (OR) that was known to be a factor affecting surgical site infections and distractions. A reduction of 46% in foot traffic in the OR was achieved through application of the PDCA method which was in A3 format. Another study conducted in the intensive care unit (ICU) at a Community Medical Centre in Salt Lake City which experienced a reduction of overtime hours resulting in real monetary savings, while reductions in wasted staff time not affecting overtime realized immediate gains in error reduction and employee, patient and physician satisfaction with the use of the PDCA cycle [17]. Price [5] used the same A3 tool to reduce patient waiting time in the Orthopedics Outpatient Department (OOPD) clinics at New Somerset Hospital (NSH) in Cape Town, in his study he successfully reduced the patient waiting time by 39.4% thus increasing time for medical practitioners to consult patients. It is important to note that the A3 report requires a simple one-page format that should be taking small doable problems so that workers can identify and make improvements rapidly [17], this inherently got the staff in NSH change their attitude towards lean management as a set of tools to improve systems throughout the hospital [5].

The common template has been adapted from the Toyota's A3 reporting system to an advanced suitable A3 template used to solve hospital operations' problems as suggested by Jimmerson, et al. [17] illustrated in (Figure 2) below.

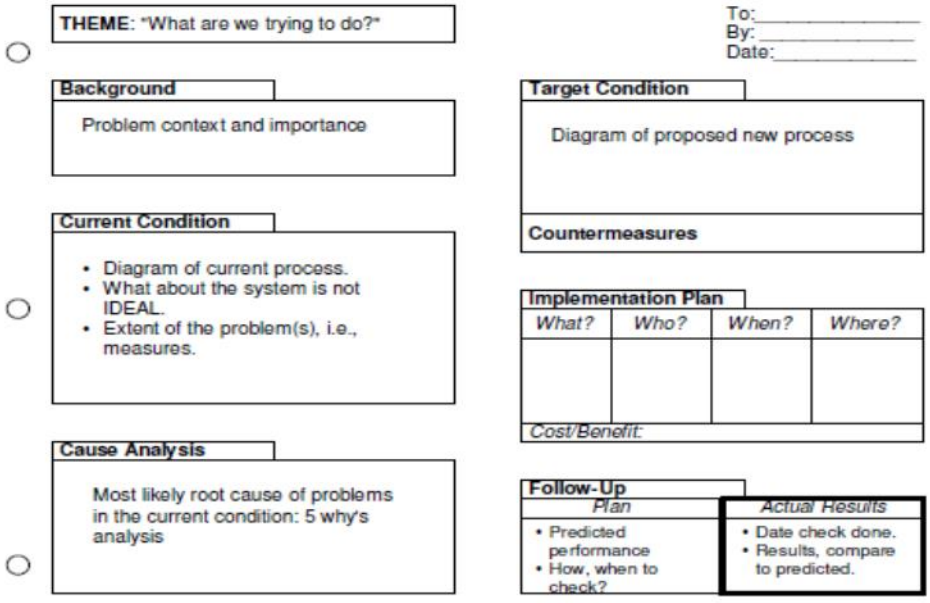


Figure 2: Problem solving A3 template [17]

2.3.3.3 Value-stream Map

VSM is a graphical, analytical tool that represents a flow of selected processes from its start (material purchase from supplier) to finish (final product) [4]. The frequently used tool in distinguishing the difference between VA and NVA activities. In the healthcare environment, a VA step would be a nurse interviewing a patient to obtain important information while a NVA step is a patient waiting for a physician to arrive in the examination room [17]. In this regard, the process to developing a VSM is broken down to four simple steps by Cohen [14].

The first step is to identify what is the value defined by the patient? This concept will require health-care providers to identify what patient's actual needs are. The second step would be to perform a Gemba walk which is a Japanese term for real place, "learn to see".

This step requires the value stream mapper to visit the workplace and observe first-hand how the process operates and get an understanding on the multiple areas causing inefficiencies for the intention of envisaging improvement opportunities. Afterwards, in the second step you will be required to create a flowchart representing the processes from beginning to end known as the current-state value stream map (CS-VSM). Those working in the processes are the ones to give accurate information on each process. This includes the use of time studies, to get actual times to complete each step and lead time (total time it takes to complete the entire process, including waiting times).

The third step will include visualizing the flow state in which all the steps are followed by another without stopping. All improvement ideas and changes recommended are welcomed and placed on the CS-VSM. Using the ideas generated new and better processes are then designed and placed on a future-state value stream map (FS-VSM). The map represents a new and improved process to which ideally lean principles reduce the time from beginning to end by eliminating NVA steps. The processes displayed in the FS-VSM should allow patients to “pull” value when they need services rather than requesting and waiting.

The fourth step begins when the future state map is completed and approved by all relevant parties involved. This would involve a plan for improvements and identifying each person responsible for the implementation phase for each activity. However, VSM has been implemented practically at Catherine Booth Hospital in KZN, SA with an overall improvement on efficiency and reduction on waiting times [29]. In Jimmerson, et al. [17] study, he achieved the same output overall improvement as [29] but his CS-VSM also highlighted medical errors in his NVA activities such as labeling errors throughout the work processes which the errors were able to decrease from an average of three per month for the prior twelve months to an error in the first two and one half months of the new process implemented from FS-VSM thus saving lives and improving throughput. Similar to the study of [17] and [29], Kovacevic, et al. [4] achieved the same results but discovered that VSM is a successful tool for initiating healthcare system changes to provide improvement opportunities.

2.3.3.4 Visual Management

According to Kovacevic, et al. [4] people are visual beings and majority of information that we receive and accept comes from a sense of seeing which proves that visual management (VM) can alter human behaviors for the better significantly [25]. The aim of VM is to apply visual indicators displayed and controlled throughout the organization to improve communication of processes easily accessible and clear to all employees. In the aspect of the healthcare environment, VM would reinforce patients and employee's safety because of self-restraint features. The 5S, A3, VSM methods are fundamental tools that require a visual approach that healthcare workers would value [14]. Kovacevic, et al. [4] did a study on the proper management of material, tools and packaging in the sterile service department which required VM of Kanban boards. Kanban which translates to queue limitation, which allows a maximum allowable on-hand quantity thus bringing about automatic replenishment method and eliminates tying up nursing and other staff searching for supplies [25]. This resulted in the reduction of material waste, costs, delayed surgery due to lack of materials and infection rate in clean surgeries [4]. Schonberger [25] applied VM in a surgery room by setting up a large white board with the surgical team names and scheduled times for each surgery and a check mark went besides the name of any personnel who was late because the effect of late surgeries would push back other scheduled surgeries thus increasing patient waiting time, costs and poor usage of valued resources. This resulted in no more late surgeries due to the shame and criticism of being singled out for bad behavior. Similar to [4] and [25], Spagnol, et al. [23] reviewed a case study where VM was applied to standardize improvements and was able to achieve large reductions in physician reassessment waiting time, these improvements required minimal material cost and no additional staff.

2.3.3.5 5S

The 5S technique which would be defined by Isack, et al. [13] and Kovacevic, et al. [4] as visual workplace technique to organize working practices and working environment as well as the overall philosophy and way of working. The 5S are mainly:

- Sort: removal of unnecessary items and papers in a given area
- Set in order: identifying the best locations for all types of items, setting inventory limits and taping workplace with label for objects in place.
- Shine: cleaning everything in and out especially unnecessary materials that was stored and continuing to inspect items by cleaning them and to prevent dirt and contamination from occurring.
- Standardize: creating rules for the maintenance and controlling the first 3S, making use of visual controls and standard procedures.
- Sustain: Ensuring the adherence to 5S through communication and self-discipline.

However, the latest trends and recommendations introduced the sixth 'S' which stands for Safety. To which safety (patient and staff) is one of the top priorities in healthcare which boils down to 6S (5S + 1) should it be implemented can add beneficial measures in a meaningful and sustainable improvement in safety practices [4]. It has been shown that 5S is not merely about cleaning and organizing but allows workers to see, know and understand the workplace. Kovacevic, et al. [4] did a study on the application of 5S in hospitals and discovered beneficial effects such as 5S making efficient workplaces for enhanced safety and increased productivity, reduction of inventory and supply costs, re-capturing spaces and minimizing overhead costs. The National Health Services in United Kingdom (UK) initiated a program that presented opportunities to identifying improvements to be made in healthcare facilities. 5S was one of the methods that was successfully implemented namely in an endoscopy unit in a community hospital which they were able to convert one storage room to a staff room which resulted in cost savings in linens and inventory thus reduction of cycle times [30]. Venkateswaran, et al. [31] discovered in his study that after successful implementation of 5S it greatly improved housekeeping practices in healthcare and made nurses be able to identify potential issues such as safety or quality problems.

Table 2 illustrates some of the successfully implemented lean projects with results shown from hospitals in the United States of America (USA) and Scotland based healthcare facilities. The results illustrated show typical tangible and intangible benefits of lean projects that have been implemented.

Table 2: Examples of successful lean projects implemented [4, 11]

Organization	Method Applied	Impact
Flinders Medical Centre	Lean thinking	Same budget, infrastructure, staff, and technology with fewer safety incidents yet 15-20% more work has been done.
Royal Bolton Hospital	Bolton Improving care systems (Lean)	• Reduction in mortality of 36%. • Reduced process time to process important categories of blood from 2 days to 2 hours. • Direct savings of £3.1 millions
Scotland Cancer Treatment	Lean Principles	Customer waiting time for first appointment reduced from 23 to 12 days on average and improved customer flow time for patients of 48%.
Nebraska Medical Centre	Lean principles: redesigning the work area in the clinical laboratories.	• Reduced manpower • Reduced lab space and specimen processing turnaround time by 20%.

2.4 Understanding Enablers and Barriers to Implementing Lean Healthcare

Through extensive reviews of past literature reviews there are proven records of the success of implementing Lean principles in healthcare. Moreover, it will be imperative to understand any resistance and any failures that should occur to sustaining a successful implementation of lean principles in healthcare. Despite the wide application of lean healthcare the success rate remains low with lean project implementation failure rate ranging between 50 to 90 percent [9]. This is due to the fact that Lean experts and consultants don't consider elements that would hinder the introduction of lean and its success. Moreover, Narayanamurthy, et al. [9] concluded three major reasons attributing to

the high percentage of failures which is the lack of adaption, the lack of readiness due to the absence of training systems or little to no knowledge of lean principles and the lack of systemic approach which also noted by Naidoo and Fields [32] of focusing on how to initiate lean principles. Healthcare organizations that implement LH haven't yet fully institutionalized LH to the level of Toyota on the ability to improve and design the work, share resulting knowledge and developing people for the work [9].

According to Chatur [7] there has been overwhelming research that lean management works with tools such as Kaizen events also referred to as Rapid Improvement Events (RIE's), which these type of projects aren't followed up on and the motivation to create and sustain change often disappears. This would require a systemic approach for lean principles to become part of the daily routine of management doing daily, weekly and monthly follow-ups, not something done once or few weeks and never again [7]. An important note stated by Narayanamurthy, et al. [9] is that it is imperative to assess the proactive readiness for healthcare institutions to begin the lean journey as the success and failure heavily depends on it. There are various methods to asses healthcare institutions readiness such as the fuzzy logic technique which is used to assist in concluding a final answer of whether the healthcare institution is ready or not [9]. After assessing the readiness factors of healthcare institutions to implement lean principles the assessor would then be able to assist on advising on the key areas to improve on facilitating to enable implementation of lean principles. The key factors of enablers and barriers to lean are summarized in Table 3 below adopted from Isack, et al. [13] and Hagg, et al. [33]:

Table 3: Enablers and Barriers to the application of lean principles in healthcare [13],[33]

Enablers	**Barriers**
Employe empowerment- always recognizing and employee's accomplishments through their contributions	Staff's resistance towards change
Top management being involved	Leadership failures
Flow orientation- good to consider audience and base processes that are easy to relate	Weak links between improvement programs and the strategy

Proper planning	Improper planning
Open talks about all wastes	Lack of democratic talk
Quality workshops organized regularly	Lack of training
Ability to learn and accept changes	Inadequate attention to internal and external customers
Internal and external customer satisfaction is tracked and reviewed- good to quantify improvements	

2.5 The 4P model

The important points mentioned above supports the 4P model strategy of achieving innovative excellence to build and sustain excellence through four categories which are people, partnership/teams and the product/services [7]. This assists and being prepared for the great risks involved when attempting to revolutionize healthcare institutions which lack a stable culture of lean principles.

In the aspects of healthcare organizations, the 4P model takes into account the awareness of human resources (clinical staff) and the role they play in the context of hospitals and clinics as the basis for improving processes. The model highlights that to achieve eliminating inefficiencies it is fundamentally important for healthcare organizations to develop staff capabilities; for it is the foundation of improving partnerships, processes and the provision of services. This supports the reason for assessing how ready healthcare institutions are to fully implement lean principles and achieve true learning focuses on continuous improvement through problem solving [7].

According to Chatur [7] and Narayanamurthy, et al. [9] when deploying the 4P strategy, the top down approach must mirror the bottom up and should be linked end-to-end and to some degree the model should be hierarchical with higher levels building on levels as displayed in (Figure 3) below.

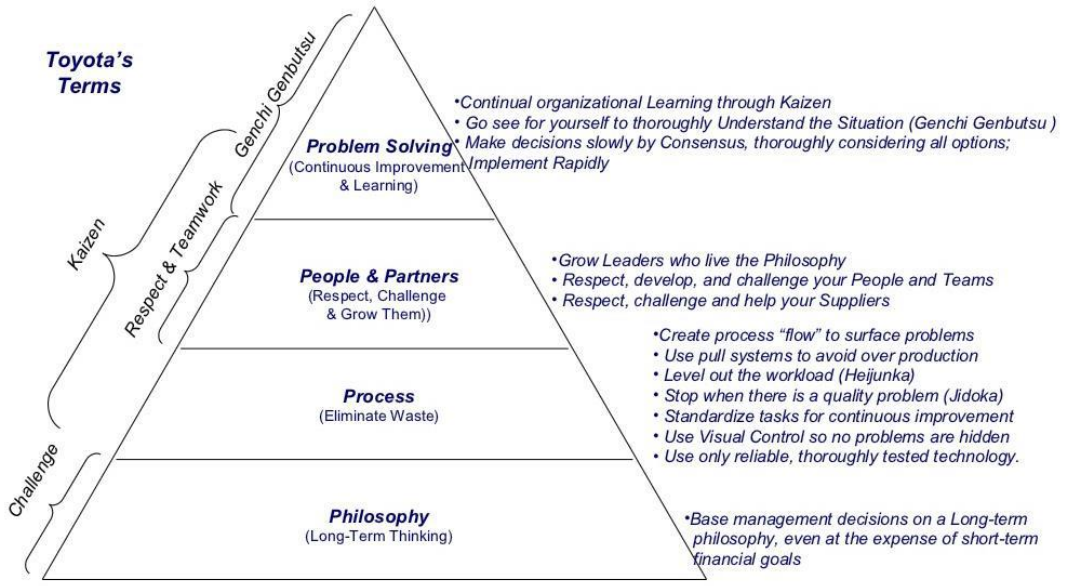


Figure 3: The 4P model [7]

2.6 Assessing Lean readiness of healthcare institutions

The increase in literature with regards to the use of continuous improvement practices that would serve the purpose of improving operational efficiencies and reducing has become one of healthcare organizations' top priority [14]. To which, the majority of publications focused on Lean healthcare as the most suitable practice in achieving operational excellence with an increase in success stories among medical professionals [34]. Despite the growing awareness of the benefits of implementing lean principles in the healthcare sector but scarcity in the research that consolidates the methodology in applying LH [34]. According to Naidoo [35], a few researchers would describe the barriers and challenges of implementing LH but that wouldn't translate to being readiness factors.

Organizational lean readiness could be defined as the ability of an organization's realization or awareness of the need for change, improvement and developing an organizational culture which understands the customer requirements and an overview of the organizations processes with the use of data to drive improvements [11]. In other words, according to Radnor [11] for sustainable use of lean tools it is imperative to consider the

organizations' readiness factors. For example, without understanding the customer's needs and values it would be impossible to draft a VSM and without understanding variation then the data collected which is used for visual charts would be pointless and demotivational. Confirmation from recent literature within the public sector organizations show that the focus tends to be more towards the tools and techniques of lean and less on the readiness factors which could lead to the lack of sustainability in the longer run and focus towards short gains [34].

2.7 Readiness factors in the Healthcare sector

Recent literature has supported reasons for considering organizational readiness which links to the principles of lean in that it reminds managers in the public sector that implementing lean isn't just about making inefficient processes more efficient by focusing on tools but to sustain a continuous improvement culture through an understanding that lean adoption requires a change of mindset, orientation and willingness to adopt new systems, most of the time both at an institutional and individual level [8, 11]. Although there has been success stories of implementing lean, Noori [36] argument is that it often leads to cultural resistance in the healthcare environment and to countermeasure the issue of establishment of critical success factors (CSF) model. There have been recent studies that address CFSs of implementing lean projects and programs in healthcare organizations but there is little research on assessing the relationship between success factors and lean success within hospitals [36]. However, Noori [36] applied a structural equation modeling (SEM) to close the gap between CSF and lean success, in his study he focused on the CFSs for implementing lean in Iran's hospital environment. In his hypothesized model of CSFs for SEM analysis included five constructs shown in (Table 4) below, and his SEM showed a high link between lean success and management systems and moderate link with the other CFSs [36]. However, according to Naidoo [35] on the review of the literature the findings of the study confirmed that some of the CFSs surveyed do not provide how to systematically enact them.

Table 4: Constructs and Variables [36]

Construct	Variables	Supporting literature
Strategic Orientation	The correlation between lean concept and hospital strategic management system. A transparent vision and clear sense to the outcome of implementing lean.	Al-Balushi, et al. [34],Naidoo [35], Nwobodo-Anyadiegwu, et al. [8]
Organizational culture	Effect of quick wins. Aiming for Change. Belief and need for ongoing improvement.	Manos, et al. [27], Nwobodo-Anyadiegwu, et al. [8], Radnor [11], Narayanamurthy, et al. [9]
Management System	Management participation, commitment and responsibility. Performance evaluation. Communication.	Narayanamurthy, et al. [9], Naidoo [35], Radnor [11], Henrique, et al. [37], Chatur [7]
Implementation Process	Project selection and Prioritization. Lean Stockholders. Project management skills. Empowerment and training of employees.	Narayanamurthy, et al. [9], Naidoo [35], Al-Balushi, et al. [34], Zepeda-Lugo, et al. [38]
Implementation team	Participation of implementation team Executing team training	Radnor [11], Zepeda-Lugo, et al. [38], Narayanamurthy, et al. [9], Naidoo [35]

According to Naidoo [35] on the practical consideration for lean initiation, broke down the key elements to the problem identification, willingness of frontline staff and managers to make improvements and the participation of leadership in the lean initiation endeavors.

2.8 Sustainability of lean healthcare

The question of sustainability of lean principles in healthcare is not as complex as researchers put it to be but it's when the realization that the implementation of lean is a long-term program and not a short-term fix [11]. For example, RIE is one of the most used lean tools due to it being able to gain quick acceptance of lean healthcare because RIE gives quick results on a short period of time [27]. However, the shortfall of implementing RIE for quick fixes is often associated with lack of follow-ups of the improvements made which will than cause the changes to disappear over time and sustaining will be merely impossible [7]. In the literature review of Radnor [11], sustaining lean healthcare was simplified in (Table 5) below, where follow-ups/monitoring and implementing new processes are fundamental to the success of long-term improvements.

Table 5: Tools within Business Process Improvement Methods [11]

Assessment: Assessing the process flows at an organizational level. For instance, process mapping or value stream mapping.
Improvement: tools used to implement and support improved processes. For instance, PDCA, RIE, 5's and structured problem solving.
Monitoring: to monitor and measure the impact of the improvements and their processes. For example, standard operating procedures (SOP), benchmarking, VM and work place audits.

Also, in the case studies studied by Henrique, et al. [37], noted by the general managers that they lost many of the improvements implemented by lean principles. This was due to one hospital being studied not properly monitoring the new processes and the other had assistance from a consulting firm. The moment the consulting firm exited, the audit system put in place to monitor the improvements was lost and identified that their biggest

failure was not investing in building a continuous improvement team internally and becoming reliant on the consultants. Not being able to sustain improvements made by a lean system can be attributed to lack of management support, time and resources may be due to the lack of organizational readiness making it difficult to support and implement lean healthcare [11].

According to Radnor [11] literature sustainability is not a concept with only two states, sustaining and not sustaining, moreover can have various states between that effect upon the degree of improvement sustained over a period of time. For instance, undergoing an improvement workshop can have a quick impact and resulting in improvement in activity by 50% in the short-term but can reduce to nothing if the momentum and enthusiasm aren't built upon [11]. To increase the odds, Hallam and Contreras [39] suggested that implementation of control plans that relied on documenting standards and processes, along with clear training plans such as in-service training as staff turnover required continuous re-education. Radnor [11], also suggested that with follow-up actions to improvements made from lean principles being implemented, this can increase to almost 90% improvement over the longer period.

According to a study done by Nwobodo-Anyadiegwu, et al. [8], past literature proposes that certain management practices and operating environment allows the implementation of lean systems which means the absence of such practices and environment will undermine lean implementation and sustainability. This supports Noori [36] CSF's in table 3, containing the constructs and variables which focuses specifically on strategic orientation and organizational culture that has a relation to quality practices of the healthcare environment. The main objective of QI in the healthcare sector is mainly to improve quality outcomes especially the quality of care of patients [14], this would need a culture of patient-focused care where services and processes are secured on identifying, understanding and prioritizing patient requirements [8].

Although there is past literature that shows lean principles highlighting the theoretical context to assist lean healthcare succeed but it does not account for the broader organizational issues that might explain why lean improvements are not sustained or achieved [39]. In that regard, the challenges lie not in theory but in application [39]. Henrique, et al.

[37] applied a case study approach in identifying CSFs and relation to lean success in hospitals that applied lean healthcare and being one of the first few of literature to attempt this. In that study a VSM was largely used amongst the case studies to improve operations in the healthcare environment, but is not mentioned as a CSF sustained continuous improvement but proves to be a decisive tool to achieve long term sustainability in the hospitals [3]. However, what emerged from applying VSM in the case studies was to focus on support flows to consider in order to sustain the improvements in the long term [3]. In the healthcare environment, the support flows can be separated into three major workflows which are [3, 37]:

i. Patient flow: Implementations of lean principles that involve patient flow are related to emergency room, operating room optimization, bed management improvements, etc.
ii. Information flow: lean implementations that involve the information flow are usually related to information technology, authorization, billing and purchasing, etc.
iii. Material flow: lean implementation that involve material flow usually refers to reduction of stock, sterilization and distribution of surgical instruments and dispensing of drugs in the pharmacy, etc.

Generally lean healthcare projects focus between those three flows to identify areas of improvements. However, in the case studies demonstrated by Henrique, et al. [37] stated that lean projects that start with information or material flow which has less interface with physicians achieved a better sustainable result in the long term in comparison to starting with patient flow which causes the physicians to be resistant. For instance, in the chemotherapeutic patient flow the patients were often in a critical condition and the clinical staff did not want anything to change in their procedure even the administrative ones. This type of posture had influence over the professionals involved, such as the pharmacists and nurses since the physicians had hierarchical power over them. However, engaging with the physicians in a more subtle way by starting with material and information flow whilst showing results will break any initial resistance which will than prompt for physicians to comfortable allow lean projects concerning patient flow [37].

2.9 Gaps and Pitfalls of existing reviewed Literature

The existing literature presents some of the most common inefficiencies and some of lean tools used to resolve the inefficiencies in healthcare facilities abroad and in SA. Even though in SA there's still more literature required on the effects of lean principles in the healthcare facilities. From the reviewed literature, there has been success stories of the positive results of implementing lean principles but later lost the results and went back to its original state due to lean experts not considering CSF's to initiating lean principles and contributing to existing inefficiencies within the management system. Indeed, the review literature addresses the CFS's to initiating lean principles in healthcare environment. In table 4 from the point made from SEM made by Noori [36] and Naidoo [35] who took the constructs of SEM and broke it down to practical consideration of applying the CSF's. However, the CSF's devised by them focused more on hospitals who had some degree of knowledge of lean principles and some interests but not taking into account about hospitals that has never heard of lean principles nor implemented any of the tools. There is still more research to be done in SA of lean principles being applied in the healthcare sector but the lean tools applied in literature favored VSM but tends to focus on patient flow and reducing waiting time whereas according to Henrique, et al. [37] when starting with the patient flow for the lean project it is more inclined to create resistance amongst the physicians who have the influence over the other professions. However, this means the project is less likely to succeed in the long-term. The literature review addresses the implementation of lean principles but little on steps taken to follow-up on the changes made to ensure long-term sustainability of implementing lean principles in the healthcare sector and more specifically towards SA which is fairly new to starting lean principles in the service industry. This means there's still more research needed to be done on systematically initiating lean principles in South African healthcare institutions than just applying lean projects and have a low success rate of implementing it to avoid adding onto existing inefficiencies in their management systems.

2.10 How the Research Project addresses the Gaps and Pitfalls

The literature review was used to study what currently has been to address the operational inefficiencies in the healthcare sector and uncover what more needs to be done. This allowed the researcher to have an understanding of the need to review policy documents that align with national goals and objectives of improving healthcare institutions according to a study done by Nwobodo-Anyadiegwu, et al. [8] that existing quality management practices to enable implementation of lean principles. This will make lean principles more relatable to healthcare managers to accommodate for hospitals that have never heard of lean principles but may have heard of quality management practices.

In that regard, the South African National Department of Health [1] (NDOH) developed a policy on quality of care with the objective of strengthening the healthcare system by continuously improving quality of care provided in both sectors. Which means there is a policy advocating for quality improvement (QI) initiatives but lack of practices in that regard in improving processes within the healthcare sector in SA. Therefore, rather than focusing on initiating lean techniques as new concept it is better to identify quality tools that will compliment lean techniques that will be familiar amongst healthcare practitioners or managers. Thus, the study will focus on South African healthcare institutions addressing the common healthcare inefficiencies and a proposed step by step approach on how lean principles should be initiated to reduce the inefficiencies and ensure the success of lean projects in the long-term. Which ultimately develops the research question of:

1. What other quality tools can compliment lean healthcare?
2. What type of framework needs to be developed to sustain lean efforts?

2.11 Conclusion

In the second chapter, the literature review covered most of the aspects of lean principles being a suitable quality improvement management system for healthcare institutions and the implementation of lean healthcare dating back to the 2000's. The chapter shows the importance of understanding the difference between the value and wastes in order to facilitate the need for lean principles to be applied. However, the chapter shows the most common inefficiencies in the healthcare sector in past literature and the lean tools applied

to reduce some of the inefficiencies presented but the efforts made to improve operational inefficiencies will be fruitless without accounting barriers to implementing lean healthcare.

Past literature uncovers the type of lean tools to be used to have quick acceptance of lean healthcare and which type of process flow to first work on to sustain lean efforts such as working on information or material flow and not on patient flow to reduce resistance amongst physicians. Furthermore, it is important to note that although the studies failed to mention about “what happens should a new problem arise after lean implementation?” in which the framework the research is aiming to develop should cover this.

Chapter 3 : Research Methodology

3.1 Introduction

The purpose of this chapter would be to describe the research methodology used for the study and justification of the type of methodology selected as well as. The previous chapter evaluated existing literature on lean principles in the healthcare environment and narrowed the research down to the application of lean principles in South African healthcare institutions whether it be public or the private sector which serves as a guide to how the research project will be carried out. This will be explained throughout the chapter which will cover the research process, the approach chosen and the research design.

3.2 Research Process

In the research process, a process map is developed to outline a starting point of how the study will be approached to the method used to collect the data and how it will be analyzed within the context of the application of lean management within the healthcare sector. The diagram shown below in Figure 4, simplifies the research process into nine steps which as adopted in the research study of Naidoo [2]. In the research process, it begins with the research problem, which is inefficiencies within the healthcare sector and lean management tools will be used to resolve the inefficiencies. The next step taken is reviewing past literature to identify similar studies on the same research problem. This is done to avoid duplicating a similar study, to identify the common trend in similar quality tools and developing research questions to closing the gaps found in past literature. This is achieved using reputable scholarly search engines such as Web of Science, Google scholar, etc.

Based on the reviews of past literature this is where the researcher develops a framework to address the common gaps within the literature. However, it is important to note that in the research process each step is influenced and dependent on its predecessor. This is where the research approach comes in of which there are three different approaches which are Inductive, Deductive and Abductive and based on how the research project was conducted one of the three approaches is selected. In this case, the deductive

approach is selected thereafter due to the characteristics of the approach the research design selected will be a quantitative design. Furthermore, the type of data collected and how it's collected has to compliment the research approach and the research design. To which the secondary data collection process was used based on the nature of lean management principles or any other quality tool such as six sigma that can pre-determine its effectiveness with quantifiable variables. This is then analyzed and interpreted by means of the framework developed by the researcher.

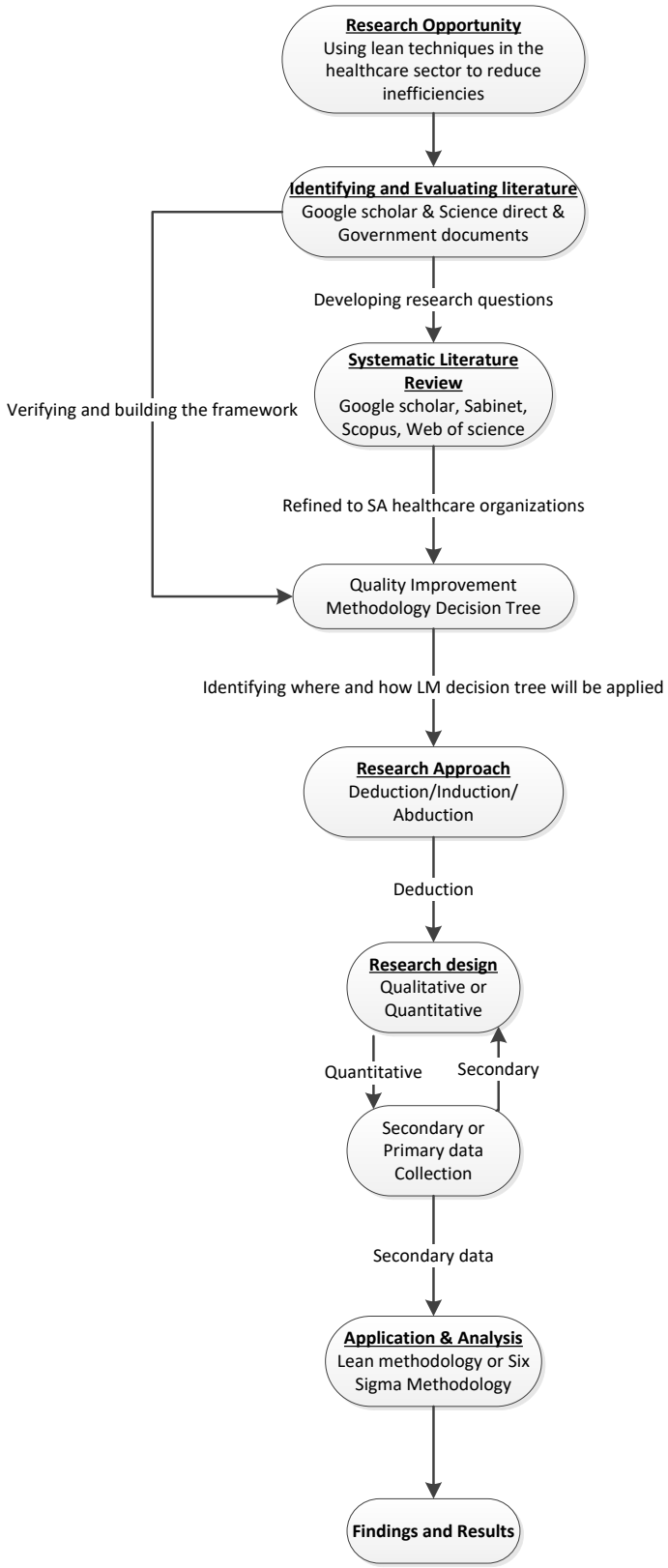


Figure 4: Research Process for this study *[2]*

3.3 Research approach used in this study

The researcher chose to adopt the deductive approach which is aligned to the aims of and objectives of the study as graphical shown in the research process. Moreover, the reason for choosing the deductive approach first begins with what the research problem or opportunity and how it led to the approach chosen. The research problem is addressing inefficiencies in the healthcare sector by using lean methodology and the challenges in sustaining lean efforts, which boils down to the need for the development of a framework to eliminate these challenges. To answer these research questions, the first step the researcher took was identifying literature reviews to determine the relevancy of the research project and identifying the common lean tools used in addressing these inefficiencies in the healthcare sector and how to approach the study. This assisted the researcher in getting an overall view on what are the gaps identified within the literature reviews in order to avoid replicating a similar study and contributing to existing literature by closing the gaps identified within literature reviews.

Furthermore, the literature review was used in building further research questions and developing the quality improvement methodology decision tree which is the researcher's contribution to the body of knowledge and framework used on how the researcher intends to close the gaps discovered within literature reviews. Based on the approach chosen, it is already predetermined on the methodology used to analyze and solve the identified problem. This influences the type of data needed to be collected to fulfil the framework created after the review of literature which is the diagram of the QIM decision tree shown below in Figure 5. The researcher then took a step further in identifying whether the framework developed is applicable in context of healthcare organizations in SA. This will be achieved by identifying processes within healthcare environment that will require a holistic improvement.

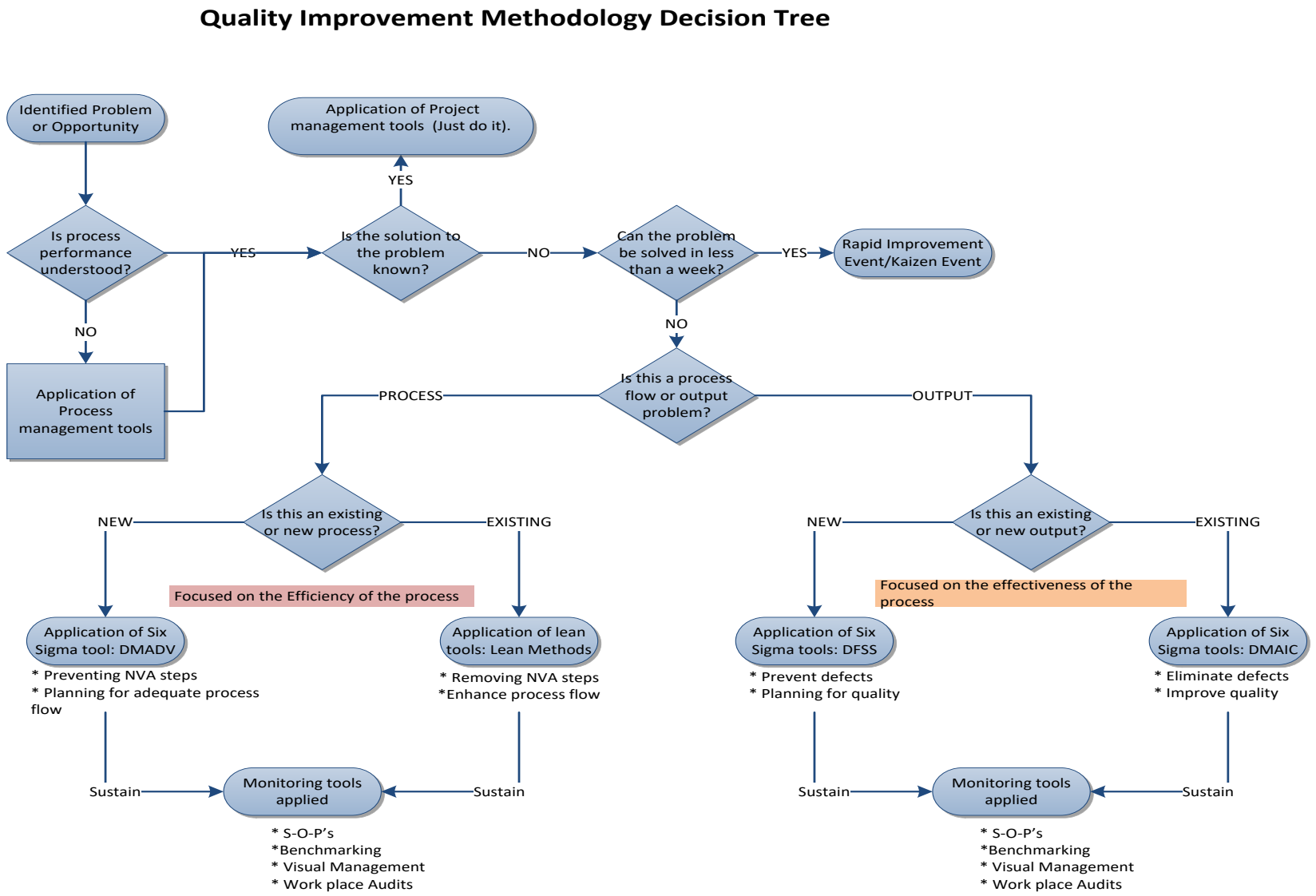


Figure 5: Quality Improvement Methodology Decision Tree (QIM Decision Tree) (Developed by Author)

3.4 Quality Improvement Methodology Decision Tree

The QIM methodology decision tree is a framework that was designed after reviewing past literature with the sole purpose of finding a suitable method in analyzing and solving the identified problems within an organization. The framework covers all the different types of QI methods with the described distinct differences and not just solely focusing on lean techniques as the only and only method suitable for resolving inefficiencies in the healthcare sector.

Upon reviewing literature for this study, it has shown that all the studies focus on applying the quality improvement method but little on the approach on sustaining the improvements. It may happen that the improvement may have occurred but every improvement implemented may have a new problem to arise or exposes a hidden problem needed to resolve so as a result of that occurring the method chosen previously is not best suited for that problem. This disrupts the concept of continuous improvement projects especially for lean management studies that have little studies sustaining lean efforts which the sole purpose of lean methodology is striving for perfection. This is where the quality improvement methodology decision tree fits into contributing to the body of knowledge of closing that gap of how we can further improve from what has currently been improved and sustaining those efforts. Although lean management is widely the most recommended tool to improve inefficiencies, other quality improvement methods can be used to supplement those lean efforts for new occurring problems thus resulting in the cycle of continuous improvement.

Lean management in comparison to other QI methodologies such as Business Process Management (BPM) and Six-Sigma is the one only quality management tool that categorizes inefficiencies to eight types of wastes. The researcher will exploit this method of categorizing the inefficiencies as it will give a starting on where exactly the problem is occurring the most which will be demonstrated.

Now, in context of applying the quality improvement methodology decision tree within the healthcare sector.

- It first starts with identifying a new problem or an opportunity after the implementation of lean principles in a health care organization and once it is identified it is then categorized in eight different wastes and tallied up, if possible, to determine which of the different wastes is the most pressing issue that needs to be resolved. In this step, lean management categorized the inefficiencies into eight types of wastes.
- Step 1; Is asking if the process performance was understood, which is how the business measures their performance such as key performance indicators. Or are there any process maps in understanding how the organization operates? If no, then application of process management tools such as process mapping should be applied before advancing to the next step. If yes, then advance to the step 2. Business process management is more familiar in this step and was used in developing step 1.
- Step 2; is the solution to the problem known? This step determines whether the problem requires further quality improvement methodologies. If yes, then project management tools should be applied to allocate a time to correct the problem or if time is there to correct the problem immediately then “just do it”. If no, then advance to step 3.
- Step 3; if the solution to the problem is unknown then it means it would require critical thinking and problem techniques to identify and resolve the problem. In this regard, the next question to be asked is ‘can the problem be resolved in less than a week?’ to which this would be dependent on whether it is a big or small scaled project. If yes, the project is small scaled than it would require a low-cost and low-risk improvements to empower employees and gain quick wins whether a small or big impact. Generally, the project takes from three to four days, and this is where Kaizen also known as RIE comes into place. If no, proceed to the next step.
- Step 4; If the project takes longer than a week, this would be where either of the two widely used quality methodologies come into place. Ultimately it is separated into two aspects of what an organization is trying to improve, either the processes within the organization or the desired output produced within the organization. Everything begins with increasing value to the customer, so if the product or service is

too slow to meet the customer's needs then it is a process problem then proceed to the next step.

3.4.1 Process Problem

- Step 5; in context of the process problem, based on the aim of the project it's either the organization is working on an existing process or a new process. If on an existing process, then the lean management tool would be appropriate which would focus on eliminating NVA or minimizing NVA. However, after applying lean techniques it does not end there but ensuring that changes made are sustainable. This is achieved by applying a monitoring tool such as VM, benchmarking or applying SOP which is similar to inputting key performance indicators but in the sense of measuring whether the improvements has been sustained or deteriorated. If it's a new process. then proceed to the next step.
- Step 6; in this step whether the organization is looking towards designing a new process or to completely redesign an existing process. The Six-Sigma methodology would be appropriate for this type of project more specifically the Define, Measure, Analyze, Design, Verify (DMADV) method. In contrast to the lean method, DMADV focuses more on preventing NVA and ensuring an adequate process whilst lean focuses on enhancing the process. This can be described as re-engineering of a process. After, the DMADV method has been implemented then the next phase would be to sustain the changes by applying the same type of sustainability tools as mentioned in step 5.

3.4.2 Output Problem

- Step 7; With regards to an output problem within the organization, the concept is not so different to the process problem in context of whether it's existing or new. In the output problem it focuses on what the organization produces whether it's a service rendered, or an actual product produced. This focuses more on the quality of either services rendered, or the product produced to meet the customer(s) demands. This problem is suitable for the Six-Sigma methodology which is a framework that focuses more on improving the quality of services or products produced. In this regard, when looking at an existing problem within an existing product or service the Define, Measure, Analyze, Improve and Control (DMAIC) method is suited for this type of problem. The DMAIC method is also most effective for the remodeling of current services or products to match the fluctuating needs of the customer in other to reduce variation from the product or service requirements and shares the end goal of reducing defects to provide high quality to customer needs.
- Step 8; When looking at a new output problem, this is when an organization is looking towards introducing a new product or service to the market. This can be described as a product or service that are not currently in existence yet. So, the aim of the organization is eliminating any possible defects that may occur. The method suited for this type of problem is Design for Six-Sigma (DFSS) which is also known as DMADV method, a variation on the traditional Six Sigma methodology. Previously, DMADV was used to develop new processes rather than improving existing processes and then verifying whether the newly developed process is successful. On the other hand, this DMADV falls under DFSS approach with sole purpose of creating a service or product that fully meets the customers expectations by providing it at the highest quality and achieving success at the first attempt. In contrast to DMAIC, the DFSS method focuses on preventing defects and planning for quality whilst DMAIC focuses on eliminating current defects and improving quality. The final phase of implementing the DFSS method is to sustain the changes by implementing sustainability tools as suggested in the previous steps.

It is important to note that the quality improvement methodology decision tree shows the distinct differences between methods that would be appropriate for the type of problem one is trying to solve. Rather than saying lean techniques is the absolute method for resolving issues within the healthcare sector and neglecting other quality tools that could act as a supplement to the lean methodology or understanding the requirements of a problem for it needing a specific type of quality tool. Although, the framework was explained in different steps on whether it's a process or an output problem, it doesn't mean it should be arranged in that order as it is dependent on what exactly the organization is trying to achieve. If the problem may take longer than a week and if it is a process problem which focuses on the efficiency of the process which is how quick the process can be with little resources used which is achieved by either eliminating or preventing wastes identified. On the other hand, the output problem focuses on the effectiveness of the process of what is being produced whether it's a service or a product. In the development of this framework, it had to be realized through other research project with the hypothesis being that this framework can ensure a cycle of continuous improvements and sustain it. Now it is a question of how it can be applicable within the context of the healthcare sector of which in order to make sense of the framework its by actual application and confirming that it is valid. However, the researcher had to look at the quality comparison framework developed by PHAB [40] in Table 6 to see how each methodology plays a role in selected improvement projects and how they can compliment each other in the quest for continuous improvement will give more understanding as to how the researcher's own framework will be developed.

Table 6: Quality Improvement Methodology Differences *[40]*

	PDSA or PDCA	Kaizen/RIE	Lean	Six Sigma	Lean Six Sigma
Definition	A concept for identifying and testing a change. Plan-Do-Study-Act (PDSA) or Plan-Do- Check-Act (PDCA) which are the same thing but reflect different translations from the Japanese concept.	A Philosophy of continuous improvement through small and steady incremental changes to always working to create more value and less waste. Kaizen "events" or "blitzes" are sessions involving all employees working on a process to identify and make multiple rapid improvements.	A method used to maximize customer value by eliminating or reducing waste. Follows the A3 process that essentially is a version of PDCA. Specific steps are outlined below in the PDCA section.	A method to reduce the probability that a defect or error that would occur. Follows the DMAIC process which will be outlined. (Described below)	An approach to eliminating or reducing waste and variation which combines both Six Sigma and Lean methodologies.
The Objective	Small scale changes are tested before adopting it as a standard practice.	Small and incremental changes that will adds up to significant changes over the longer-term.	Development of a set of practices that are standardized so that process speed is maximized at the least amount of time and decrease waste with no unnecessary steps.	Reduction of variability in the outputs of products or a process.	Increasing quality and reducing defects/variation whilst increasing process speed.
Situations where the approach is most useful	PDSA/PDCA is part of Kaizen, Lean and Six Sigma methodologies. All of which entail the following steps: To analyze the problem and its root causes; identify potential solutions (plan); test the solutions (do); analyze the results of the test (study/check); and implement the new process (act). On its own, PDSA/PDCA is a useful framework for process improvement when other approaches aren't clear as indicated.	Any process which can be tested and changed over a limited time period. Generally, takes up to a week to implement.	When a process is too slow to meet the customer demands. Or a process is felt to be overly cumbersome due to excess of motion, transportation, people, supplies, or time delays.	When a process has defined its "normal limits" for its measurable outcomes and yet the outcomes vary more than what is considered to be within the normal limits. Then the goal is to reduce the variation so that all the outcomes are within normal limits.	Combination of situations such as process improvement and reduce variability within the output of the process in which it would be helpful to apply both Lean and Six Sigma tools and methods.

		PDCA/PDSA	Kaizen	Lean	Six Sigma	Lean Six Sigma
Major Steps	Plan	- Defining the problem - Collect baseline data - Assemble a team - Develop aim statement - Design a flow chart - Conduct root analysis - Identify and mistake-proof solutions. - Carefully consider the solutions proposed, identify problems that could occur, and revising the solutions. - Create a workplan to test the changes.	- Defining the problem - Collect baseline data - Assemble a team - Documenting the current situation/process - Identifying root causes/key issues - Develop high impact solutions	- Define the problem and assemble a team - Design a "current state" process map that identifies problem areas (document baseline data if needed) - Conduct a root cause analysis - Identify and develop counter-measures - Design an "ideal state" process map - Develop a plan for execution - Develop a follow-up plan with predicted outcomes - Communicating with everyone that will be affected by the process	- Define: Articulate the problem and assemble a team, customer, voice of the customer and imperative process outputs - Measure: Initiate baseline process performance measures - Analysis: Identification of the root causes, develop a hypothesis as to why the problems exist and prove or disprove the hypothesis	
					- Development of design concepts and high-level designs. (DFSS/DMADV)	
	Do	- Test or implement the changes and collect data	- Assess solutions	- Execute the plan	- Improve: Develop and pre-test solutions then collect data to measure improvements to test its effectiveness.	
	Study/Check	- Analysis of the results (study) - Analyze expected results vs actual results		- Assess results according to the follow-up plan	- Design: development of design and control/test plan (DFSS/DMADV)	
	Act	- Organizing and testing or, once desired results have been obtained, standardize the new process and monitor indicators in order to "hold the gains"	- Acquire sponsor approvals to install solutions - Install solutions		- Control: Develop a Monitoring Plan to continue to measure the performance of the process and develop counter-measure in case of performance drops.	

					- Verify: validation testing is conducted to assess whether prototype/designs meet customer needs before actual product/process launch. (DFSS/DMADV)	

	PDCA/PDSA	Kaizen	Lean	Six Sigma	Lean Six Sigma
Key tools	- Flowchart/Process maps - Data Tools (e.g., run chart, Pareto chart) - Root Cause Analysis Tools (e.g., fishbone diagram, interrelationship diagraph, force field analysis, 5 why's)	- Value Stream Mapping (VSM) - Gemba Walk - Root Cause Analysis Tools (e.g., 5 why's) - Pareto chart	- VSM - Process Mapping - Takt Time - Root Cause Analysis Tools - Load Balancing - 5S - 8 Wastes - Kanban	- Voice of the Customer - VSM/ Process map - SIPOC diagram - Root Cause Analysis Tools - Kanban - Control charts - Pareto charts	Combination of Lean and Six Sigma tools.
Notes on Value Stream Mapping		VSM gathers detailed measurements of many small improvements that, when combined, can add up to significant amount of improvements.	VSM identifies wasteful steps in a process.	VSM/Process Maps identify problems that can lead to variation in process outputs	

In addition to the quality methodology comparison, it is important to note that all four methods are data driven to understand the problem and whether the changes will result in an improvement. Furthermore, all the methodologies essentially all use the same tools and often combine approaches. All methodologies are grounded on the concept of continuous improvement therefore it is not merely a series of discrete improvement efforts but rather building the QI methods as part of the culture of the organization. So, understanding the distinct differences sheds light to what specific problems it is intended to solve.

3.5 Research Design

The research design depends on the research approach chosen. Reason being is that it is predetermined by the methodology used to address the problems in the healthcare sector through the QI methodology decision tree which was developed through a deductive approach. In other words, the framework developed will be used to analyze the problem which separated the different QI methodologies which guides the research design in what type of data is required to validate the framework and add to literature.

In selecting the appropriate method for this research project, the researcher had to consider three factors which was adopted by Soiferman [41]. These are:

1) Matching the approach to the research problem: For problems where trends or explanations need to be made then a quantitative research design is best suited for this. On problems where it needs to be explored to obtain a deeper understanding than the qualitative research design.
2) Fitting the approach to the audience: it is imperative to remember who the audience is and who read and possibly use the findings from the study.
3) Relating the approach to the researcher's experiences: the method selected must be relatable to the researcher's own experiences and training. In this regard, quantitative researchers will have taken training or courses such as statistics, measurements and quantitative data collection approaches such correlation, experimental or survey techniques. Whilst qualitative researchers require experience in field

studies in which they gather new knowledge in a setting and learn the skills interviewing and observing groups or individuals.

In context of the three factors, the researcher looked at the quality improvement methodology whether the Six-Sigma methodology or the Lean Methodology is data driven and uses quantitative methods in analyzing and interpreting. This is done through understanding once quality methodologies are implemented, based on the results it determines whether there have been any signification changes. To which the QI methodology is an objective approach. The researcher's consideration of the audience to this study is intended for explanation and justification of the quality methodologies and development of the framework to determine its applicability within the healthcare organization which falls under the service sector.

A suitable research design would be the quantitative research design. Reason being is that the study aims to identify whether the quality improvement methodology decision tree is applicable in the healthcare sector and will it result in a significant improvement and ultimately end in a cycle of continuous improvement and sustain the changes. In contrast to a qualitative research design which would focus on individuals or groups' experiences and perception of a phenomenon which is to understand the problem at hand which cannot be measured with tests or surveys making it not suitable for this study and is an objective approach. Table 7 was used in shedding light in guiding the researcher in the distinct differences between the different research designs.

Table 7: Different Research Methods *[41, 42]*

Quantitative methods	Mixed Methods	Qualitative Methods
Pre-determined methods	Both emerging and pre-determined methods	Emerging methods
Deductive Approaches	Abductive Approaches	Inductive Approaches
Instrument based questions	Both close and open-ended questions	Open-ended questions
Performance, observational, attitude and census data	Various forms of data drawing on all possibilities	Observation, document and audio-visual data
Statistical analysis	Both text and statistical analysis used	Text and image analysis
Statistical interpretation	Across databases interpretation	Themes, patterns interpretation

3.6 Data Collection

After it was established on which research design was appropriate for the study it then gave guidance as to what type of data that needs to be collected. The researcher had to consider exactly how the data would be collected to validate the research design. There are two types of data collection processes which are:

3.6.1 Primary data collection

The primary data collection process is defined as the first-hand data which is data that is gathered by the researcher. In context of the research project if the researcher had to select this type of process, then ethical considerations have to be considered, costs and time consumption to achieve collecting the data required. In applying a quality management system to improve a problem within the healthcare sector, the first step would be to apply an observational technique on the basis of understanding what the processes and understanding the contributing factors to the problem and documenting the findings. In this case the researcher would physically have to be in the healthcare and conduct the observations. The researcher would apply the “Gemba Walk” which is essentially part of the lean management philosophy which aims to observe the employees, ask questions about their daily tasks, identifying project opportunities and possibly ask the customer questions to understand the value adding activities with the purpose of only listening, documenting and connecting with all contributing factors to the organization’s functions.

According to past literature, waiting time is the most problematic factor within the healthcare sector with lack of emphasis on the sustainability of lean tools or other quality management tools. The researcher will need to take that into consideration by investigating whether that is still a relevant problem currently within healthcare organizations. However, due to the researcher's geographical location the researcher would choose to conduct the research within South African healthcare organizations whether it be the public or the private sector. The researcher would only need one hospital or clinic to test the effectiveness of the QI methodology decision tree. To achieve the primary data collection process for the research project the first step would be gather ethics approval, reason being is that the researcher will need to engage with all the participants that play a role in healthcare organizations to complete the research project which would go as follows:

- Step 1: Submit research project to the Department of Industrial Engineering in the Durban University of technology (DUT) to gain approval to the next step. (Lead time: 6-12 months)
- Step 2: Obtain ethics approval from the Institutional Research Ethics Committee (IREC) at DUT. (Lead time: 3-6 months)
- Step 3: Submit ethics approval document to Provincial Health Research and Ethics Committee (PHREC) to gain access to selected healthcare vicinities in KZN to conduct an observational study. (Lead time: 3 weeks or more)
- Step 4: Permission from the CEO or relevant manager of the hospital as the gatekeeper. (Lead time: highly dependent on the CEO/Manager)
- Step 5: Gatekeeper appoints mediators.
- Step 6: individual Participants identified. In this stage the researcher will need to issue out a consent forms which abide by the ethical rules set by IREC and PHREC. Even if the researcher knew the participants personally the information collected would be null and void until ethical considerations has taken place.

After the necessary steps to gain approval to gain access to the selected healthcare environment then the researcher applied a Gemba walk to gather:

- Detailed information about the daily tasks to develop a detailed process map of the particular department. In this regard, the participants selected would be

the admin clerks to gather the process of the information flow because they would know steps a medical patient would take from start to finish as they are the central point of how the information of the medical history of the patient is handled. This stage would also fall under the observation techniques to verify the information given to the researcher by observing firsthand if information given matches the process observed.

- Detailed information about bottlenecks encountered within the hospital/clinic, the admin clerks would be able to assist and obtain access to information of medical patient complaints. The researcher would then break down the complaints into eight types of wastes to determine which is the most problematic area.
- The researcher would also measure the waiting time and process time of each process by means of observing.

The important factor that would play a part in the primary data collection is when and how it is collected. The period of the research project was from 2021 to 2022 where covid-19 regulations had a huge impact on how the research would be conducted and creating further bottlenecks and delays in approval statuses of ethical stages to consider. Another factor was a natural disaster such as flooding that affected KZN in 2022 which was where the researcher planned to conduct the research project which all played the part in the delays of the primary data collection process.

3.6.2 Secondary data collection

The secondary data collection process can be defined as gathering information that has already been collected by someone else and which is available for the researcher to use. In contrast to the primary data collection, secondary data is much cheaper and quicker to obtain. One of the main advantages is that data can be re-analyzed to demonstrate actual or potential relationships between variables, for example it's between environmental conditions and health. There are various ways where the data can be collected by published or unpublished data, government documents, reports, publications, reports prepared by other research scholars from universities and other sources which can be found easily. However, the researcher must be cautious of using secondary data. Reason being is because it is possible that the secondary data may be unsuitable or may be inadequate in context of the problem which the researcher wants to study.

If the researcher were to collect secondary data, then the selected approach to collect the data based on the researcher's experience is through the analysis of a PRISMA flow chart. This will be used to serve the purpose of the study to gather our own interpretation. In that regard, A comprehensive analysis of the private Medical Centre's day-to-day operations, including waiting times from reception to discharge or admission area, was extracted as secondary data from the study of Theunissen [6] which was conducted in 2012.

3.6.2.1 The selection process:

The researcher would adopt the approach of Tlapa, et al. [12] which utilized a PRISMA flow chart as illustrated in Figure 6 below. This would assist the research to narrow down all the LH or any other quality improvement principle studies in context of SA in order to identify re-usable data that can be re-interpreted to fit the purpose of this research project.

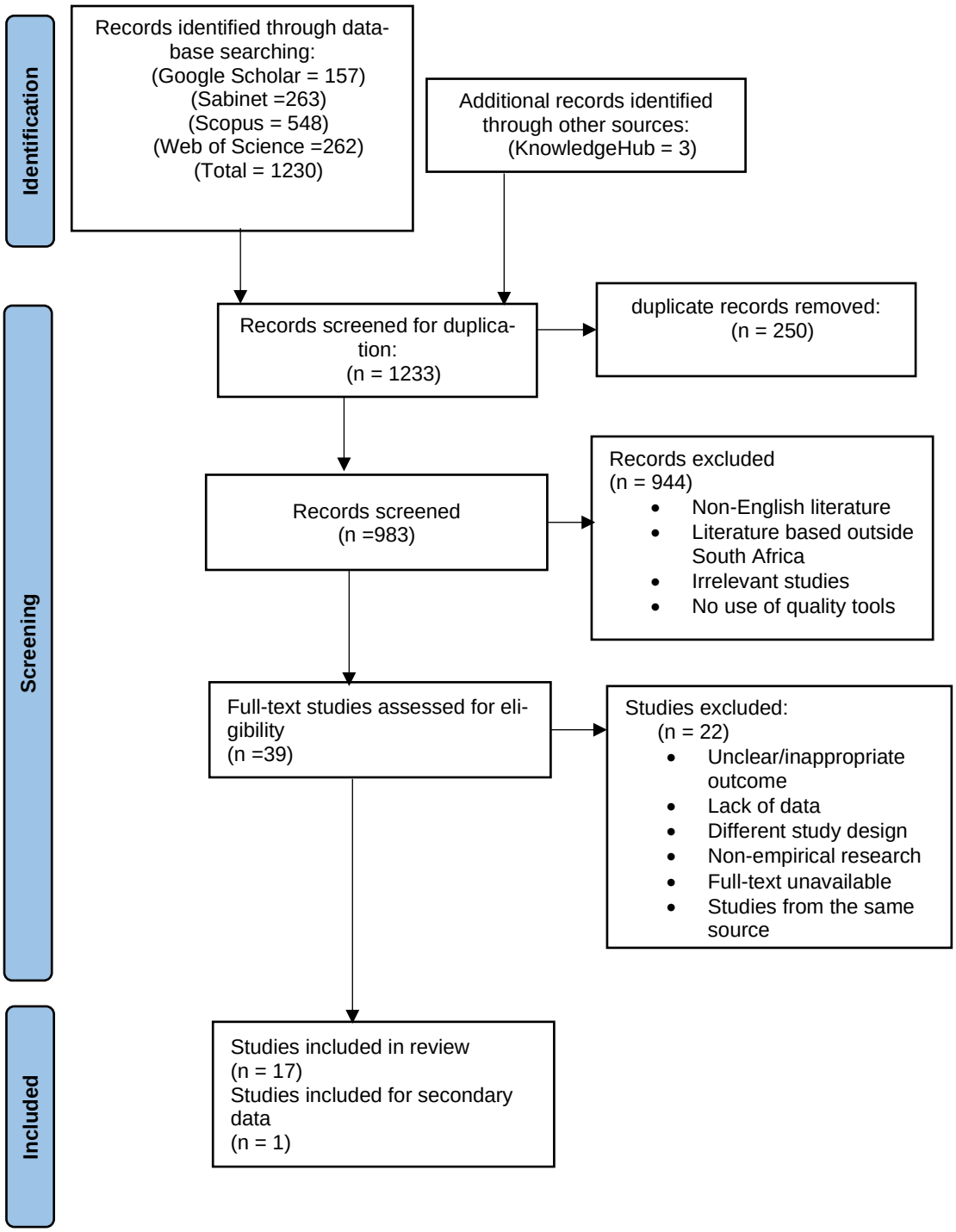


Figure 6: Prisma flow chart

In summary of Figure 6 illustrated above, out of 984 studies concerning any literature or other sources concerning the implementation of quality or lean management practices in South African health organizations. Only 16 studies were eligible and relevant to the researcher's research project. However, a step further was to analyze the eligible studies to determine which of the studies is suitable for secondary data collection and analysis suited for this research project. The researcher set the criteria for the data needed for the research project which is:

- The Research Problem: Are the studies' research problems relevant to the researchers? To validate the relevancy of the problem we first had to identify whether the problem is still a current issue even though a quality tool was implemented. The researcher will use customer reviews which will give insight of the customers experience with the service of the healthcare environment of where the quality or lean tool was implemented. The website called HelloPeter is a respected online platform which allows consumers to express their experiences about services or products received whether good or bad. The online platform will be used to source out the reviews to evaluate the relevancy of the research problem which asks the question of:
- Does the healthcare environment still need use of quality improvement tools presently even though it has been implemented before?
- The Process: does the study have sufficient information to document the processes within healthcare environment? In this case the researcher should be able to conclude whether its information or material or patient process flow that the study will towards improving.
- Reliability of the data: to determine the reliability, the researcher looked at factors such as ethical procedures implemented, was there any bias in conducting their research? Where was the data collected? And were proper methods used to collect the data?

Based on the criteria set by the researcher, out of the 16 studies only one study was eligible to be used for the research project. The study was conducted in a private hospital by Theunissen [6], the hospital is a Medical Centre situated in Kempton in the province

of Gauteng, SA. The studied utilized an experimental case study method, which is more familiar with qualitative methods but could be used for quantitative purposes. To explain this further, it is best to look at the reasons why this particular study was chosen which goes as follow:

- The research problem: The study broken down its research problem to two sections which one focuses on improving infection control rates in medical patients with ventilator associated pneumonia and central line associated blood stream infections and also reducing waiting time in the waiting area through lean management techniques. However, for the purposes of this study the researcher will focus on the reduction of waiting time as it is more familiar with the researcher and a common problem within past literature. However, to validate the research problem is relevant and still a pressing problem then this is where HelloPeter plays a role in proving that waiting time is still issue that private hospital is facing through the complaints of the patients because value is determined by the eyes of the customer which is the medical patients.
- The process: The study was the only one out of the 16 studies to have sufficient information to document a process map and understand how the Medical Centre operates. The study is clear on the process of the patient flow, but the study can also interpret the information flow that concerns the patient.
- Reliability of the data: The study did apply ethical considerations and was granted clearance to proceed with the research project. The research project used secondary data which was used to collect customer complaints and actual times of when patients were admitted over a 24-hour period which was taken from the Medical Centre's IT-department database. The study analyzed this which assisted with finding the peak admission times in the casualty waiting area and the trend in customer complaints. The primary data was used to apply observational techniques to document the patient flow from beginning to end of the causality area. The study analyzed the patient flow by measuring the trauma unit in context of waiting times, inefficient procedures in terms of wasteful procedures and its complexity to propose improvements. The study applied lean management techniques which followed a three-step method which observation of flow, value analysis and redesign.

In addition to the reason for selecting this study it is important to note the study was of a business administration discipline which was examined and approved by the Nelson Mandela Metropolitan University which makes the study reliable. However, it was unclear to the researcher how exactly the waiting time has been improved through value analysis and sustained but was clear on how the patient flow would improve. To summarize the lean tools the study utilized Gemba walk, Direct Observations, standardizing of protocols, 5 why's and Macro Process flow.

3.6.3 Data collection method chosen

The selected data collection process for the research project is the secondary data collection method. Reason being, is that the researcher had first attempted to apply the primary data collection process but the noted delays occurred mainly in the lead time in approval processes. The secondary data collection process is a cheaper and more efficient option as it cuts down on time, traveling costs and any constraints that would have occurred if the primary data collection process was followed through to the end. Due to the nature of the selected secondary data, it is possible for the researcher to re-analyze the data and draw out a different interpretation and conclusion by applying a different approach to solving the problem at hand. However, to avoid any negative implications the name of the healthcare organization being studied will not be disclosed, however describing the background of how the organization operates is permitted.

3.7 Data Analysis

Once the secondary data is collected it is then analyzed using the appropriate methods. The data analysis seeks to make use of data collected in order interpret and draw out a conclusion and make an accurate decision on the subject at hand. In this regard, the researcher first analyzed medical patient's complaints from the online platform where customers share their experiences in order to understand and post the lean application in the Medical Centre. This will show if there had been any improvement on the patient

experience from the patients' point of view, this will also shed light to what is value and what is waste in the eyes of the customer/patient because every healthcare environment functions on the basis of providing care to the community. The tool used to analyze this will be a Pareto Analysis which is a lean tool that will guide in prioritizing which problem to tackle by observing the relationship between the various root causes and effects of the processes within the organization. Pareto Analysis defines that 80% of the problems is traced to 20% of its causes to which significant amounts of improvement can be achieved by minimal efforts [43].

However, to articulate the problem it is broken down into eight types of wastes and then analyzed using the pareto analysis. After this is completed then the framework developed by the researcher will be used to interpret the causes and analyze even further by analyzing the continuous improvement tools used to solve within the context of the problem in the study and guide in proposing additional or missing improvement tools required to reduce the inefficiencies found within the processes and sustain the cycle of continuous improvement.

3.8 Summary and Conclusion

This chapter explains in detail how exactly the research project aims to solve the particular inefficiencies encountered in healthcare organizations by using lean management techniques through means of a proper research process. The study primarily will be using lean management tools to identify and solve the problems but through a deductive approach of analyzing past literature that other quality tools may compliment lean efforts by means of sustaining and further improving the improvements. Since quality management tools such as lean techniques utilizes quantitative methods of improvement the study opted to use a quantitative research design but using a non-experimental research design by means of understanding the independent variable is the QIM Decision Tree and the dependent variable being the outcome of an improved process within the healthcare environment without the researcher being present to do the changes but rather propose how the change will happen. In short, the data needed to solve the research problem was:

- Past literature reviews
- Customer/Patient reviews to share their experience

- Documented process flow in this case patient flow and information flow

The Software and tools needed to analyze and solve the problem is:

- Excel to extract patient experience
- MS Visio for process mapping of the processes within the healthcare organization
- Lean methods
- QIM Decision Tree

Chapter 4 : Analysis, Application and Interpretation

4.1 Introduction

The objective of this chapter is to analyze the secondary data collected for the research project in order to interpret the results within the context of the quality improvement methodology framework developed. Primarily, the study intends to apply lean management tools in addressing, identifying, articulating and solving the inefficiencies encountered within the healthcare sector. However, the QIM decision tree that was developed after reviewing past literature will supplement the sustainability of the lean techniques applied which will be shown in this chapter.

Before addressing any inefficiencies within the healthcare environment, like any other QI method a brief description of the background analysis of the organization being studied is imperative to understand the context of the problem the researcher is trying to solve.

4.2 Background Analysis

The Medical Centre is one of the largest independent Private hospitals in SA and situated in Kempton Park, Gauteng. The Medical Centre has over 50 different departments covering various types of disciplines. It has the following:

- a 24-hour emergency department also known as casualty department and a trauma unit
- 343 beds with 33 ICU beds and 10 neonatal ICU beds
- Sees an average of 2000 patients per month therefore averaging of more or less of 500 patients per week.

Regarding lean management techniques applied, the study first observed customer complaints to determine which inefficiency or problem to resolve and improve from the patient's point of view. Upon the study's analysis it was the long waiting time to see the doctor to which the causality department is the area of concern. Sampled data was collected looking at a 24-hour period within two months in 2012 to determine the average

patients seen per hour. To which, an average capacity of patients seen per hour is three to four patients with the busiest times being from 16H00 to 24H00.

Waiting time is noted in each process alongside measuring which process contributes the most to waiting time which is administrative processes. The lean tools used to combat the inefficiencies were:

- Identification of the wastes within the process was highlighted
- Developing the spaghetti diagram to depict the current process in the healthcare organization and the recommended future process.
- Ensuring a standardized protocol of the newly developed process in the spaghetti diagram

In the study it notes the wastes identified within process but does not clearly indicate how the wastes will be reduced or eliminated but merely just adding more beds and cubicles to prevent any bottlenecks and standardizing the recommended patient flow. Since the lean management was applied to the hospital over a decade ago, so it should be assumed that the customer complaints regarding the waiting time to see the doctor will be reduced. Therefore, the patient experience score will improve thus making the hospital more recommendable to potential patients. However, that seems to not be the case upon analyzing recent patient experience. In this regard, the application of the QIM decision tree developed by the researcher. The methods in the framework will be labeled in alphabetical order to guide the researcher in explanation of each step taken to resolve the problem as displayed in Figure 7.

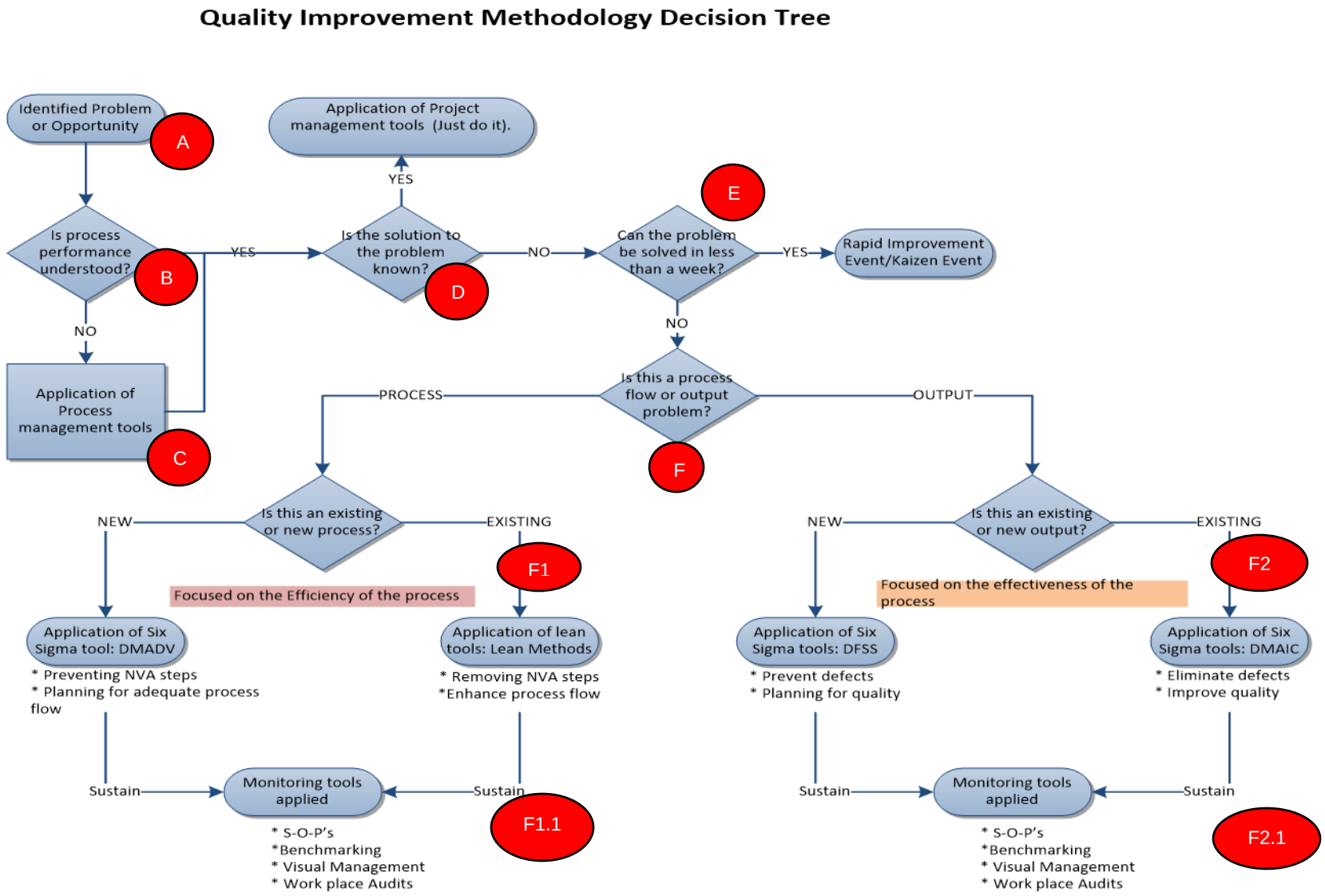


Figure 7: Analyzing QIM the Decision Tree (Author Developed)

4.3 Applying QIM Decision Tree

A: The identified problem is that there are still inefficiencies present enough to impact negatively on patient experience within the private hospital. The lack of sustainability of the lean efforts implemented bring an opportunity for the quality improvement project to instill measurable outputs to improve by improving the processes within the healthcare as it is noted that there are not any measurable outcomes but merely identifying the wastes within the hospital.

B: The process performance is not clearly understood based on the secondary data analyzed. Since the project began with patient satisfaction score and the waiting time was the primary concern, then what are the indicators that will show that there has been an improvement through the application of the lean management technique?

C: In applying the process management tools, it's in the basis of what tools are being used to measure and the management of the processes within the hospital. In this regard, the focus is on improving the patients' experience by improving the process flows within the hospital. This will be done by analyzing the patients experience reviews and interpreting the data and instilling quantifiable and measurable outcomes. A current state process map is developed which will be designed after establishing the performance indicators which will be shown in this chapter.

D: the solution to the problem is not known as this is a large-scale project.

E: Due to the problem being a large-scale project and more data collected to solve the problem such as instilling performance indicators through analyzing patient experience and interpreting them then the project will take more than a week.

F: Based on letter B and C, the project has to develop process performance measurable outcomes. Thereafter, attempt improving the process and then standardize the recommended approach with measurable output indicators of the process.

F1: the process the researcher is trying to improve is an existing process within the hospital by application of lean tools to minimize waste to enhance the process. In this regard, the lean tools used will be:

- Lean Waste Identification: through the analysis of patient experience reviews and interpreting the reviews by categorizing the reviews into the different eight types of waste.
- Pareto Analysis: After interpreting the reviews into the types of wastes to get the described causes then the pareto analysis is applied to focus on the main problems to get a high impact result. Which by definition is that if it solves 20% of the causes to the inefficiencies in the Medical Centre than it will reduce 80% of the inefficiencies within the hospital.
- Value Process Map Identification: In order to enhance the flow, the researcher has to eliminate the wastes within the flow discovered within the process by waste identification and standardize the approach.

F 1.1: to standardize the recommended approach then it would be preferable to use a:

- SOP by means of a flow chart on how the new process is recommended within the department to avoid deviation of the process.
- Benchmarking will be used to measure internally if the hospital has improved from their previous performance and can possibly improve even further. For e.g., medical patients are less likely to complain when they are attended to for less than 45 min therefore the benchmark would be to consult to all the patients in under 45min. Another example is to achieve the average five-star review rating which means the hospital is notable for giving an outstanding service to their patients and highly recommendable to other potential patients to receive their services there.
- VM by means of displaying charts that's visible to all stakeholders such as process flow charts that's displayed around the hospital or graphs displaying the benchmark of what the hospital should achieve or notice board displaying to patients the average time they are expected to wait before consulted with a doctor.

F2: After analyzing the problem by using the QIM decision tree to eliminate waste within the process for the purpose of making it more efficient. However, once the new recommended flow has become the new norm and defined its normal limits there will be hidden problems that will expose new problems that will be encountered and deviations in the output of the process. This is where letter F2.1 comes into place in using the six-sigma method which will utilize the control chart tool in identifying and minimizing the deviations within the improved process which will be displayed in this chapter.

Patient experience

In analyzing the patient experience the researcher is also measuring the performance of the hospitals capacity to render efficient services to their patients and to instill a performance indicator as mentioned in letter C. Analyzing the reviews about the patient experience in the Medical Centre gives the researcher an idea of if there's been any improvement post lean application of the patients experience. The data on the patients' experiences is a review dated from May 2016 to October 2022 which is all the reviews about the private Medical Centre and none of the reviews was excluded. Snapshot taken from the online platform displaying hospitals performance in terms of meeting the demands of customers/patients is shown in Figure 8 [44].

Figure 8: Performance Ratings

In Figure 8, it shows that based on 221 reviews on patient experience it has a 3.3 average star rating out of 5 which is quite low for a private hospital. The only platform breaks down the performance of the hospital based on three factors which are:

- Trust index rating: The trust index is a way where consumers determine how credible the business is. This is measured by observing and calculating the average review star ratings and average time to reply to the reviews [44]. The Medical Centre scored 3.3 out of 10, which is fairly poor and is a clear indication that the business does not focus on providing great customer service to its consumer due to a low response rate alongside a poor start rating.
- The ranking: The ranking of the hospital is determined by the overall customer service in comparison to hospitals in the private or public healthcare sector. However, upon the researcher's analysis of the ranking it is inconclusive because not all the private and public hospitals did not have sufficient data to support its ranking and some of the comparisons between the healthcare services were irrelevant such as comparing a pharmaceutical company to a hospital.
- Net Promoter Score: The net promoter score is measured by how likely the reviewers which the consumers are going to recommend the hospital. The ranges are if less than 0 = less likely, 1 to 49 = likely and above 49 = very likely. The hospital scored -24 which means the reviewers are less likely to recommend the hospital or return for future services. The score is a good indicator that the hospital is losing potential patients.

Upon analyzing a summary of the patients' experience toward the hospitals providing good service to their patients. More importantly, what the data tells us is that post lean application that any improvements made disappeared over a period and the customer service deteriorated over time. Analyzing the patients experience provides an overall view of how the hospital is performing, but it's imperative for the researcher to analyze the comments of the reviewers and interpret it in a lean management perspective by identifying the wastes which are regarded as inefficiencies from the customers point of view and possible cause.

It’s important to note that out of the total 221 patient reviews, negative comments of patients who received poor services contributes 62% of the total reviews which is mostly the one-star rating which has about 136 negative comments about their experience in the hospital. Due to the negative comments contributing mostly to the customer review then this will be analyzed as a foundation of applying the lean management technique. Furthermore, out of the 136 negative comments analyzed 23 were excluded. This was due to the irrelevancy of the complaints contributing to the poor service delivery received within the hospital and such as complaints that were beyond the boundaries of the hospitals activities like complaints about parking or the patient expressing their complaint by using vulgar language or detailing the problem encountered [44]. In Figure 9 shows how 113 negative comments were analyzed and interpreted. However, for interested readers for the detailed comments below refer to the website of HelloPeter [44].

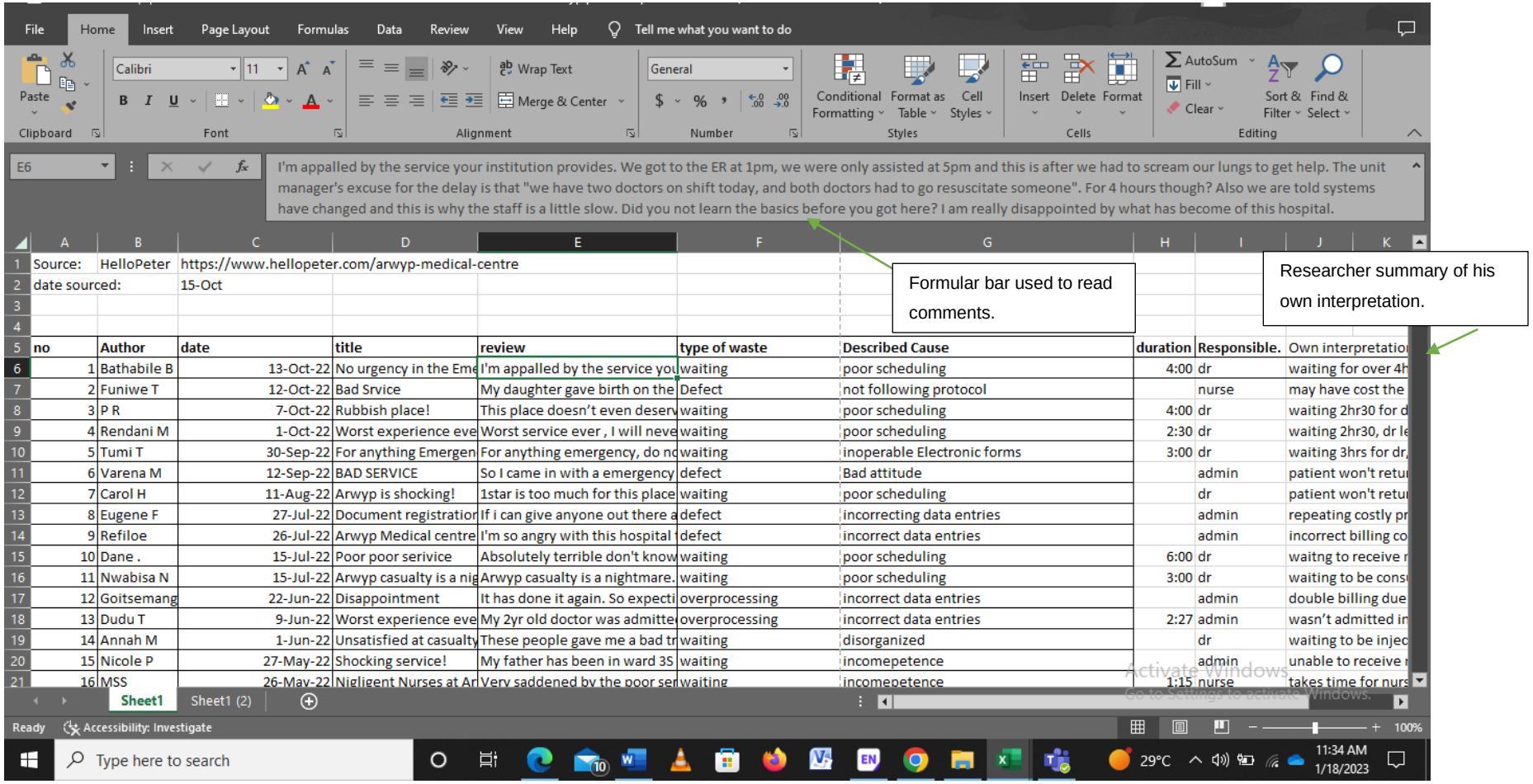


Figure 9: Patient Experience data Analysis (Author Developed)

As observed in the excel spreadsheet in Figure 9, consisting of ten columns in which the first five columns are data extracted from the online platform containing when the comments were written and the title of the review and the actual review in itself. Then the researcher applies the lean management method of interpreting the patient's point of view of what is regarded as waste as seen in column F. Moreover, the advantage of this data collected is that the customer describes where and who is causing the problem of providing poor service to them, which could provide guidance to the hospital on how to improve. In the last five columns from F to K is where the researcher starts interpreting the data in which the described cause in column G is mentioned from the customers explanations received as to why poor service delivery given to them or from their own understanding as to what's the cause of the problem. However, the researcher has ensured that the described cause is logical within the context of the problem in a lean management point of view which past literature plays a role in categorizing the described causes.

In column H is where data is extracted on how long the patient had to wait before receiving a service from the hospital in which the duration is described to be unreasonable and causing the patient to lay a complain. In context of the waiting time, 13 reviews detailed their waiting to which their average waiting time is 2 hours and 32 minutes. The longest recorded waiting time is 6 hours for an admitted patient who has only received medication after displaying that their condition is deteriorating and the shortest recorded waiting time is 45min in which the patient noted the inefficiencies observed on two accounts of hospital staff deliberately not attending to patient and duplicating administrative work due to missing files. With that being said, it is notable that patients are most likely to complain when they are waiting for over 45min without reasonable explanation when the patients can visibly see that the medical workers are within capacity to attend to them.

Column I, displays who is responsible for the problem whilst column J is the researchers own comments about their own interpretation. Now that the table has been populated and interpreted to the different wastes identified than a graphical representation is displayed throughout the number of years the wastes has been tabulated first using pivot tables in an Excel Spreadsheet as shown in Table 8.

Table 8: Yearly distribution of total counts wastes Identified

Count of type of waste	Years							
type of waste	2016	2017	2018	2019	2020	2021	2022	Grand Total
waiting	1	2	7	7	8	8	12	45
defect	2	4	7	5	5	6	7	36
skills	3	2	3	4	6			18
overprocessing	1		1	1		1	3	7
motion					2	1		3
inventory	1		1					2
underproduction	1				1			2
Grand Total	**9**	**8**	**19**	**17**	**22**	**16**	**22**	**113**

In Table 8 the collected total count of the different types of wastes in the context of lean management which has been tallied up through the analysis of the 113 patient reviews throughout seven years from 2016 to 2022. The numerical values highlighted in red are highlighted because they represent the highest inefficiency faced within the hospital each year. Furthermore, the table designed is for the purpose of collecting data and interpreting the data but simpler graphical representations of the table which will be used as summary to display visually for readers to understand are shown in Figure 10Figure 11.

Figure 10: Yearly Count of Wastes

In Figure 10, shows a description of all the types of wastes categorized and tallied up to give an overall summary of understanding if there's been an increase in inefficiencies discovered by the patients entering the hospital. Most importantly is what is understood by analyzing the summarized chart which is throughout seven years of patient review comments where there has been an increase in poor service delivery to the medical patients. This could also be used as a benchmark to see if the hospital is improving from the previous years. Now that it is known that there has been a decline in service delivery it brings about the question of where exactly most of the inefficiencies are encountered by the patients which is summarized and translated in a pie chart in Figure 11.

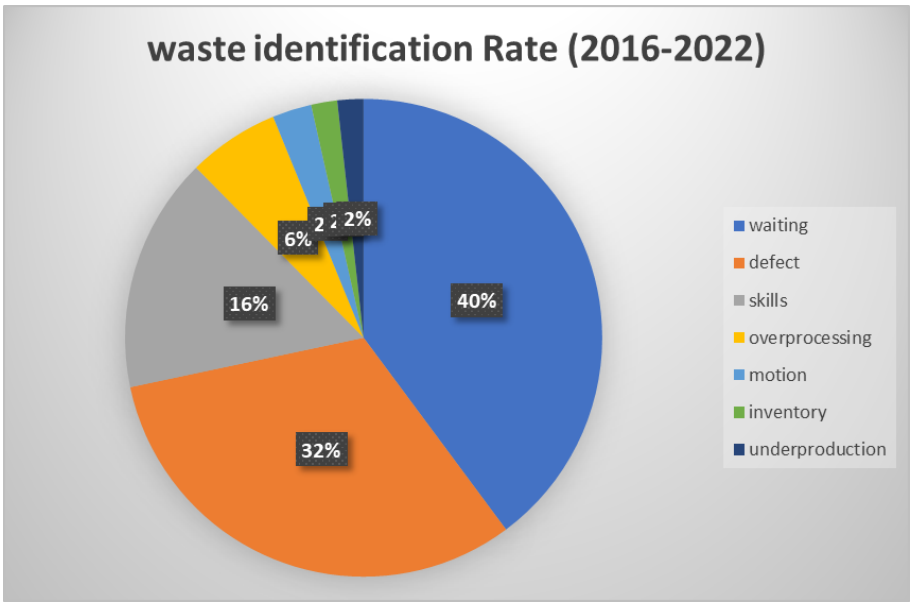


Figure 11: Waste Identification Rate Pie chart

The pie chart in Figure 11 is a visual representation of all the inefficiencies encountered within in the hospital but categorized into the different types of wastes within the context of lean management. Based on the chart, it displays that out of eight types of wastes there are seven wastes identified within the hospital which waiting contributes 40% of most of the inefficiencies encountered within the hospital which has been interpreted through patient comment reviews.

Although in Figure 10 and Figure 11 provides an overview of where are the most problematic areas to focus on and a measurement system put in place to measure where there are improvements on based on the total count of wastes analyzed on the comment reviews. Now, it's about what is causing the problems which once this is known it will give the researcher an idea on to how to solve the problems. From the types of wastes listed in Figure 9, the described causes to those wastes were noted to prioritize which causes of the type of wastes to be solved have a high impact result by using a lean management tool called the pareto analysis as displayed in Table 9.

Table 9: Pareto Analysis Table of causes

		Cumulative Percentage Cutoff:	80%
#	**Causes**	**no. complaints**	Cumulative%
1	poor scheduling	25	22.1%
2	Incompetence	23	42.5%
3	communication breakdown	16	56.6%
4	incorrect data entries	13	68.1%
5	bad attitude	12	78.8%
6	Negligence	11	88.5%
7	not following protocol	5	92.9%
8	telephone etiquette	3	95.6%
9	inoperable electronic forms	2	97.3%
10	hospital layout	1	98.2%
11	Disorganized	1	99.1%
12	poor inventory management	1	100.0%

In Table 9 illustrated above, which is the first step before creating the visual chart of the pareto analysis which Microsoft Excel was used to generate the chart. This is achieved by re-arranging the causes in a descending order from highest to lowest number of complaints and then cumulative frequency calculated to develop the chart alongside the cumulative percentage cutoff which is 80% which is shown in Figure 12.

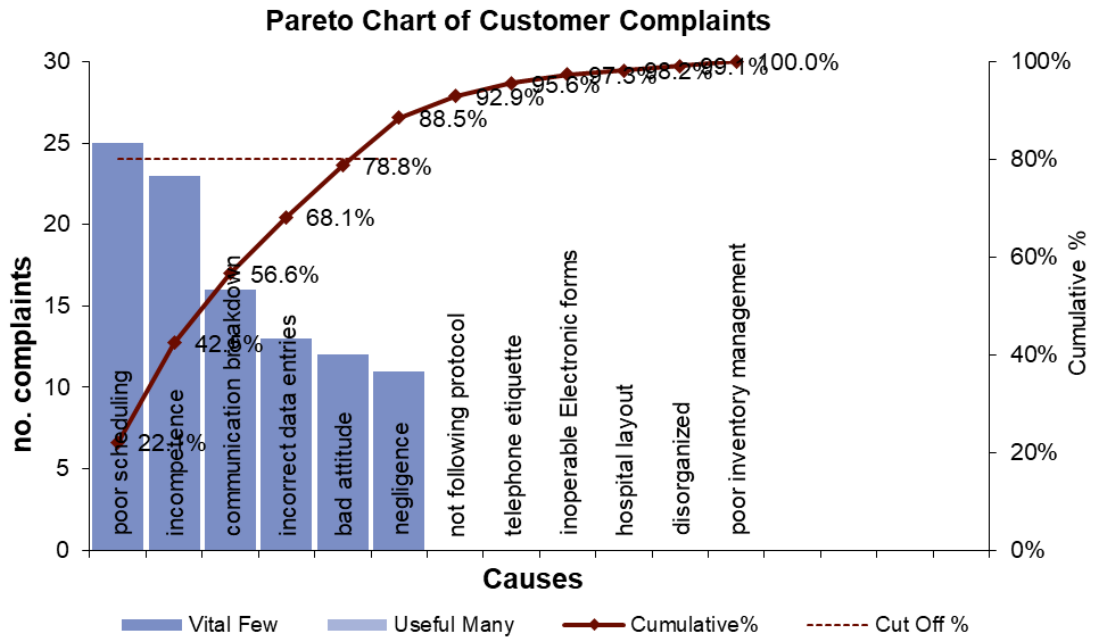


Figure 12: Part chart analysis of waste causes

The pareto chart in Figure 12, shows that these first six causes in the pareto chart covers 88.5% of the customer complaints which means if the researcher focuses on eliminating or reducing 20% of the causes within the hospital then there will be an 80% project benefit according to the pareto principle. Among the six causes identified as the vital few, most of it is attributed to customers complaining about waiting too long to receive a service which means there's inefficient processes within the hospital. However, out of the six causes, number 1 and 4 in Table 9 above could be improved through quality improvement tools whilst the rest could not be regarded as process improvement problem because it's based on human behavior.

Poor scheduling will be the focus of process improvement as it carries more weight in achieving a high project benefit whilst the incorrect data entry could also be caused by poor scheduling. Reason being is because it goes back to understanding that poor scheduling will result in an increase in waste such as overscheduling or incorrectly billing the patient which will negatively impact workflow, productivity. Resulting in medical workers feeling overworked and always seeming that there is a shortage of staff or simply not enough time to attend to all patients within reasonable time which ultimately will affect

customer satisfaction resulting in hospital having a bad reputation of poor resource management.

Furthermore, note that the cause is justified through quantifiable measures; now it's about how will the study go about solving it through the QIM decision tree? Since it's clear that the problem we are trying to resolve is a process problem and the lean technique is suitable to solve this problem, it may be easy to simply say the solution to the poor scheduling would be to just schedule the right employees at the busiest time or higher more employees to attend all the patients in order to reduce the waiting time. This is only but an expensive solution as it doesn't address eliminating or reducing any waste encountered within the process which means even if those proposed changes of re-scheduling or adding more workers would make a significant difference. As seen in the secondary, that even with noting which times are busiest within the hospital didn't make any significant difference in the long run as the same type of issues are still present.

In context of lean management which was selected by the QIM decision tree illustrated in Figure 7, a process map which is part of letter C displayed in Figure 13 below is required to be developed in order to understand where the wastes are coming from as the primary focus of lean technique is to increase the efficiency within a process to meet customer demands and the wastes identified must be eliminated.

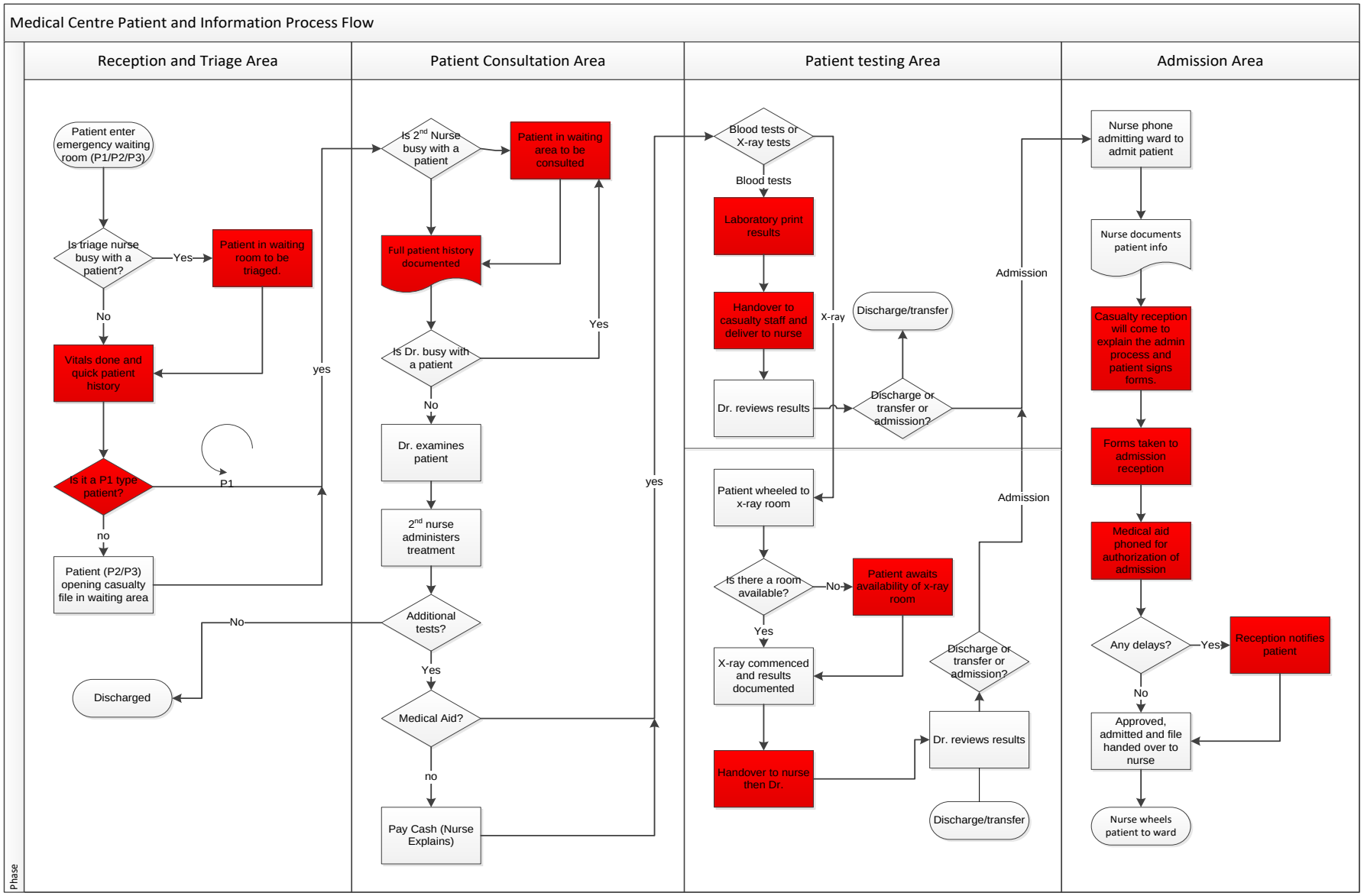
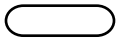
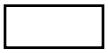
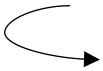


Figure 13: Medical Centre Process Map

4.4 Improving the Flow

In order to improve the flow within the private hospital a visual process map has to be designed and analyzed in order to understand how each process contributes to the organizations day-to-day activities. An advantage to note is that the visual map can assist in avoiding deviation of a standard process but not necessarily a tool used for continuous improvement as a VSM. The process map in Figure 13 displays how the private hospital operates to which the symbols represent each process which is explained in Table 10 below.

Table 10: Process map symbol description

symbol	Description
	Start/End of a process
	Process
	Documentation
	Direction of following steps
	Decision making process
	Pull

The symbols highlighted in red are steps within the process map that the researcher identified as areas that will need to be revised for improvement to minimize or eliminate waste which will be explained in further detail in the development of the value stream map after the process map has been explained in detail. Furthermore, the researcher broke the process down to four departmental areas in which goes as follows:

4.4.1 Reception and triage Area:

This is the starting point of all the patients that enter the private hospital from serious to non-critical cases which are categorized into three types of patients by the triage nurse which are:

- P1: These patients which are regarded as very critical cases that take priority over non-critical cases like P2 and P3. Their process doesn't differ from non-critical cases except that they are seen immediately and less complaints are usually received from them and sometimes these patients arrive in ambulance.
- P2: These patients are regarded as critical but are less critical patients in comparison to P1 patients and are seen by Doctors before P3 patients.
- P3: These patients are regarded as less critical and taken priority over the other types of patients meaning they are most likely to complain as they are seen by the doctor after P1 or P2 even though they have arrived first, so it is to be expected that their waiting time carries more weight than the other two categories.

The distinct difference in the triage process before seeing the doctor is that if the patients are P2 or P3 then they will be redirected to opening a casualty file in the reception and wait to be seen by the doctor upon availability. In this area of the department there are complaints where patients aren't triaged immediately and as a result some patients who are in actual critical condition deteriorated. Also, it's important to note that the patients that wait over 45min are most likely to complain without reasonable explanation of the delay of them being consulted by the doctor as observed in Figure 9 above of the patient experience data analysis.

4.4.2 Patient consultation area

After the patient has been triaged by the triage nurse all the types of patients are then seen by the second nurse upon the nurse's availability. The second nurse documents a full patient history and leaves the file for the doctor to review the document and consults the patients upon the doctor's availability. Once reviewed, the doctor will then instruct the second nurse to administer treatment if that's all that is needed to be done then the patient

will be discharged, if not then additional tests will be required and the doctor will instruct the second nurse to advice the patient further on the following steps. Before proceeding to the next steps doing the additional tests the nurse will ask whether they are on medical aid or not, which means if they are not, they will have to pay cash but on a separate account for each of the different types tests that will be needed to be conducted.

However, in the consultation area there has been discrepancies raised by the patients regarding the medical aid process with patients being double billed due to incorrect data entry from the administrative staff of the hospital. Delays with authorization process from the medical aid and at times payments not being processed through due to the private hospital not sending through necessary information about patient's admission status.

4.4.3 Patient testing area

After the payment process has been settled then the patient will proceed to additional testing which is do an x-ray where the patient will have to fill out admission forms and allocated to an available bed but if there's no bed available then the patient will have to wait. The x-ray results will be printed and hand delivered to the nurse who will document the time back from the x-ray department. Or either, do blood tests in which the laboratory staff will come in upon the nurse's request to draw out the patient's blood to conduct the tests; once done the laboratory will print out the results and hand deliver to the causality staff who then delivers it to the nurse. The second nurse will document the time they received the blood results. Both the x-ray and blood test result share the same end process of waiting for the doctor to review the results and give feedback to the patient of whether they need to be transferred, discharged or admitted in the hospital.

It's important to note that in this process the information shared about the patient's medical situation is shared manually which would require movements between the medical staff and patients. In this regard, delays do occur with reports being taking time to be received from the laboratory due to the laboratory sisters not being situated within the unit. Another inefficiency encountered is within the x-ray department is that although they

open for 24 hours the radiologists are only available at certain hours to do reports which will cause delays in medical treatments for the patient.

4.4.4 Admission area

If the doctor instructed the nurse to admit the patient in the hospital, then the second nurse have to phone the admitting ward to confirm an available bed in the ward to admit patient. Thereafter, the patient details alongside all the details of the doctors who consulted with the patient and the time in which information was handed down to the causality receptionist. The casualty receptionist will then come to the cubicle where the patient is situated and explain to the patient all the necessary information regarding the admission process in which the patient will have to sign agreeing to the terms and conditions. After the necessary documentation is done for admission within the hospital then the receptionist will note the time in the registry book and if the patient is on medical aid, then the receptionist will call the medical aid scheme that covering the patient's expenses to authorize admission if any delays occur the patient will be notified. Once all has been approved with signed documents then the admission file will be handed over to the allocated nurse who will wheel or direct the patient to the hospital ward.

The most cumbersome process within the admission area is waiting for the authorization from the medical aid scheme to allow admission and sometimes resulting in patients being neglected for other patients whilst waiting and not being notified. Another inefficiency encountered is delays due to predecessor processes such the doctor not receiving blood or x-ray reports in time which would delay the admission process.

4.4.5 Concluding the process map

Based on all that has been analyzed in the process map which details all the steps the patient takes when entering the hospital dependent on the type of condition the patient is in. Although the aim is improved patient flow, the researcher should consider the factors that influence the patient flow. Adopted from Henrique, et al. [3] which explains that hospitals are comprised of three supporting flows which are material, information and patient flow but the process map developed for this study only comprises of two flows out of the

three. These flows are the patient flow which is focused more towards the movement of the patient from department to department, if the researcher were to solely focus on the patient flow, then revision of the hospital layout would be required to shorten the distance for the patient to receive a service or adding addition triage nurse to quicken the triage process. if the researcher had to focus on the information flow which is a pivotal factor that influences the patient flow, reason being is when any type of patient that enters the hospital is managed by the information provided by the medical workers about their condition which is recorded in the patient file that determines where the patient should be going to next. An example of this is the consultation received from the medical doctor that determines whether the patient should be discharged or admitted or patient being described medication to which the patient would have to move to the next destination under the instruction of the medical doctor but this will have to be recorded on the patient file which the patient will need to have to be assisted further. Should the information on the patient file be incorrect then it would result in two things either a repetitive process of the patient moving back and forth to get it corrected or worst-case scenario of it leading to death due to patient being described the wrong medication. Another example is a disconnect between the private hospital gathering details in certain medical aid scheme authorization process which would cause delays in the admission process of the patient.

This can be concluded that in order to improve patient flow it is imperative to understand the information flow and identify any flaws in the process. Since the study aims to sustain any quality improvement methods such as lean techniques it would be advisable to start with projects that target improvement of the information flow to gain acceptance of suggestions for improvement then starting with patient flow which will guarantee failure in the long run [37]. However, there are three types of patients being P1 to P3 but the process they undergo when entering the hospital is very similar but treated very differently as sickly patients differ in their conditions. But the significant difference between all the patients is that P1 cases are likely to be received at the hospital through an ambulance but the similar point is that the P1 patient will still need to be seen by two nurses a triage nurse to determine how critical the patient is and the second nurse who does a full re-inspection of the patient history before seeing the doctor.

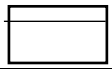
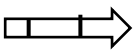
4.5 Developing the value stream map

In context of lean principles, in the development of the value stream map it is imperative for the researcher to develop a detailed process map of how the Medical Centre currently works to get a gist of how the CS-VSM will be developed because the VSM doesn't cover every aspect of how organizations operate and the complexity within each step of a process flow. Already within the process map the researcher was able to identify areas within the process map in Figure 13 on where the symbols are highlighted in red in which the CS-VSM will touch on. However, the whole purpose of a VSM is to identify waste in order to minimize or eliminate within the context of lean principles in order to make a process more efficient. In other words, by making the process quicker.

In this case the researcher will be looking at all the category of patients P1-P3 but P1 patients CS-VSM will be developed separately since their process is different from P2 and P3 where both P2 to P3 are similar in all areas but prioritized differently by the seriousness of their condition.

VSM symbols

Table 11: VSM symbols

symbol	Description
	Process
	Production control
	Inventory
	Pull arrow
	Electronic information
	Push arrow
	Kaizen burst

	Waste identified

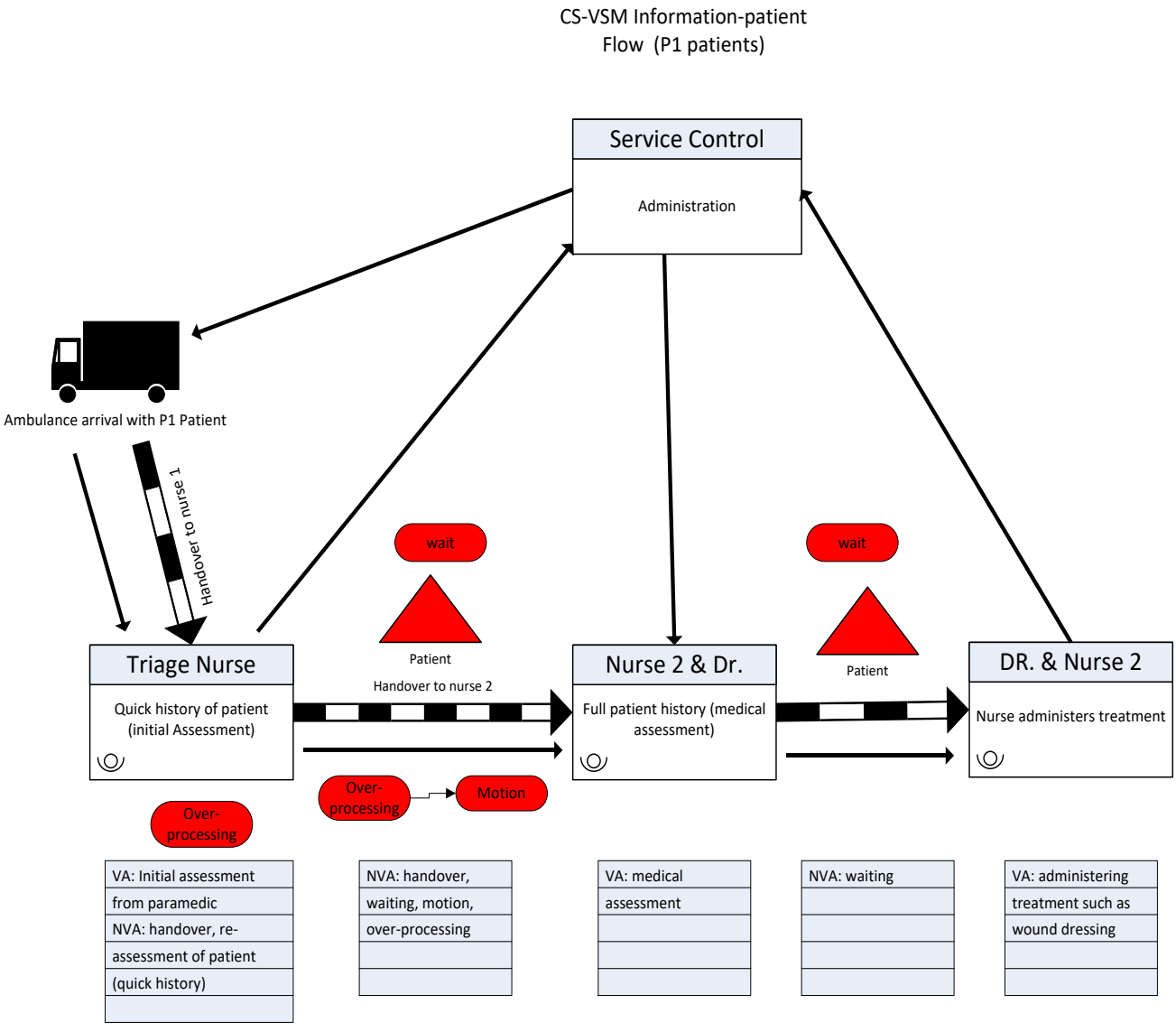


Figure 14: CS-VSM information flow (P1 Patients)

Figure 14 above illustrates a simple VSM that was developed to demonstrate the flow of information that controls the patient flow. It begins with the service control which is the administrators who directed the paramedics on where to find, collect and transport the sickly patient to the private hospital. The paramedics will assess the patient's health by doing a quick history of the patient and then hand-over the patient to the triage nurse whilst transferring the information about the patient to the triage nurse when entering the hospital in which the nurse will re-assess the patient before handing over the patient to the second nurse to determine whether the patient will go in the resus room or in the available cubicle rooms. Also, it's important to note the information about the patient is transferred manually.

The diagram entails the VA and NVA processes. The analysis shows the process from when the patient enters to when the patient is nursed reason being for the admission or extra reports such as the x-ray and blood tests is much more detailed for P2 and P3 patients because complaints are mostly received from them in comparison to P1 patient who don't have to wait as long as the other categories. The research details each waste identified in the CS-VSM in Table 12 below in order to justify improvement need in the current flow developed.

Table 12: CS-VSM waste identification table

Waste identified	description	NVA
Over-processing	Paramedic already conducts quick history of patients by doing an initial assessment but hand-over to a triage nurse will do the exact same thing in determining the patient's condition in deciding whether patient can go to resus room or cubicle room.	Hand-over
		Rework (re-assessment)
motion	Hand-over from nurse 1 to nurse 2 to conduct full assessment but nurse 1 will first have to walk back and forth to get necessary documentation for the patient file before doctor	Hand-over
		waiting

waiting	can fully diagnose the patient. At the same time the patient will have to wait upon the doctor's availability.	
waiting	After the full assessment of the patient the doctor will then instruct the assisting nurse to commence treatment or conduct additional tests in which the patient will have to wait for nurses to get all the equipment needed to follow through with the doctor's instructions.	waiting

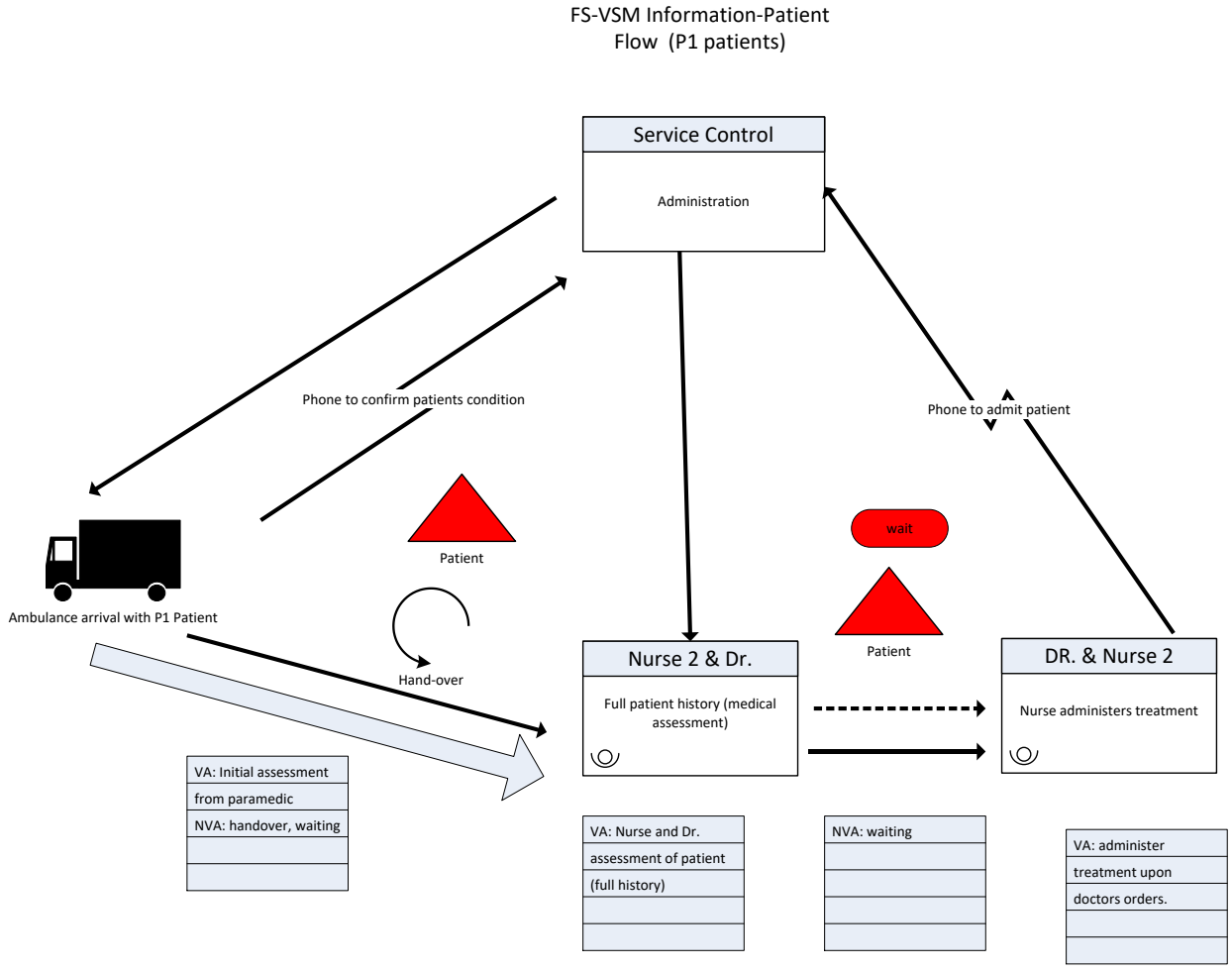


Figure 15: FS-VSM Information-Patient Flow (P1 Patients)

In Figure 15 above illustrates how the flow will change information about the patient which will automatically influence the waiting time of the patient. The VA activities remain the same. The only changes that have been made are when the paramedics collect the P1 when patient and conduct the quick history of the patient by assessing the patient's condition the paramedics can already determine whether patient will be in the resus room or the cubicles so it would not be necessary for them to handover the patient to the triage nurse.

The paramedics will then radio transmit or phone the hospital to make them aware of the incoming patient of whether they are either in the resus room or the cubicle to cut down on any delays in handing over the patient to the prepared nurse and doctor to do a full health assessment of the patient. Once the patient has been received at the hospital and handed over to the nurse and doctors, the paramedics will then give any administrative documentation needed for the patient to the hospital reception. Once the patient has been assessed, the doctor will then instruct the other nurses to conduct treatment or further tests on the patient in which it will be unavoidable for the patient to wait on the nurses to follow through with the instructions of the doctors to get all the necessary things required for the patient especially the admission process but in this the nurse will phone the admission reception rather than walking back and forth to admit the patient.

Expected outcome (P1 information-patient flow)

After developing the VSM, measurable outcomes have to be put in place to determine the difference in improvement. In this regard, the researcher measured by counting all the activities that will be required to receive the patient from the paramedics to the doctor giving instructions nurses to administer more tests or treatment on patient. There would be a noticeable difference in how long it would take for the patient to be seen by the doctor by merely reducing NVA activities as illustrated in Table 13.

Table 13: P1 patients VSM differences

	CS-VSM	FS-VSM	Remarks
# Of activities	8	7	Overall activities reduced by 12.5% due to minimizing NVA activities.
# NVA	5	3	The NVA activities within the process was reduced by 40% through lean waste identification in the VSM.
# ENVA	0	1	An additional activity was added to the overall process to accommodate for the more efficient process.
# VA	3	3	VA activities remain constant as the patient/customer determines what is value to them.

In addition to Table 13, the ENVA (essential non-value adding) activity is regarded as an activity that adds no value to the patient but is absolutely necessary to complete the process. In this regard, the additional process is where the paramedics will have to electronically transmit information about the patient to the hospital. Automatically, this would make the process quicker in a way since there isn't a need for cycle time to represent the activities within the overall process of the area or department represented in the VSM. Then a mathematical representation must be developed for justification of how the recommended FS-VSM is a more efficient process. the justification will go as follows:

If it takes about one minute to complete each activity in the overall process then when looking at the difference in NVA activities in both the current and future FS-VSM. It would go as follows:

- 1 activity = 1 min then,
- 5 NVA activities = 5 min, therefore reduced to
- 3 NVA activities = 3 min

The significance of this is the overall reduction of the process from start to finish resulting from the reduced NVA. The total recorded steps within VSM for the current state and future state, which is 8 steps and 7 steps respectively which means the total process time of each is 8 min and 7 min. This ultimately means there will be a reduction in the waiting time for the patient to be consulted by the doctor. In this case, in the current state the P1 patient arriving with paramedics needs to be screened again by the triage nurse before seeing the doctor which is a NVA but in the future state that has been eliminated which quickens the process to seeing the doctor by also eliminating the NVA of waiting and handing over the patient from the triage area. This represented one activity, therefore a reduction of one minute in the overall process time.

P2 and P3 patients VSM

After analyzing and establishing improvement recommendations, the researcher then took a step further in analyzing the P2 and P3 patients by using the VSM to have an overall impact in all the activities within the private hospital. As improving one category of patients will affect the other in terms of the waiting time. Since P2 and P3 share the same process therefore both current state and future state VSM will be developed for both.

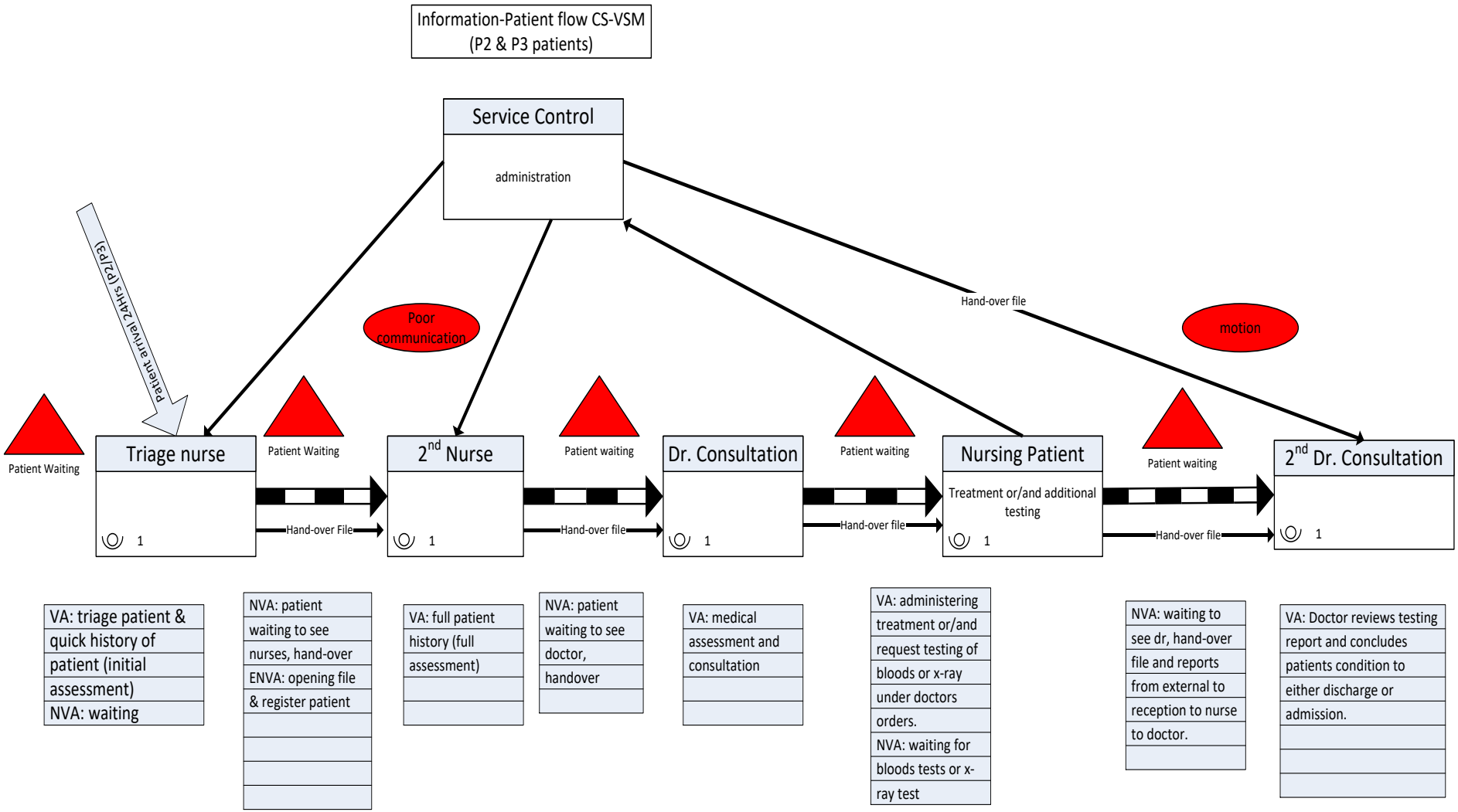


Figure 16: Information-Patient flow CS-VSM (P2 and P3 patients)

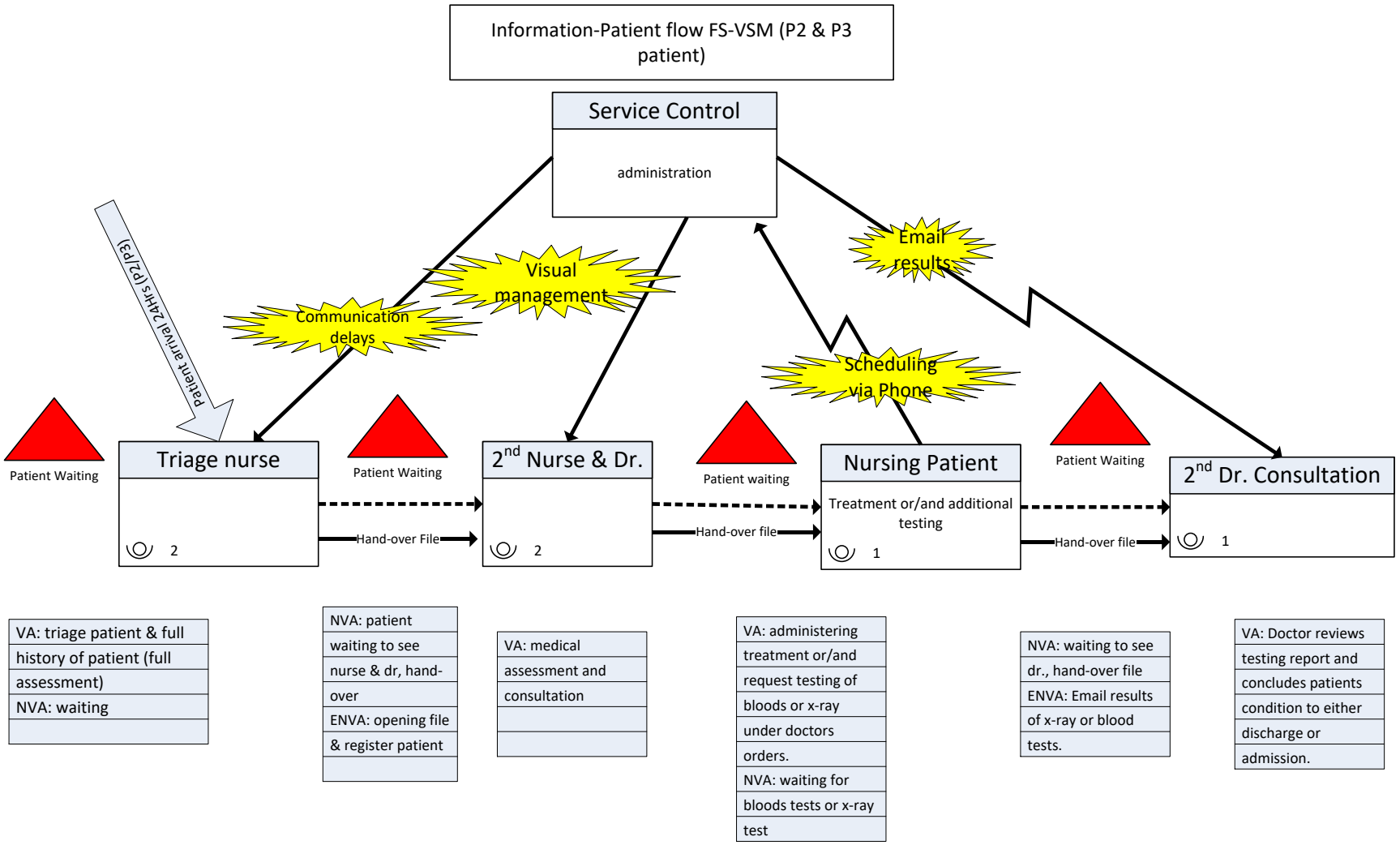


Figure 17: information-patient flow FS-VSM (P2 and P3 patients

In Figure 16 andFigure 17 above illustrates the VSM of the P2 and P3, demonstrating the value and waste in the overall process. Similar to the P1 VSM, the information flow for this VSM also determines the movement of the patients. In this regard, developing a table detailing each waste will not be necessary as it is similar to Table 12 above in a sense of the waste type of “waiting” and “hand-over” but the researcher will explain the significant waste identified from the customer point of view which influenced the development of the FS-VSM. However, the notable wastes identified and changes goes as follows:

CS-VSM (P2 and P3 patients)

The notable waste identified is communication delays in regard to the patient either waiting to be triaged or to be seen by the doctor. In which, this has been observed in Figure 9 above where it analyzes the patient experience of when patient is most likely to complain after 45min when there is no communication as to the reason for the delays. Another notable waste identified is within the activity of nursing the patient when additional testing is required, either x-ray or blood testing upon doctor’s instructions. In the aspects of after the tests has been conducted then the results are printed and hand delivered from the laboratory and the x-ray room staff to the medical hospital receptionists to the nurse then lastly to the doctor who will conclude whether the patient is admitted or discharged.

FS-VSM (P2 and P3 patients)

Based on the wastes identified within the CS-VSM, the researcher is able to conclude with recommendation on the changes needed to be made. The advantage of this is based on the data collected from Theunissen [6] who specifies how many medical workers are operating within each activity and suggests how many workers should be placed to improve the flow specifically in the triage area. However, the researcher took a step further in explaining how exactly the additional worker will add value to the process within the FS-VSM.

In the triage activity, to reduce the time spent waiting to the see the doctor, the suggested approach would be the additional nurse added to the triage process should be sufficient enough for both the triage nurses to do a full patient history depending on the condition of the patient. For example., if the patient just has a sprained ankle or minor flue then it

would not be necessary for the second nurse to do an overall patient history as the information documented about the patient is sufficient for the doctor to review and assess the patient. However, if the triage nurse is unsure of the patient's condition, then the nurse will specify on the patient's file whether the patient will still be needed to be seen by the second nurse who will do the full patient history.

The process of the P2 and P3 patients remains the same of those opening a casualty file after being triaged remains the same but the minor change will be whether it is necessary to see the second nurse or not to conclude the patient's history. However, the second nurse will continue documenting the patient full history if the two triage nurses specify the need for it on the patient file. Seeing that it is known that patients are most likely to complain after 45min of waiting to see the doctor then the receptionist working in the waiting will notify the patients of any delays for them being seen in time and visual charts being displayed explaining that more severe cases will be seen before them and the hospital doesn't operate in a first in first out bases due to avoidance of not seeing patients in time if they are in a life-threatening situation. However, visual charts that display their average waiting time based on which category they are placed in either they are in P2 or P3 to make the patients understand the private hospitals standard operating procedures.

Another notable change identified in the VSM is within the nursing of the patient of doing additional tests whether doing blood tests or x-ray testing or both in regards to hand-delivering the additional tests from the external entities to the private hospitals. Rather than hand-delivering the reported results, it would be much more efficient to email the results directly to the doctor to conclude whether the patient is being discharged or admitted. This will cut down the motion needed to hand-deliver the reports, however if hard copies are necessary for the patient filing then the assistant nurse will print the results after the doctor concludes the patient's medical assessment. Lastly, when dealing with the x-ray process instead of just moving the patient to any bed after the x-ray the nurse should phone the administrators if beds will be allocated in time after the patient will be done with the x-ray process to have better scheduling of the patient waiting time.

Expected outcome (P2 and P3 information-patient flow)

Table 14: P2 and P3 patients VSM differences

	CS-VSM	FS-VSM	Remarks
# Of activities	15	13	Overall activities reduced by 13.33% due to minimizing NVA activities and re-arranging VA activities
# NVA	8	6	The NVA activities within the process was reduced by 25% through lean waste identification in the VSM.
# ENVA	1	2	An additional activity was added to the overall process to accommodate for the more efficient process.
# VA	6	5	There has been a reduction in the VA but this may vary depending on the triage nurse ability to discern the patient's condition.

In summary of what has been explained in Table 14 about the CS and FS VSM of the P2 and P3 patients, the overall reduction of the activities within the flow is attributed to the reduction in NVA activities in waiting to receive a service in the overall process which is the change of the triage process of documenting the patient history and the other NVA being motion of hand-delivering the reporting results from either the laboratory or the x-ray room. However, the notable added ENVA activity is the process of emailing the lab result and x-ray report.

In other words, there would be a reduction in the overall waiting time and the process time.

Admission Process VSM (P1-P3 patients)

The admission being the common process of all the different types of patients from P1 to P3 share the same process of admitting the patient in the Medical Centre as illustrated in Figure 18. The process only covers P1 to P3 patients who are conscious and are able to communicate as opposed to unconscious patients as the process explained does not cover those type of P1 patients who are received in the hospital from the paramedics.

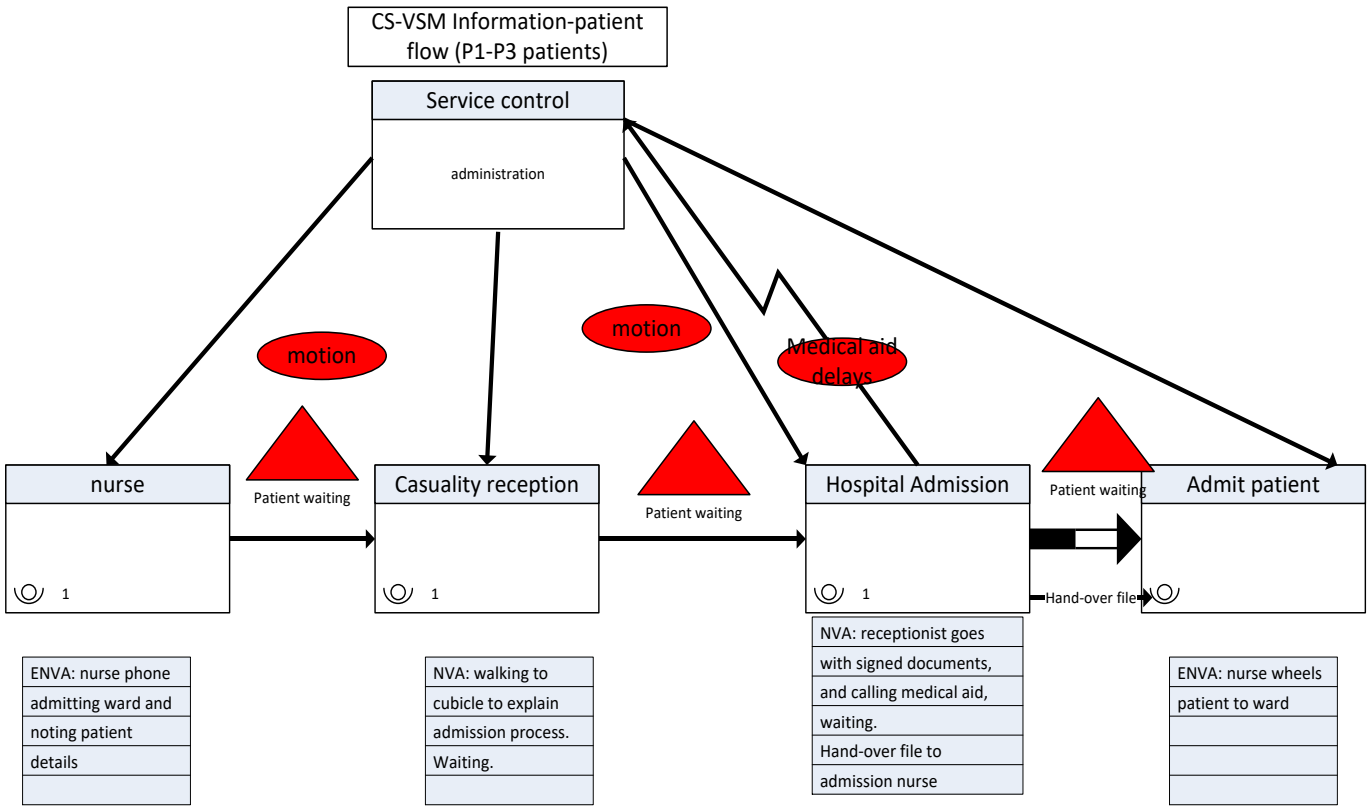


Figure 18: CS-VSM Admission Process (P1-P3 patients)

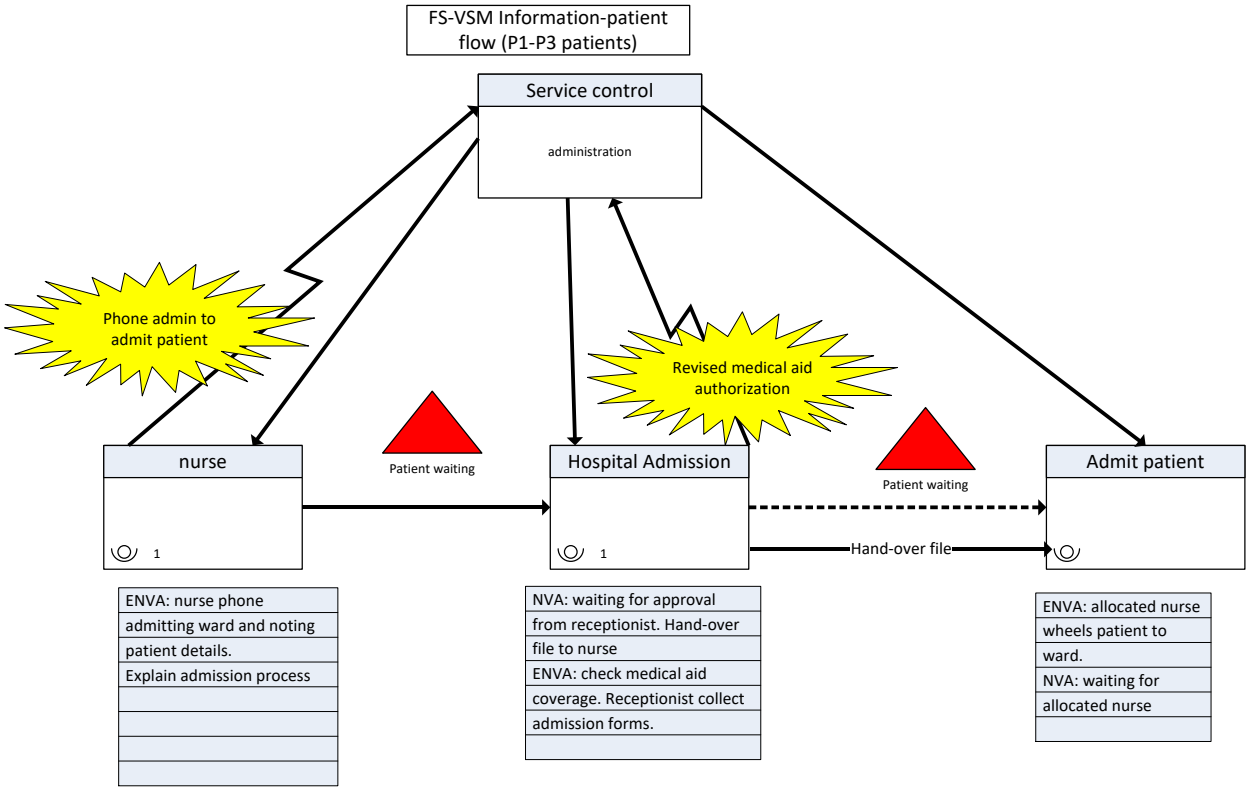


Figure 19: FS-VSM Admission Process (P1-P3 patients)

CS-VSM admission Process (P1 – P3 patient)

As shown in Figure 19 the admission process there is no notable VA activities that would be regarded as value as each activity just serves the purpose processing information about the patient to gain admission in the private hospital. The significant areas identified by the researcher are requiring improvement where waste has been identified is the activity in which the nurse has to phone the admitting ward to admit patient. This results in the patient having to wait for the casualty receptionist to walk into the cubicle room and explain the admission process. Once the patient has understood the process then the patient will be advised to sign the terms and conditions paperwork.

Whilst another notable area where waste occurs is within gaining authorization from the medical aid scheme. In this case, should there be any delays the receptionist would have to walk back to the cubicle room to explain the delays. The main cause is the disconnect in context of the private hospital gaining access to information detailing what services

within the hospital is covered by the medical aid scheme which results in patients having to do unnecessary double payments and long waiting time for authorization for the hospital to be phoning and confirming patients medical aid scheme coverage plan.

FS-VSM admission Process (P1 – P3 patient)

Based on the two notable areas needing improvement. The researcher recommends eliminating the motion of the receptionist walking from the reception area to the cubicle room to explain the admission process. Then the nurse should be the one required to explain the admission process and collect details required alongside signed documents for the patient to be admitted which also includes information about the medical aid scheme that they fall under. The nurse will first phone the admitted ward to confirm availability of beds and then the receptionist to come collect the necessary documentation needed for the patients to be registered into the hospital ward.

However, before the receptionist comes and collect the signed documents the nurse would have already phoned and given them details to check the medical aid scheme that covers the patient's hospital expenses. In context of the medical aid authorization delays it would be suggested that the private hospital develops a policy that comes into agreement with various medical aids scheme to allow access to information on their database in their website that pertains to information about the medical expenses they cover for the patient admitted in the hospital to bypass any delays with waiting for authorization. This way the advantage would be instead of the receptionist notifying the patient of any delays, the patient would only be notified if there are certain expenses that the scheme does not cover and only collecting signed documents for administrative purposes and having the need to walk back to the cubicle room to explain any delays. This would also reduce cases of double payments being made by the patient and the medical scheme as details of the medical expenses covered for the patient will be readily available for the private hospital to utilize.

Expected Outcome of Admission Process

Table 15: P1-P3 patients VSM differences

	CS-VSM	FS-VSM	Remarks
# Of activities	9	8	Overall activities reduced by 11.11% due to minimizing NVA activities and re-arranging ENVA activities
# NVA	6	3	50% reduction due to eliminating through lean waste identification.
# ENVA	3	5	67% increase in ENVA activities to accommo-date changes in the process that will make it more efficient
# VA	0	0	None VA activities found in the process.

In summary of Table 15 illustrates the difference in outcomes of the admission process. The 50% reductions in NVA activities can be attributed to the elimination of two accounts of patient waiting and the other being motion of the receptionist having to walk back and forth in case of delays in authorization and explaining admission process.

The increase in ENVA activities is caused by the nurse being the one to explain the admission process instead of the receptionist and then the nurse phoning the administrators to check patients details on their medical expense coverage with the medical aid scheme upon patients' approval through signed agreement between nurse and patient being the other additional activity.

4.5.1 Concluding the recommended VSM

Notably, since the VSM projects is a large-scale it would be advisable when tackling each major process within healthcare organization by breaking it down into kaizen projects in order to have an initiation phase of introducing the proposed process and implementing it. The objective of this is to leave room for improvement and further suggestions taken from the stakeholder as the whole idea is to strive for perfection as a principle of the lean methodology [13]. Thus, the creation of newly detailed process map in Figure 20 below that will be used as a discussion point of how do we further improve from what has been done as initially done for this research project. In that regard, the revised process map developed entails how the Medical Centre would operate based on the proposed VSM of P1 to P3 information-patient flow.

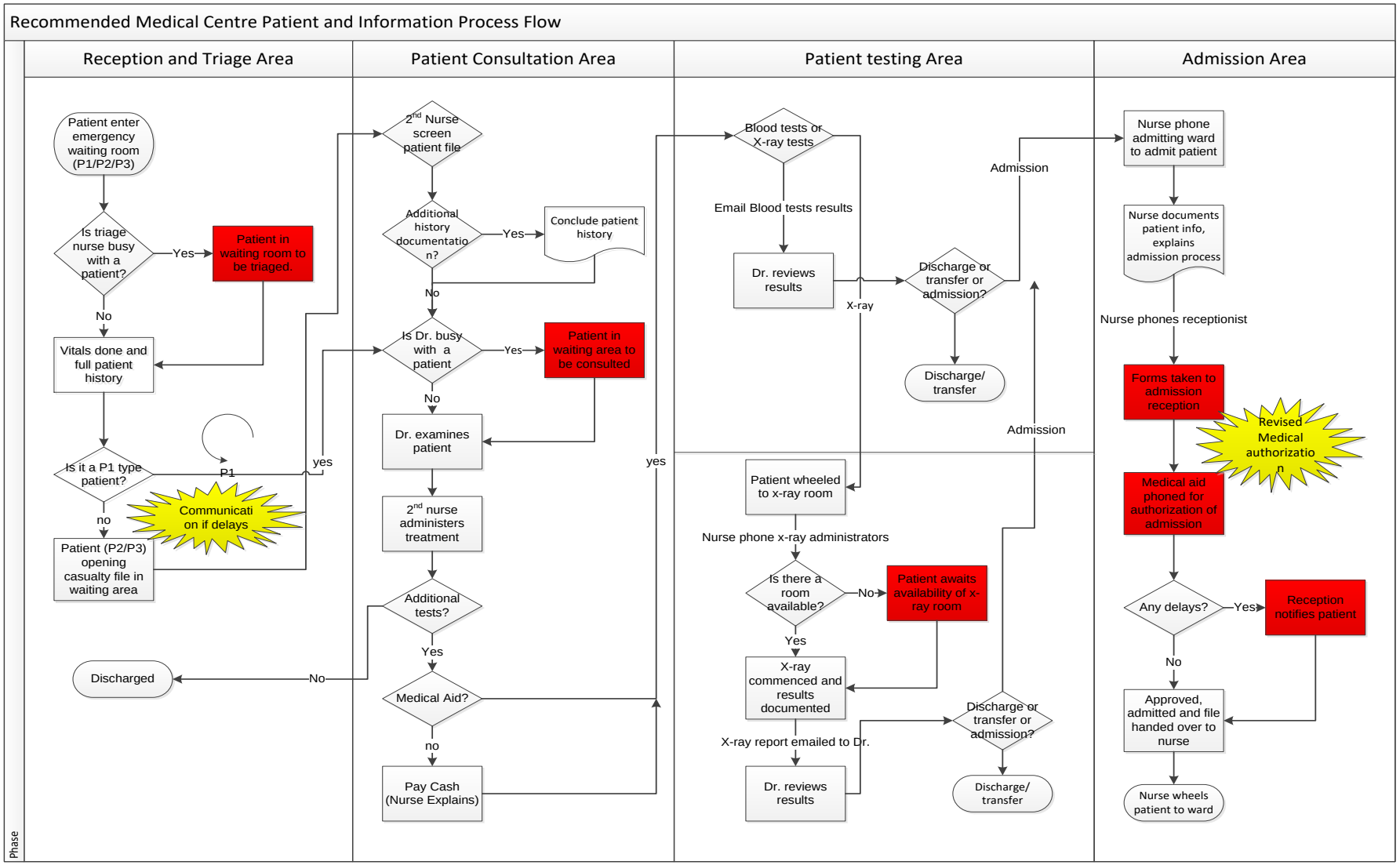


Figure 20: Proposed Medical Centre Process map

4.6 Sustaining Lean efforts

In the journey of sustaining the recommended changes through the lean management application, which brings the question of what monitoring tools will be used to identify any deviation from the new process implemented. The reason for this is to avoid any loss of lean management efforts to improve the waiting. To answer this the QIM decision tree in figure 6 of letter F will guide the researcher to understanding that this would become an output problem in F2. Reason being, is that despite the changes made through lean principles it may deviate back to its original process due to a lack of systems put in place to make sense of a follow-up routine which has quantifiable variables to determine whether there has been an improvement or not.

Furthermore, the six-sigma tool which will be used to sustain the efforts will be the control charts which is a great visual and monitoring tool to assess and evaluate any deviance over a period. In this case, the researcher will analyze the waiting time to see the doctor as this is where most of the complaints come from. The data sourced from the study of Theunissen [6], whom which collected time stamps of waiting time of each activity in the Medical Centre. The advantage this study has is that the private hospitals' standard procedure is documented the time they receive the patient to the time patient left each activity within the hospital. This is what is known about the sourced data:

- Date Time stamps were collected: Oct-Nov 2012
- Date researcher sourced the Data: 15 Oct 2022
- Number of patients studied: 49
- Type of patient: All categories (P1 to P3)
- 16 different time stamps and arrival times are randomized

However, based on the data sourced the researcher sampled the selected P3 patients due to this type of patients having the highest average waiting time and complaints are mostly received from them. Before the development of control charts and developed data set in Table 16 below the following calculations had to be done:

- Measurement in Hours: Minutes
- Re-arranging time stamps to from earliest time arrived to latest time arrived

- Total number of P3 patients analyzed (N): 16
- Arrival to seeing doctor difference = Doctor time stamps – Arrival time stamps
- Standard Deviation $(S_x/\sigma) = \sqrt{\frac{\sum_{i=1}^{n}(X_i-\bar{X})}{n-1}}$, in MS excel you would use the function =STDEV.S $(\sum_{i=1}^{n} X_i) = 0:27$
- Mean $(\bar{X}) = \frac{\sum_{i=1}^{n} X_i}{n}$, in MS excel you would use the function = Average $(\sum_{i=1}^{n} X_i) = 0:30\ min$
- Upper control Limit $(UCL_{\bar{X}}) = \bar{X} + 3\sigma = 1:52$, in MS excel you calculate as is for each column
- Lower control Limit $(LCL_{\bar{X}}) = \bar{X} - 3\sigma = 0:00$, in MS excel you calculate as is for each column. The answer would be zero because negative time does not apply to this study.
- An addition line will be inserted in the control chart to illustrate the time where patients are most likely to complain, which is 0:45.

Table 16: Control Chart Data set (P3 Patients)

Patient Name	Arrival to Dr	mean	UCL	LCL	patient complaints
3	0:17	0:30	1:52	0	0:45
4	0:30	0:30	1:52	0	0:45
6	0:16	0:30	1:52	0	0:45
7	0:21	0:30	1:52	0	0:45
8	1:58	0:30	1:52	0	0:45
9	0:05	0:30	1:52	0	0:45
11	0:24	0:30	1:52	0	0:45
12	0:24	0:30	1:52	0	0:45
14	1:00	0:30	1:52	0	0:45
15	0:00	0:30	1:52	0	0:45
17	0:20	0:30	1:52	0	0:45
21	0:38	0:30	1:52	0	0:45
27	0:25	0:30	1:52	0	0:45
36	0:20	0:30	1:52	0	0:45
39	0:20	0:30	1:52	0	0:45
41	0:44	0:30	1:52	0	0:45

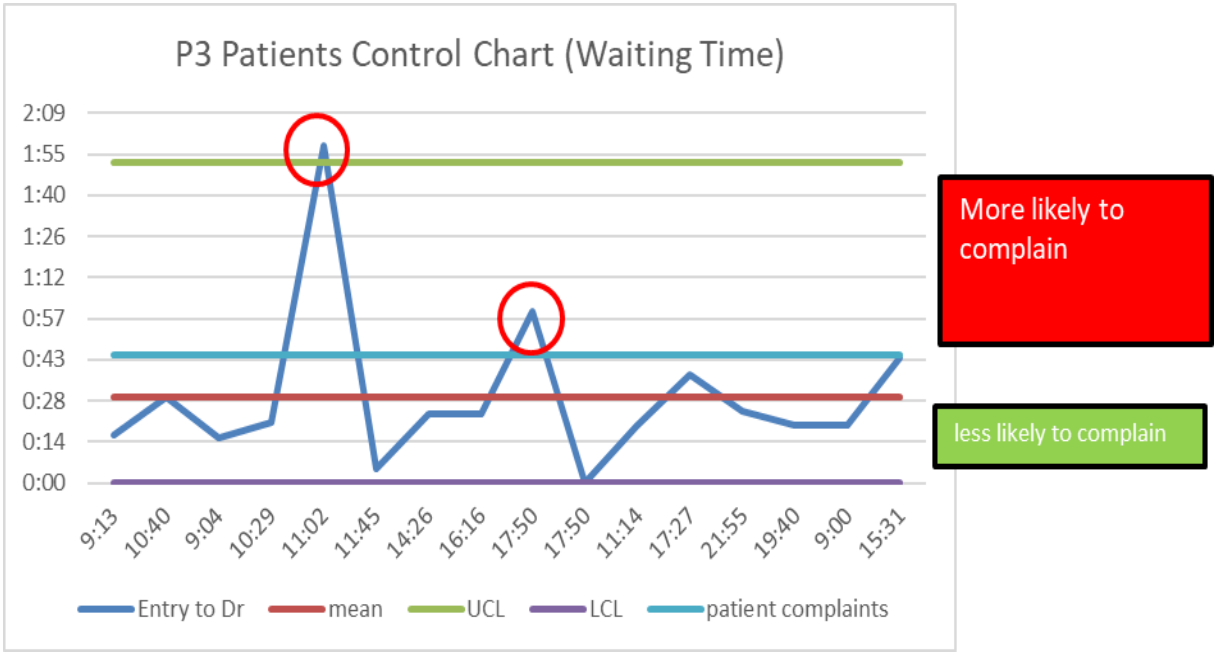


Figure 21: Control Chart waiting time to see doctor (P3 Patients)

4.6.1 Control Chart Stability Analysis

The control chart in Figure 21, is a visual chart that would give an accurate measure of how stable the overall process is for the waiting time to see the doctor. The chart illustrates exactly when exactly the patients are most likely to complain or less likely to which the x-axis represents the time stamps and the y-axis representing the waiting time.

For a control chart to be stable, the stability rate should be 99.7% of all the data points and must be below the UCL and either above the LCL line or touching the LCL. In this case, in the chart displayed above shows an unstable trend in which the stability rate which is the number of data points within Control Limits divided by the total number of data points this would be 87.5% which represents the two patients who are most likely to complain due to the result of a slow process. This will send a signal to the management team for a need for continuous improvement and further need of the QIM decision tree to achieve a 99.7% stability rate because there is a numerical measure of how efficient the process is through visual charts for all involved to see and improve their performance.

This type of method would serve as a catalyst for the culture of follow-ups because there is a system put in place to measure either daily, weekly, monthly or yearly of which you can only improve what you can measure. This in turn will result in the reduction of a poor patient experience by reducing the waiting time to see the doctor.

Chapter 5 : Conclusion and Future Research

5.1 Conclusion

In summary of the previous chapter which aimed at applying the quality framework that was developed after evaluating literature with the objective of closing the gaps found within the literature. This was where the QIM decision tree was constructed through combinations of all the major different quality management tools in order to solve any opportunistic problems sustaining an improvement made.

Upon reviewing literature of past studies that would have little to no success in sustaining lean efforts due to focusing on improving a flow that will result in a loss in the end. An example of this was in : Literature Review, where Henrique, et al. [37] stated that studies that focus on improving the patient flow first will have little success in the long run and most likely to receive initial resistance from medical doctors. This statement was validated through the analysis of the re-usable secondary data where it was observed that the lean tool was implemented with the attempt to reduce the waiting time through improving the patient flow. However, with close to a decade later the same problem persists and all the lean efforts being forgotten.

Although studies suggest focusing on initiating lean; this can be argued with the same point of studies most likely to fail in the end by focusing on patient flow. However, at the same time the researcher needs to consider even if improving the information and material flow; it is imperative for a framework that tackles new problems after the lean tool has been implemented. This is where the question arises based on the problem - what quality tool is required for this? Which the QIM decision tree answers.

In short, the researcher first applied the QIM decision tree to cover all the aspects that the healthcare organization needs to facilitate continuous improvement which goes as follows:

1. Began with the patient experience to determine value and waste in the eyes of the patient/customer to guide the researcher on which inefficiencies to focus on. The tools used to discern the problems was through the lean method of categorizing

the patient complaints to different types of wastes and pareto analysis to focus on the main problems to yield a high improvement rate.

2. Thereafter, according to the QIM decision tree a process map would need to be developed to gain an understanding of each process and the decision making behind each process with the establishment that the problem we are trying to solve is a process problem. However, it's important to note that the process map focused on information flow to avoid resistance from the medical doctors [37]. The process map broke down the private healthcare sector to four major flows. This prompted the development of the VSM's which resulted in pre-determined results of an average reduction rate of 38.33% of NVA of the entire system, which ultimately produced the recommended the new process map that is inclined to further recommendations to ensure the cycle of continuous improvement.
3. Lastly, is to ask the question of what to do next to ensure sustainability of the improvement made through lean techniques. To answer this, the QIM decision tree was used in guiding the researcher on which monitoring can be used as a catalyst for follow-ups.

Ultimately, this follows the fundamental approach suggested by Radnor [11] in Table 5 above of assessing the problem through visual process mapping, improving the problem identified through the selected appropriate quality methodology and monitoring and measuring the impact for a long-term success of lean technique improvements. This was all achieved through the use of the QIM decision tree. However, since the research project is focused towards improving the information flow through observing administrative tasks and the flow of information about the patient, the chances of long-term success and gaining quick-acceptance of the medical works is mostly likely guaranteed as suggested by Henrique, et al. [37]. However, most importantly is how the research project is approached and the manner it is analyzed which is focusing more on critiquing and improving the process rather than people; in other words, highlighting that the problem is the process not the people. This will result in engaging the medical workers in a subtle way without triggering any resistance.

This will prompt for more improvement projects because doing this will ensure the cycle of continuous improvement as doing one quality improvement project unravels the next hidden problem solved such as the study done by Price [5] which aimed at improving patient flow but unraveled how administrative process influences patients waiting time. This is where the QIM decision tree comes into place in answering what quality tool is required triggering the cycle of continuous improvement of what quality tool should be used in addressing the new problem or opportunity to resolve.

To add on to this, initiating lean principles goes back to creating the need for it, which visually seen in Figure 8: Performance Ratings above which displays their poor performance in the quality of their service delivery. Therefore, the QIM decision tree will recommend the lean methodology but first ensures their quality tools are in place that will compliment it such as the business process map which guided the researcher in developing the VSM. Then finally the framework instills a monitoring tool that will assess the effectiveness of the process and any deviations from the current standard. Thereafter, should there be deviations the QIM decision tree will be used to reduce or eliminate the deviations and possibly further improve from the current standard.

5.2 Future Research

In the context of what should be researched further. It goes back to the CSF's mention in the literature review which focuses on initiating lean principles in healthcare organizations. Which could be answered through the brief review of the quality policy document developed by the National Department of Health [1] which suggests in electing a quality assurance (QA) individual who will take responsibility of QI initiatives in all hospital levels. In this regard, prompts the question requiring further research of:

Which discipline is most appropriate in taking the role of QA in hospitals within the context of improving service delivery?

Since healthcare organizations' inefficiencies are mostly attributed to administrative processes and although there are digital platforms present within the sectors but are inoperable as noted in the analysis of the patient experience in Figure 9 above. So, it would be

proposed to do further research on how QIM decision tree may facilitate digitizing administrative processes within the healthcare sector.

Furthermore, future research should also include the collection of primary data via system observation to:

1. validate the QIM Decision Tree Framework developed in this study,
2. ascertain the precise strategies that could be used to handle varieties of patients service demand in hospital, and

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