Sustainability of Lean healthcare in South Africa: A practitioner's perspective

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Dissertation accepted in fulfilment of the requirements for the degree *Master of Engineering in Industrial Engineering* at the North-West University

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Graduation: June 2025

DECLARATION

I declare that this dissertation is my own independent work. It is being submitted to the Degree of

Master of Engineering to the University of North-West, Potchefstroom. It has

not been submitted before for any degree or examination to any other University.

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30 May 2024

PUBLICATIONS EMANATING FROM THIS RESEARCH

Wagner, R.S., Hattingh, T.S. and Meijer, H., 2022. Factors affecting the sustainability of Lean in healthcare: a systematic literature. *South African Journal of Industrial Engineering*, *33*(3), pp.124-136.

Wagner, R.S., Hattingh, T.S. and Meijer, H., 2024. Sustainability of Lean in South African public hospitals. Abstract accepted for full paper submission – due date 01 June 2024. *SAIIE34 conference*

ABSTRACT

South African public healthcare organisations have adopted lean as one of the initiatives to enhance service delivery. This aligns with the global trend of Lean applications in healthcare, which has been steadily increasing since 2000. Lean implementation has yielded some positive results. Despite these successes, the long-term rate of success remains fairly low. This is often attributed to many factors including a lack of well-planned and sustainable implementation and misapplication of Lean. Furthermore, the scarcity of Lean healthcare literature has created a knowledge gap, including reasons for failure, that needs to be addressed to improve Lean sustainability. This study aims to identify the factors that impact the sustainability of Lean healthcare in South Africa and draw lessons from these findings to improve Lean implementation sustainability. The scope of this study is limited to public hospitals because they represent a bigger portion of the public healthcare sector and the majority of literature on Lean implementation is on them. The study employs semi-structured interviews to explore these factors. The interviews are limited to practitioners who have been involved in Lean implementations in South African public hospitals. Through these interviews, 44 factors were identified and grouped into 13 themes (Long-term philosophy, Lean alignment, Implementation, Leadership, Commitment, Training, Teamwork, Support, Motivation, Communication, Management, Empowerment, and Healthy competition). These themes were grouped into four sustainability pillars (Foundation, Concepts of Lean, People and Organisational culture. The study further employs a systematic literature review (SLR) to explore the factors that would be used to test or evaluate factors from interviews. The SLR identified 46 factors affecting Lean sustainability, that were grouped into 13 themes. The themes identified through both methods were found to be compatible with each other. The findings from the interviews were then used to draw lessons that can be applied to enhance the sustainability of Lean in South African public hospitals.

Keywords: Lean, healthcare, themes, factors, systematic literature review, hospital, sustainability, interviews

Acknowledgements

Let me first give thanks to the almighty God for making this happen, in good and bad times he provided light, direction and courage for this project to reach the finish line.

Let me thank Prof Teresa Hattingh my supervisor for allowing me to embark on this journey. As difficult as it was, she made sure that I didn't feel the pain, she always had a way out.

Thanking Mrs Meijer my co-supervisor for agreeing to join this team and pass her expertise to me. Even when called away by her commitments she always found the way to come back and join this journey.

Let me thank my wife Mrs Wagner for holding it down while I was busy with this project. She paused her life for me to run this marathon.

Thanks to Ms Mebalo my mother in-law who became the third leg of this family and took over my responsibilities. She became home to my kids.

Let me thank my extended family, friends, colleagues, and participants who have contributed directly or indirectly to my studies.

Last but not least let me thank my children who allowed me to take a leave of absence in their daily lives while busy with this project. They managed to live with so many gaps and unfulfilled wishes, I say to them "That's the spirit of being a Wagner, injure one injure all."

MAY GOD BLESS THE HAND THAT GIVES.

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Abbreviations

OC	Organisational Culture
RDP	Reconstruction and Development Programme
NHI	National Health Insurance
PHC	Primary Health Care
DHS	District Health System
SS	Sustainability Science
SLR	Systematic Literature Review
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
ENTREQ	Enhancing transparency in reporting the synthesis of qualitative research
NGO	Non-Governmental Organisations

Chapter 1: Introduction

1.1 Background

The South African constitution guarantees every citizen the right to access healthcare services (Constitution of South Africa, 1996). However, a significant portion of the South African population still lacks adequate access to those healthcare services. This lack of access can be attributed to a shortage of healthcare facilities and inadequate resources, especially in previously disadvantaged communities (Maphumulo and Bhengu, 2019). The apartheid system created a highly fragmented and discriminatory healthcare system. As a result, oppressed and impoverished communities suffered from a deterioration in healthcare delivery due to limited resources (Department of Health, 1997). Since the introduction of the democratic government in 1994, public healthcare has been made available to all individuals, including those previously oppressed, exiled, and refugees from other countries (Kruger, 2014). Including these extra people overburdened the already stressed healthcare system, and to address past injustices, the public health sector underwent significant reforms (Fusheini et al., 2017). The National Department of Health developed a strategic plan to create an accessible, compassionate, and high-quality healthcare system (Department of Health, 2010). The government committed itself to developing and transforming the healthcare system to efficiently provide quality healthcare to all citizens in a compassionate environment (Department of Health 1997).

The transformation of healthcare in post-apartheid South Africa began with developing an enabling policy and legal framework, establishing an integrated national public health system, and the removal of racial barriers (Department of Health, 1997). The new democratic government introduced Universal Health Coverage as a reform to address the poor condition of the country's public healthcare (South African Parliament, 2003). To achieve universal health coverage, institutional and organisational reforms are necessary to address structural inefficiencies, ensure accountability for the quality of health services provided, and ultimately improve health outcomes, especially for the poor, vulnerable, and disadvantaged groups (South African Parliament, 2003). To support universal health coverage, government also introduced a draft policy on National Health Insurance (NHI) to ensure that everyone

has universal access to appropriate, efficient and quality health services (Naidoo, 2012). The principles for establishing the NHI were centred on improving access to quality health services and providing financial risk protection to the poor and vulnerable. The government adopted the district health system model, which prioritised primary health care in health care policy (Rispel, 2016). This approach, based on a social justice philosophy, aimed to improve population health through legislative, policy, and resource allocation measures (Rispel, 2016)

However, despite these new policies and initiatives, the overall performance of the country's health system did not improve significantly (Rispel, 2016). This was attributed to skills gaps in management, leadership, and stewardship, resulting in inadequate implementation of these transformative public health policies (Coovadia et al., 2009). Public hospitals had to establish continuous self-assessment, remove barriers to improvement, and implement information systems that facilitate ongoing progress and demonstrate results. Recognising the importance of enhancing quality and reducing waste, healthcare institutions began adopting Lean healthcare (Mutingi et al., 2015).

In the past decade, international healthcare organisations have embraced the Lean concept to improve patient flow processes and enhance performance (Daultani et al., 2015). Lean is a management approach that focuses on continuous improvement by identifying and eliminating waste and losses to create customer value (Womack et al., 2003). Lean can also be described as a philosophy (known as Lean thinking), a set of principles, and a collection of practices often referred to as tools (Čiarnienė and Vienažindienė, 2012). Lean is based on the fix right at the first time concept, and this concept is at the centre of medicine because healthcare processes cannot afford mishaps, delays, and faults (Pakdil et al., 2020)

Lean has been adopted by healthcare entities as an operations management model that can simultaneously improve quality and productivity, provided that the tools and concepts are successfully applied (Sobek and Lang, 2010). The literature mentions that Lean tools and techniques are equally applicable to healthcare operations as they are to production. The rate of Lean success is strongly linked to the implementation process, and there is still potential for a greater impact (Sobek and Lang, 2010). To transition an entity into a Lean operation, it is crucial to fully understand the Lean philosophy, principles, and tools. While understanding the Lean concept as a whole is

essential, it should be noted that the implementation of Lean goes beyond the philosophy itself, it requires prior planning and should follow a sound methodology (de Barros et al., 2021).

For a long time, several companies have focused solely on Lean tools, neglecting the other aspects of Lean as a system (Henrique et al., 2021). While Lean tools are important, their ultimate effectiveness depends on the ability to develop an underlying culture that supports continuous improvement (Henrique et al., 2021). Lean should be approached as a way of thinking, as a socio-technical system based on a set of principles that should be integrated into the organisational culture (Erthal et al., 2021). Lean implementation often faces challenges due to significant organisational and process changes that can clash with the existing culture (Erthal et al., 2021).

According to Erthal et al. (2021), several studies have shown failures in Lean implementation in healthcare because Lean has not been well adapted and is often misunderstood. The success of Lean in different industries depends on continuously aligning the existing organisational culture (OC) with the changes brought about by Lean implementation (Erthal et al., 2021). Although the crucial role of OC in Lean implementation is increasingly understood, healthcare organisations struggle to effectively align their existing OC with their Lean efforts (Erthal et al., 2021).

According to Henrique et al. (2021), implementing Lean philosophy, principles, and tools in healthcare is particularly complex. This complexity arises from the need to strike a delicate balance between strategic goals and delivering excellent care, which presents unique challenges compared to other industries. Some of these unique challenges are as follows (Henrique et al., 2021):

- a surge in demand for healthcare
- the importance of patience and quality care in the healthcare environment;
- the variety of professional backgrounds that are within a hospital facility;
- the high hierarchical power of physicians over other employees; and
- the belief that some management practices of other industries are not compatible with hospitals.

The implementation of Lean in South African healthcare is still in its early stages and underdeveloped (Nwobodo-Anyadiegwu et al., 2020). In South Africa, most Lean

implementations have been limited to specific sections of hospitals rather than being implemented holistically throughout the entire hospital (Price, 2013). Lean implementation is resource-intensive and to implement it successfully, organisations must avail sufficient investment towards getting the competencies and other appropriate resources (Nwobodo-Anyadiegwu, 2021). Many public healthcare centres and clinics would struggle to implement Lean due to the availability and inefficient distribution of resources within the public sector (Nwobodo-Anyadiegwu, 2021). Because of the reasons mentioned here, this research study focuses on public hospitals as they are the public healthcare facilities that have the most published literature about their Lean implementation.

While the literature mentions the use of Lean healthcare and its early successes, there is a lack of empirical evidence to evaluate its long-term effectiveness and sustainability (Chatur, 2018). This lack of empirical evidence is not unique to South Africa; it is an international concern. Despite widespread reports of low success rates in Lean implementation, Lean has been widely adopted and reported in healthcare, however, there is a scarcity of literature addressing its long-term sustainability (Henrique et al., 2021). Costa and Godinho Filho (2016) also identify a gap in the Lean healthcare literature regarding the barriers and lessons learned in sustaining process changes throughout a Lean journey in healthcare. This gap highlights the need for more in-depth studies on sustaining Lean improvements in hospitals (Henrique et al., 2021). Fleiszer et al. (2015) also emphasise the lack of attention given to the sustainability of healthcare innovations, despite significant contributions in empirical, theoretical, and practical aspects of their development and implementation. This lack of sustained improvements not only wastes resources but also leads to resentment among stakeholders and demotivates staff (Fleiszer et al., 2015).

To fully realise the potential of Lean, it is crucial to understand the Lean healthcare paradigm, develop sustainability models for effective utilisation in specific contexts, and successfully design and implement patient-centric Lean solutions (Pakdil et al., 2020). The available literature indicates the need to gather information that can enhance our understanding of the factors that impact the sustainability of Lean healthcare improvements.

1.2 Problem statement

Lean has been adopted and implemented in South African public hospitals to improve the service delivered to the people. However, it is evident that these Lean implementations are not sustainable and there is a shortage of empirical information that can assist in addressing sustainability. Therefore, the problem faced by South African public hospitals is the sustainability of Lean healthcare and the lack of research information that can be used to address it.

1.3 Research Aim.

This study aims to explore factors that affect the sustainability of Lean healthcare in South African public hospitals and draw lessons that can be used to address the sustainability of Lean implementations.

1.4 Research questions

1. What factors affect the sustainability of Lean healthcare in South African public hospitals?
2. What lessons can be drawn from the factors that can be used to sustain Lean healthcare in South African public hospitals?

1.5 Research objectives.

To reach the aim of the study, the research objectives are as follows:

1. To explore factors affecting the sustainability of Lean healthcare in South African public hospitals;
2. To explore factors affecting the sustainability of Lean healthcare in hospitals from published literature;
3. To appraise or evaluate factors from South African public hospitals against factors from published literature;
4. To draw lessons that can sustain Lean healthcare in South African public hospitals.

1.6 The scope of study

The purpose of this study is to identify and understand factors that are affecting the sustainability of Lean healthcare in South Africa. And draw lessons from factors that can assist with sustaining Lean healthcare. The focus is on public healthcare as they serve the majority of the population in the country compared to private healthcare. The primary healthcare clinics and centres were excluded because of lack of literature about their Lean implementation, that is why the focus is on public hospitals. The attention is on sustainability because public hospitals are struggling to sustain the success derived from the Lean implementations. The factors will be explored from South African-based practitioners' perspectives through interviews as they have gained experience in Lean implementations and their effects in public hospitals. Factors explored through a systematic literature review will be used to evaluate factors from interviews because they represent worldwide views.

1.7 Ethical clearance

This study deals with healthcare issues and the application for ethics was done to the Health Research Ethics Committee of North-West University for approval. It should be noted that this study will not have any contact with patients and their records. People regarded as vulnerable and minors will not be involved in this study. All participants will be independent and abled people who will participate in this study in their professional capacity. Privacy and confidentiality will be observed during data collection and analysis, only the researcher and supervisor will have access to data. All participants gave consent to participate in the study.

The ethics application was approved by the Health Research Ethics Committee of North-West University with the ethics number: NWU-00151-22-A1.

1.8 Chapter division

This study will be laid out as follows:

Chapter two will deal with the literature review of the topics and theories that will be used. First, it will review Lean theory and its application, Lean healthcare, and sustainability thereafter. Secondly, it will review the South African healthcare system,

Lean status and its sustainability. Thirdly it will explore organisational culture and its effect on healthcare. Fourthly it will review Sustainability Science that will help to explain the sustainability context. Lastly, it will review the Systematic Literature Review approach to explain the theory and its relevance in the research field.

Chapter three will deal with research design and methodology to explain the thinking about the choices made in this study. It will also discuss the data collection methods and analysis methods used.

Chapter four will present and describe the findings of this research separately.

Chapter Five will analyse and evaluate the interview findings against the SLR findings.

Chapter six will discuss the findings and draw lessons learnt from this study.

Chapter seven concludes the research with the conclusions of the research, limitations of the study and recommendations for future work.

Chapter 2: Literature Review

2.1 Introduction

The literature review chapter will expand on the important concepts used in this study. The chapter will begin by reviewing the concept of Lean, including its general application, how it is applied in healthcare, and its performance. It will then shift to reviewing the sustainability of Lean in healthcare. The second part of the chapter will examine the South African healthcare system, specifically Lean healthcare in the South African context and its sustainability. The third section will discuss organisational culture in hospitals and its role in the implementation and sustainability of Lean. Moving on, the fourth section will explore sustainability science as a means to explain sustainability. Finally, there will be a brief review of the systematic literature review method as it is used to evaluate the findings of this study.

2.2 The Concept of Lean

The word Lean was suggested by then-graduate student John Krafcik, who argued that “Lean means doing more with less” (Liker, 2004). Lean was started and applied at the Toyota vehicle production plant but it has since been adopted and adapted by many other industries because of its success and reputation. This section will discuss the Lean concept from its definition to its application, paying more attention to the descriptions and basic theory. It will then discuss a focused application of Lean in healthcare, and Lean sustainability in healthcare.

2.2.1 Definition of Lean

Lean as derived from Toyota production systems, can be defined as the phenomenon that aims to identify and eliminate waste along the value streams to create more value for customers (Arfmann and Barbe, 2014). Lean is also defined as a process-based philosophy, that is focused on enriching customer value-delivery, rather than just improving performance (Hallam and Contreras, 2018). Basically, Lean is a philosophical approach towards management, focused on the identification and

elimination of all types of waste, creating customer value, and continuous improvement (Kovacevic et al., 2016). The basic concepts derived from the above descriptions of Lean are continuous improvement, value creation, and waste elimination. To capture the essence of Lean, these concepts are discussed below. These concepts are interconnected because continuous improvement leads to waste elimination, which in turn leads to value creation.

Continuous improvement, also known as 'Kaizen', is defined as the ongoing elimination of actions, resources, and processes that do not add value (Hampson, 1999). Kaizen gradually eliminates unnecessary manpower, materials, and processes until the workplace is left with only the essential requirements to perform a specific function (Hampson, 1999). Continuous improvement is a never-ending process and should be embraced as a culture of constantly scrutinising processes to identify and eliminate unnecessary activities (Erthal et al., 2021).

Value can be defined as the ability to deliver a customised product or service that meets the customer's exact requirements, with minimal time between the customer's request and the actual delivery, and at an appropriate price (Womack and Jones, 1997). It is important to emphasise that value is not solely determined by product quality, but also includes factors such as price, customer expectations, and delivery time (Poppendieck, 2011). To understand the concept of Lean, it is crucial to consider value from the customer's perspective, rather than assuming its definition, and to identify the activities and resources necessary to create that value (Womack and Jones, 1996). Failing to accurately define value before implementing Lean techniques can result in efficiently providing the wrong product or service (Womack and Jones, 1996). Once the value is understood, anything else is considered waste and should be eliminated (Poppendieck, 2011).

Waste is defined as any activity that consumes resources without creating value (Čiarnienė and Vienažindienė, 2012). Waste includes activities that have no impact on the value of the product when removed and resources that can be saved without affecting the product's value (Čiarnienė and Vienažindienė, 2012). Graban (2016) identifies eight types of waste: defects, overproduction, transportation, waiting, inventory, motion, over-processing, and underutilised talent. Although these wastes were initially identified within the automotive production system, they can be adapted

to any industry. Three Japanese words represent a wider range of waste, or its sources than is normal (Hampson, 1999):

- Muda - is referred to as reducing non-value-adding activities (waste)
- Muri - translates as overburden, when workers or machines are pushed beyond their capacity.
- Mura - is the irregular or inconsistent use of a person or machine.

These three interrelated concepts of waste should be considered as a whole because focusing on waste alone limits the capacity of Lean (Radnor et al., 2012). Another cornerstone concept of Lean related to necessary waste is Heijunka, which means levelled, smoothed, or balanced production (Hampson, 1999). Heijunka is responsible for levelling imbalances mentioned in Muda, Muri, and Mura, and balancing the workload based on the capacity of the workforce, machines, and processes (Hampson, 1999). Achieving Heijunka is challenging because systems producing complex products or providing unpredictable and variable services cannot instantly adjust to changes in demand or accommodate variations between different services (Hampson, 1999).

The extended definition of Lean by Čiarnienė and Vienažindienė (2012) refers to Lean as a philosophy that integrates a set of principles, tools, and techniques in the organisation to maximise the use of time, human resources, and productivity while eliminating waste and enhancing the value of products and/or services to customers. This description includes additional concepts that are important features of Lean, including philosophy (Lean thinking, which deals with the beliefs and purpose of the organisation), a set of principles, and tools and technology. These concepts will be defined below.

Lean thinking or philosophy is about strategically planning and executing activities to add value for the customer in the shortest possible time (Poppendieck, 2011). It involves eliminating unnecessary steps, time, and people, and only retaining the activities that add value (Poppendieck, 2011). Lean thinking requires a mindset and strategic direction that the entire company must consistently adopt and apply (Čiarnienė and Vienažindienė, 2012). It involves shifting to a new organisational culture based on Lean principles. The Lean principles as per Čiarnienė and Vienažindienė (2012) are:

1. Identify Customers and Specify Value,
2. Identify and Map the Value Stream,
3. Create Flow by Eliminating Waste,
4. Respond to Customer Pull,
5. Pursue Perfection.

“Lean principles have proven not only to be universal but to be universally successful at improving results” (Poppendieck, 2011). These principles are derived from the underlying assumption that organisations comprise processes. Using these principles in a “step-wise and sequential way”, organisations can create a cycle of value enhancement, waste elimination and continuous improvement (Radnor et al., 2012).

Lean is also defined as a system designed to avail the tools for staff to continually improve their functions and add value to customer’s products or services (Shazali et al., 2013). Robinson et al. (2012) distinguishes between three groups of Lean tools: assessment, improvement, and performance monitoring.

1. Assessment tools, are used to review the performance of existing processes regarding waste, flow, or capability to add value.
2. Improvement tools are used to improve or redesign processes.
3. Monitoring tools are used to monitor the processes and measure the improvement.

Lean tools include Value stream mapping, Kanban and pull, Demand levelling, Single-piece flow, 5S, Kaizen events, A3 reports, Visual management, and more. The foundation of Lean implementation is based on the core principles of "eliminate waste, create flow, and have respect for people" (Spagnol et al., 2013). As agents of change, tools are used to build the structure for achieving continuous improvement, with customer value creation as the main goal (Spagnol et al., 2013).

Putting together all the concepts mentioned above, Lean can be defined as a philosophy that seeks to create customer value by reforming organisational processes to eliminate waste and improve productivity using principles and tools while

transforming the existing culture into a culture of continuous improvement (Radnor et al., 2012).

Poppendieck (2011) mentioned two key features that a truly Lean enterprise must have:

1. The assignment of the majority of tasks and responsibilities to the workers that are in effect adding value to the product.
2. A system for detecting defects that quickly trace every problem, once discovered, to its ultimate cause

In conclusion, using the definitions mentioned, Lean can be widely defined in this study as an unending cycle of continuously improving customer value by identifying waste and problems, analysing them, developing solutions, communicating widely and effectively, implementing solutions, and monitoring the improvement, using defined principles and relevant tools.

2.2.2 Application of Lean

It is argued in the literature that Lean should be applied to the entire organisation to achieve consistent and visible results. While Lean can be applied successfully in isolated sections with selective tools, it is important to note that maximum benefits can only be achieved if it is applied holistically and across the entire system (Kilpatrick, 2003). Many enterprises have recognised that the isolated use of Lean tools and techniques does not lead to sustainable improvement (Liker and Morgan, 2006). According to Hallam and Contreras (2018), successful Lean transformation requires a strategic adoption of Lean tools and cultural changes. If Lean is adopted at the strategic level, the entire enterprise must align and work together during implementation. Strategic adoption also necessitates a strategic change in organisational culture to the new Lean culture. "The broader organisational culture of the firm separates short-term improvements from long-term Lean enterprises" (Liker and Morgan, 2006). Cultural changes include communication between and within different levels and disciplines, long-term commitment to stabilising the changing environment, ongoing focus on the customer, and a change strategy that reflects the organisation's goals (Liker and Morgan, 2006).

Liker and Morgan (2006) proposed a set of 13 management principles that can be considered Lean-based product development principles. These management principles are set out into a framework of process, people, tools, and technology as illustrated below:

- Process principles of Lean: 1. Establish customer-defined value to separate value-added from waste. 2. Front load the product development process to thoroughly explore alternative Solutions while there is Maximum Design Space. 3. Create a levelled Product Development Process Flow. 4. Utilise Rigorous Standardization to Reduce Variation, and Create Flexibility and Predictable Outcomes.
- People principles of Lean: 5. Develop a “Chief Engineer System” to Integrate Development from start to finish. 6. Organise to balance Functional Expertise and Cross-functional Integration. 7. Develop Towering Technical Competence in all Engineers. 8. Fully Integrate Suppliers into the Product Development System. 9. Build in Learning and Continuous Improvement. 10. Build a Culture to Support Excellence and Relentless Improvement.
- Tools and technology principles: 11. Adapt Technology to Fit your People and Process. 12. Align your Organisation through Simple, Visual Communication. 13. Use Powerful Tools for Standardization and Organisational Learning.

Even though these principles are based on product development they can be equally applied to service and professional entities (Liker and Morgan, 2006).

"Integrating people, process, tools, and technology into a coherent system requires purposefully designing, aligning, and mutually supporting subsystems" (Liker and Morgan, 2006). Even if the process itself is advanced and efficient, it will have no benefit if the people lack the necessary skills to perform their tasks or if the organisation does not provide the right people and tools at the right time (Liker and Morgan, 2006). Additionally, the organisation should ensure that the people's skills, practices, and organisational characteristics are relevant to executing the process. Finally, tools and technologies that do not align with the process or enable the activities of the people will not result in any progress (Liker and Morgan, 2006). Organisations should reflect and learn from Toyota to better understand the implementation of Lean as recommended by Liker and Morgan (2006):

> *"What can other companies learn from the Toyota Way? The journey is far more complex than applying a few tools or holding some classes. It truly is a cultural transformation. You need to start on the learning journey and then keep going and never stop. You need to practice deep reflection and learn. Toyota is continually learning. They are far from perfect and would become very nervous if anyone thought they were. What we can take away from Toyota is the importance of becoming a humble, learning organisation".*

Arfmann and Barbe (2014) argue that knowledge about Lean methods, tools, and processes alone is not sufficient to improve performance. It is the understanding of the daily business reality that enables managers to take action and improve performance. According to Hampson (1999), the choice of management strategy emphasising Heijunka and production continuity, or Leanness and Kaizen, is influenced by the surrounding social settlement and industrial relations system.

Čiarnienė and Vienažindienė (2012) have developed a model for the Lean implementation process, as shown in Figure 1. This model is recommended for guiding the implementation of Lean, starting with planning the change, defining success factors, and finally implementing and monitoring progress.

The establishment of Lean culture is as important as Lean principles, techniques, processes, and tools for successful implementation. Lean culture includes motivating staff to fully participate and even take initiative and lead in the implementation of Lean (Čiarnienė and Vienažindienė, 2012). This means that Lean implementation success requires an environment that empowers employees to take ownership and fully participate as individuals or teams in the development of solutions and process improvements.

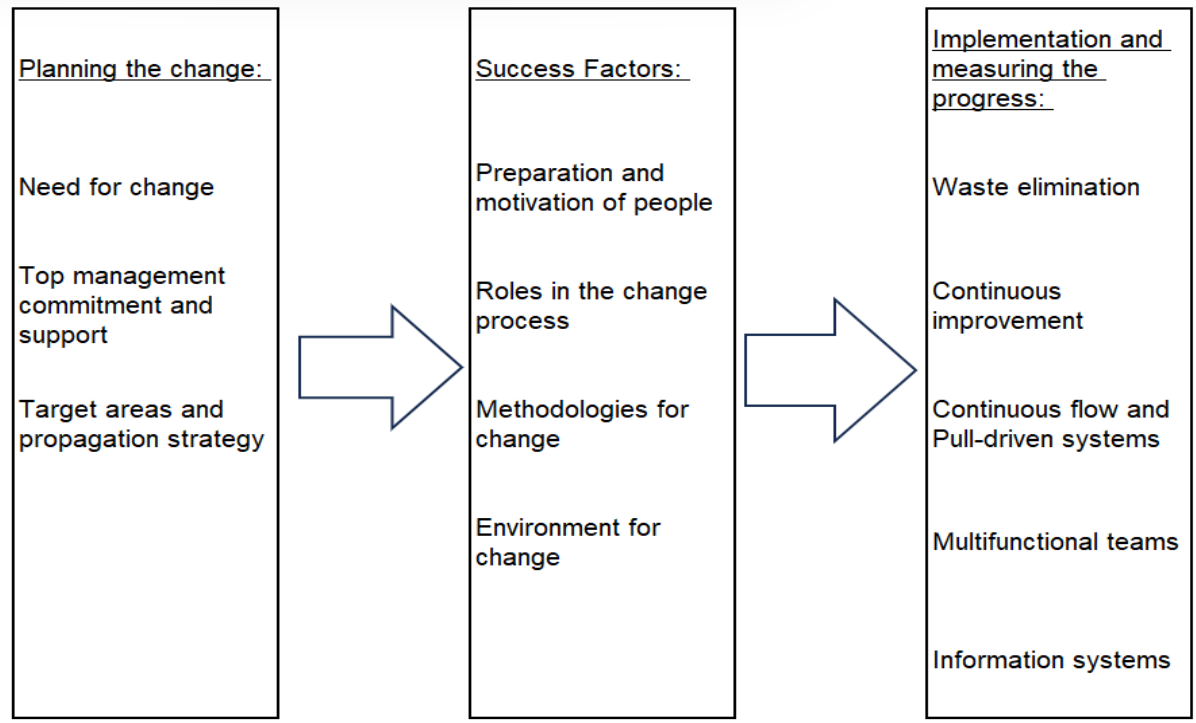

Figure 1: Model of Lean implementation process as per (Čiarnienė and Vienažindienė, 2012) (recreated by author)

2.2.3 Lean in Healthcare

Healthcare organisations began adopting Lean in response to pressures to improve their performance. This motivation stemmed from the success of Lean in other industries, including service industries. The healthcare sector recognised that, despite differences in organisations and technology between production and healthcare, the challenges of improving quality and reducing costs are the same (Pakdil et al., 2020). However, adopting Lean in healthcare poses unique challenges due to the presence of customers in the system, as healthcare is a service operation (Daultani et al., 2015). Another distinctive feature of healthcare is the prioritisation of cure, safety, and efficiency over cost and efficacy (Daultani et al., 2015). These differences and unique features of healthcare caused a delay in the adoption of Lean in healthcare compared to other industries (Daultani et al., 2015). Nevertheless, with sufficient resources, discipline, and a long-term focus, Lean can be successfully implemented in healthcare, despite its high process variability and unique characteristics (Pakdil et al., 2020).

Lean healthcare is a field that focuses on efficiency and patient satisfaction, driven by the need to accomplish more with fewer resources (Hallam and Contreras, 2018). Lean healthcare can be defined as below:

> "*Management philosophy to develop a hospital culture characterised by an increased patient and other stakeholder satisfaction through continuous improvements, in which all employees (managers, physicians, nurses, laboratory people, technicians, office people, etc.) actively participate in identifying and reducing non-value-adding activities (waste)*" (Dahlgaard et al., 2011).

Lean healthcare focuses on eliminating waste and creating value for the customer, which, in the case of patients, can include prevention, cure, or pain relief. The process of waste elimination in healthcare begins by identifying the problems faced by patients and staff. Lean principles and tools are then used to develop and implement solutions. Radnor et al. (2012) adapted the concept of 7 wastes from production to apply to healthcare, as shown in Table 1. These healthcare wastes can lead to inconsistent care, unreliable treatment, constant interruptions, and higher operating costs, as well as potential errors, worker frustration, delays, and duplication (Hallam and Contreras, 2018).

Table 1: The original seven wastes and healthcare examples as per (Radnor et al., 2012)

No	**Original Wastes**	**Examples of Healthcare Wastes**
1	Transportation	Transportation: -staff walking to the other end of a ward to pick up notes -central equipment stores for commonly used items instead of locating items where they are used
2	Inventory	Inventory: -excess stock in storerooms that is not being used -patients waiting to be discharged -waiting lists

3	Motion	Motion: -unnecessary staff movement looking for paperwork, -not having basic equipment in every examination room
4	Waiting (Delay)	Waiting for: -patients, theatre, staff results, prescriptions and medicines -doctors to discharge patients
5	Overproduction	Overproduction: -requesting unnecessary tests from pathology -keeping investigation slots 'just in case'
6	Over-Processing	Over-processing: -duplication of information -asking for patients' details several times
7	Defects	Correction: -readmission because of failed discharge -repeating tests because correct information was not provided

Just like other organisations, healthcare organisations often start implementing Lean without fully understanding the cultural and structural prerequisites for successful implementation (Dahlgaard et al., 2011). Given the significant impact that Lean can have on an organisation, organisations must be adequately prepared before implementation (Dahlgaard et al., 2011).

Leadership and management should have a clear understanding of the Lean concept before introducing it to the rest of the organisation. Top leadership should also be familiar with the potential ambiguity that Lean may introduce to the company (Dahlgaard et al., 2011). With so many unsuccessful implementations of Lean observed in healthcare, healthcare organisations need to address three questions regarding the implementation of Lean (Dahlgaard et al., 2011):

1. What concrete purpose is Lean health care going to serve?
2. How is this going to be worked out in an organisation-wide change program?
3. How can this program be applied in intra-organisational change projects?

These three questions would help organisations better prepare for successful Lean implementation. As mentioned by D'Andreamatteo et al. (2015), organisational readiness is essential for the implementation of Lean and determines its success. Organisational readiness prevents using Lean to simply make inefficient processes more efficient by only relying on tools (Radnor, 2011).

Implementing Lean requires a cultural change that includes soft management qualities like leadership, people management, and teamwork (Dahlgaard et al., 2011). This change develops a new organisational culture that supports improved core processes. "A supporting culture is required for changes to be successful, but successful changes reinforce the fundamental values on which the culture is based" (Dahlgaard et al., 2011). Therefore, it is important to note that organisational change and culture are interdependent and must work together. This interrelationship also highlights the need for visible success early on to motivate staff and encourage cooperation (Dahlgaard et al., 2011).

When Lean is implemented holistically to improve overall organisational performance, healthcare organisations have a high probability of achieving process orientation, cost reduction, and quality improvement (D'Andreamatteo et al., 2015). However, some healthcare organisations treat Lean as merely a quality improvement method rather than a holistic and integrated management system (Erthal et al., 2021). This superficial implementation of Lean limits its potential and benefits (Erthal et al., 2021). Although implementing Lean in small segments may lead to best practices and small successes, it does not have a significant impact on overall value creation for the organisation (Hallam and Contreras, 2018). This hinders the implementation progress and the extended potential and benefits of Lean (Erthal et al., 2021). As Pakdil et al. (2020) argue, "By optimising only one process in the entire value chain, sub-optimised components would be at risk, and eventually, the entire value chain." Therefore, selectively implementing Lean may provide short-term success but can be detrimental to the entire organisation or value chain in the long run.

Radnor et al. (2012) mention that healthcare has a highly political, complex, and regulated work system. This system is characterised by powerful and respected professional groups, which makes it challenging to implement management techniques compared to other industries (Radnor et al., 2012). The unsuccessful implementation of Lean can be attributed to workforce behaviours, including a lack of

trust and commitment exhibited by management (Čiarnienė and Vienažindienė, 2012). The term Lean seems to downplay the significance of human motivation and understanding how work is organised and led. It mainly emphasises techniques and methods (Čiarnienė and Vienažindienė, 2012). These deeply ingrained ways of functioning can inhibit the adaptation and implementation of Lean in the healthcare sector (Radnor et al., 2012). D'Andreamatteo et al. (2015) emphasise the importance of emotionally connecting the program and people to successfully adapt to Lean.

Lean's five principles have been adapted for healthcare, as shown in Table 2, and are considered an effective technique to address the increasing need for treatment (Hallam and Contreras, 2018). The application of Lean principles in healthcare can help eliminate duplicate processes and unnecessary procedures, such as redundant patient record-keeping, unjustified waiting times for staff, and disjointed discharge processes leading to longer stays (Radnor et al., 2012). Lean principles provide a theoretical framework for successful Lean healthcare but are not the sole cause of organisational-wide problems that could prevent Lean successes from being achieved or sustained (Hallam and Contreras, 2018).

Table 2: Lean principles adapted to healthcare as per (Hallam and Contreras, 2018)

No.	Original Lean principles	Lean principles adapted to healthcare
1	Identify customers and specify a value	Value can be examined using patients' wants and needs, which may include providing the appropriate diagnostic testing or avoiding excessive or costly tests
2	Identify and Map the Value Stream	Value stream means finding the activities that produce or add value to the patient's episodic care. For patients, numerous steps and waiting times should be reduced throughout the value stream

3	Create flow by eliminating waste	Flow is related to efficiency within healthcare, for example, reducing interruptions or queue times between a patient walking in the door and being seen by a physician
4	Respond to customer pull	Pull relates to providers' ability to have downstream process steps signal upstream process steps.
5	Pursue perfection	Perfection may be defined as providing timely and outstanding care that results in the correct diagnosis and cost-effective therapy for patients.

Although adapting Lean to a complex environment such as healthcare is a challenging task, many hospitals have managed to improve their performances and achieve positive outcomes using Lean. D'Andreamatteo et al. (2015) mentioned different positive outcomes from the studies they reviewed, based on Lean effects on performance. Observed positive outcomes were related to productivity and cost efficiency, clinical quality, patient and staff safety, patient and staff satisfaction, and financial results. Only a few studies showed the Lean-based improvement in support activities such as information technology processes, meal delivery and supply chain management. "*Accordingly, there would be several challenges and factors that affect the successful implementation of Lean as well, including receptivity of staff, the complexity of the adoption process, the evidence of innovation sharing, the embedding of change, high process variability, a lack of understanding of Lean, problems in defining waste and a poorly defined focus, and some of these challenges are as a result of a silo focused Lean implementation that moves problems from one section to the other*" (D'Andreamatteo et al., 2015).

One important aspect mentioned by D'Andreamatteo et al. (2015) regarding the successful implementation of Lean is when employees are empowered to become change agents through a team-based approach. A progressive implementation strategy involves allowing people to fully participate in the initial step of

implementation, where critical success factors and performance indicators are evaluated to cultivate a culture of Lean healthcare (Dahlgaard et al., 2011). Excluding or limiting staff involvement during this phase, where important decisions are made, leads to a sense of disconnection, dissatisfaction, and demoralisation within the organisation, as staff members no longer feel engaged and fail to take responsibility for their roles in continuous improvement (Nwobodo-Anyadiegwu, 2021). Shazali et al. (2013) mentioned four Lean healthcare practices in their model that contribute to healthcare performance as:

- Leadership,
- Employee Involvement,
- Organisational culture, and
- Customer focus

Sobek and Lang (2010) identified factors that are often considered crucial for successful implementation, including widespread involvement, organisational commitment and support, communication, training, and problem-solving. Daultani et al. (2015) noted that the success or failure of Lean can be attributed to the efforts made during implementation. Hallam and Contreras (2018) also mention that challenges to Lean success in healthcare are not necessarily theoretical, but are mainly influenced by practical application.

According to Drotz and Poksinska (2014), some of the main barriers to Lean healthcare include a lack of trust or belief among healthcare staff that Lean is suitable for the healthcare setting, as it originates from the production industry. Additionally, there is a scarcity of consultants who possess knowledge and experience of both the healthcare organisation and culture, as well as the principles, methods, and tools of Lean. Many Lean consultants used in the healthcare industry do not have sufficient understanding and knowledge of the healthcare context, which creates negativity among healthcare staff (Drotz and Poksinska, 2014). A critical factor for gaining attention and achieving successful participation from healthcare workers in Lean implementation is the accurate and appropriate translation of Lean management principles, tools, and philosophies from other industries to the healthcare context (Radnor et al., 2012). Below are some of the findings that Radnor et al. (2012) mentioned from their study:

- There is a clear difference in defining the customer and thus customer value
- Process improvement is easier within departments than across departments.
- Disjointed approach to implementing Lean across the organisation instead of an integrated and system-wide approach
- Lean was widely articulated as a tool-based approach.
- Implementation projects tended to 'hit a glass ceiling.

Considering this literature review, it can be concluded that Lean is implemented in healthcare systems as a “management method and philosophy with main focus on elimination of all types of wastes and loses in all tasks and processes so that time, materials, resources and medical procedures could be realised as effectively as it is possible” (Kovacevic et al., 2016). However Lean implementation in healthcare can be difficult due to some inhibitors that might be unique to the industry. (Sobek and Lang, 2010) mentions several inhibitors to the successful implementation of Lean in healthcare:

- Adaptation of Lean tools and concepts to healthcare - difficulty is due to the steep learning curve, lack of leaders with expertise, and trainees having limited knowledge of basic tools and skills commonly used in manufacturing
- Changing the underlying organisational culture - difficulties associated with the departmentalism of physicians and staff.
- Management styles - difficult to move away from a quick-fix mentality to a more long-term perspective,
- Buy-in of staff - staff members can be suspicious of the concept of Lean thinking and can perceive Lean as a method for eliminating jobs or as another management fad
- Motivation for change - because change can be uncomfortable, or because the system has no differentiation for better performers

It has become clear that “the future of Lean in healthcare is to develop structures, mindsets and systems which ensure that the significant existing investment in Lean is sustained, while its underlying assumptions are recognised. To derive the full benefit

of Lean, in any context, there simply is no shortcut to understanding its fundamental principles and underlying assumptions" (Radnor et al., 2012).

2.2.4 Sustainability of Lean Healthcare

The sustainability of Lean healthcare can be defined as the extent to which Lean healthcare approaches continue to operate after efforts of implementation have ended (Flynn and Scott, 2020). Sustainability will be achieved if the individual behaviour change introduced by Lean implementation is maintained or adapted while the Lean process continues to deliver the improvements (Flynn and Scott, 2020). Sustainability is a product of successful implementation that is not yet fully understood as mentioned by Flynn et al. (2018):

> *"Sustainability is a key implementation outcome, yet remains one of the least understood issues for implementation research. Implementation of interventions for improvement is meaningless without including long-term sustainability efforts".*

Several companies in various industries have experienced positive outcomes from implementing Lean methodologies. However, many of these companies struggle to maintain these achievements, leading to a regression to their original state (Henrique et al., 2021). The healthcare industry, in particular, has a low success rate when it comes to implementing Lean (Drotz and Poksinska, 2014). Medical studies often focus on the state before and after the intervention, neglecting to consider important factors such as employee roles, behaviour and engagement, work characteristics, and leadership (Drotz and Poksinska, 2014). These factors are crucial for sustainable Lean implementation (Drotz and Poksinska, 2014). By taking a comprehensive approach that considers readiness and sustainability, healthcare organisations can work towards promoting an organisation-wide, self-sustaining approach that fosters long-term continuous improvement (D'Andreamatteo et al., 2015).

There is also a lack of information regarding the long-term sustainability of Lean in the healthcare industry (Henrique et al., 2021). While literature acknowledges the importance of long-term sustainability in healthcare, there is a scarcity of empirical evidence on the subject (D'Andreamatteo et al., 2015). Flynn and Scott (2020) use the

analogy of the "tip of the iceberg" to highlight that our current understanding of sustainability only scratches the surface of the larger, more complex concept. This analogy underscores the need for more empirical information that explores the intricacies of sustainability and provides insights into the factors, resources, and reasoning required to sustain Lean efforts. The future of Lean in healthcare lies in developing structures, mindsets, and systems that ensure continued investment in Lean, while also acknowledging its underlying assumptions (Radnor et al., 2012).

2.2.5 Section Conclusion

This section provides a detailed introduction and definition of Lean and its applicability, to draw attention back to its roots. It explores various meanings of Lean, including waste, value, philosophy, Lean thinking, principles, and tools. Additionally, this section examines different approaches to applying Lean to achieve success. It also delves into the adaptation and adoption of Lean in healthcare, explaining its performance and benefits. Moreover, it discusses the hindrances and advancements of Lean in healthcare, as well as the issues that impact its sustainability. Specifically, it highlights the need to sustain Lean in healthcare and the challenges associated with it. Furthermore, it emphasises the shortage of research and lack of empirical evidence regarding the sustainability of Lean.

2.3 Public Healthcare and Lean in South Africa

The healthcare system in South Africa is made up of both private and public sectors, each with distinct characteristics. While both sectors share the common goal of providing treatment and promoting healing for patients, they operate under different conditions and face unique challenges. The public sector, for instance, is composed of government healthcare institutions that offer free services to the public. Conversely, the private sector consists of profit-driven organisations that can only be accessed by those who have medical insurance or can afford to pay for their healthcare expenses out of pocket (Jordan et al., 2015). This section will review the structure of the South African public healthcare system as well as the challenges it faces to understand if

any inherent issues may affect the sustainability of Lean. Will also review Lean and its sustainability to understand its status in public healthcare.

2.3.1 Structure of South African Public Healthcare

In 1994, the new democratic South African government set itself the task of developing a unified health system capable of delivering quality health care to all citizens efficiently and in a caring environment. This was done by introducing Comprehensive Primary Health Care as a strategic approach together with the health objectives in the Reconstruction and Development Programme (Department of Health, 1997). Details of the proposed health sector strategies were based on a common vision that reflects the principles of the RDP and is set out as follows (Department of Health, 1997):

1. The health sector must play its part in promoting equity by developing a single, unified health system.
2. The health system will focus on districts as the major locus of implementation, and emphasise the primary health care (PHC) approach.
3. The three spheres of government, non-governmental organisations (NGOs), and the private sector will unite to promote common goals.
4. The national, provincial, and district levels will play distinct and complementary roles.
5. An integrated package of essential PHC services will be available to the entire population at the first point of contact.

As per the white paper Department of Health (1997), Healthcare system transformation was meant to replace a hospital-reliant system with a primary-care-based system where resources are equitably distributed amongst provinces to reach the secluded rural areas and poor communities. The unified health system has a single National Department of Health, with nine provincial Departments of Health under its authority. The nine provinces were further subdivided into health districts, refer to Figure 2.

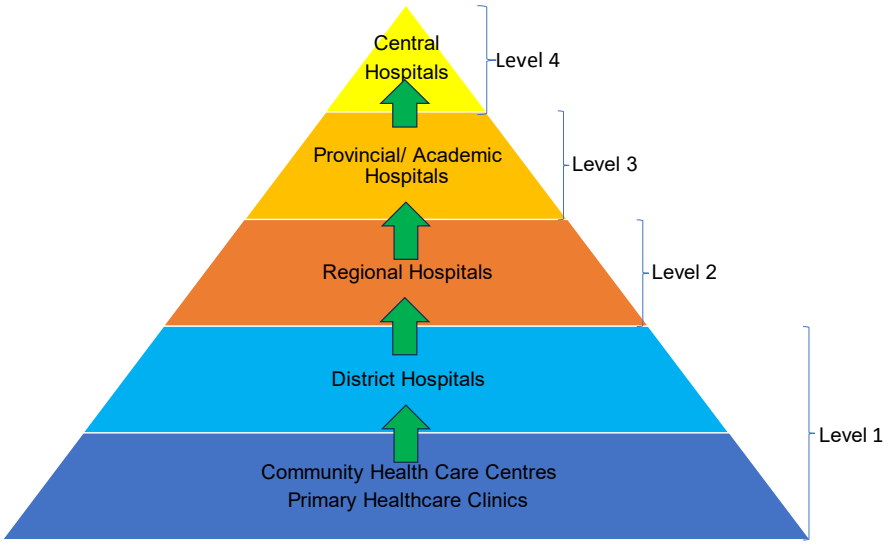

Figure 2: Depiction of healthcare levels (constructed by author)

This restructuring of health services required that distinct functions be assigned to the national department, the provinces and the districts. National department functions remained in policy and regulations development, budget distribution, support, and monitoring of the provision of health services in the country. Provincial departments would be responsible for regional and specialised hospitals (level 2), and academic health services (level 3). The mission of a provincial health department is also to develop and support a caring and effective provincial health system, through the establishment of a district health system (DHS) based on the principles of primary health care (PHC). District health (level 1) will provide community hospital health care (non-specialist and non-emergency) and facilitate health promotion, nutritional services, maternity and family planning services, mental health services, elderly and hospice care, and dental health services through primary health care centres.

The District Health System (DHS) was created and given the responsibility to manage the primary health care system, in which responsibility for service delivery is entrusted. In each health district, a team will be responsible for the planning and management of all local health services for a defined population. The team will arrange for the delivery of a comprehensive package of PHC and district hospital services within national and provincial policies and guidelines. DHS is responsible for the overall management and

control of its health budget, and the provision and/or purchase of a full range of comprehensive primary health care services.

Primary healthcare (PHC), which includes clinics and community healthcare centres, is the initial point of contact with the national health system, bringing healthcare closer to where people live and work. It addresses the main health issues in the community by offering promotive, preventative, curative, and rehabilitative services. As the first point of contact, patients can visit PHC facilities with any healthcare needs and will either receive the necessary care or be referred to a hospital for specialised services if required. The efficient functioning of the PHC system relies on the support of hospitals to which patients are referred. District hospitals and PHC facilities are both under the authority of the District Health Services (DHS) and together form the first level of the national health system.

Regional and specialised hospitals, as well as academic health services, are under the control of the provincial government and serve as referral hospitals for specialised services as per Figure 2. Regional hospitals serve as the second level of referral after district hospitals, while provincial hospitals are the third level of referral, housing advanced specialised skills. Central hospitals, which are at the fourth level of referral, are a national resource and must provide healthcare services to the entire population. They also serve as platforms for research, the training of health workers, and centres of excellence for national, continental, and global innovation. The management of central hospitals has full delegations and decision-making powers, including control over financial management, human resource management, infrastructure, technology, planning, and decision-making.

The health sector transformation did not quickly overcome the historical legacies of wide disparities of services and provision across the country or improve population health outcomes (Surender, 2014). A combination of factors including health worker shortages, insufficient resources, uneven distribution of personnel, a complex and evolving burden of disease with emerging infectious and non-communicable epidemics, a curative-oriented health service and deficiencies in managerial capacity and health system leadership at all levels continue to hinder the success of PHC in South Africa today (Kautzky and Tollman, 2008). The spread of different types or levels of public hospitals substantially differs across the nine provinces, with a concentration of district hospitals in poorer provinces (Eastern Cape and Kwa-Zulu

Natal) and a concentration of bigger specialist hospitals in the richest provinces (Western Cape and Gauteng) (Surender, 2014).

2.3.2 Challenges in South African Public Healthcare

It should be noted that approximately 80% of the population in South Africa relies on the public healthcare sector (Price, 2013). Unfortunately, the majority of this population is poor and living in unfavourable conditions, which makes them more susceptible to diseases. As a result, public hospitals in South Africa are facing challenges such as overcrowding, overwhelming workloads, lack of resources, and inadequate staffing (Maphumulo and Bhengu, 2019). Furthermore, there are significant healthcare disparities between rural and urban areas, as well as among the nine provinces and even within provinces (Rispel, 2016). Despite government initiatives implemented since 1994, public health organisations are still struggling to meet the basic standards of care and fulfil patient expectations (Maphumulo and Bhengu, 2019).

The public healthcare system continues to grapple with structural and governance issues. One of the major challenges is the lack of authority and delegation in public hospitals, which makes it difficult for management to address financial, strategic, internal performance, clinical, and stakeholder governance concerns (Maphumulo and Bhengu, 2019). Decision-making regarding the appointment and procurement of equipment is often centralised outside of hospitals, and these strict controls hinder public hospital managers and impede their ability to innovate and think strategically (Fusheini et al., 2017).

Another area of concern in public healthcare is the management of hospitals. Numerous studies have highlighted the shortage of skilled personnel, managerial incompetence, and the complex relationship between clinical and administrative leadership as ongoing issues in public hospitals (Fusheini et al., 2017). The governance and management problems have had a negative impact on the operations of the public healthcare system (Fusheini et al., 2017).

Another issue of concern is the processes and functioning or operations of public hospitals. During an analysis of hospitals in Gauteng, Kruger (2014) found that processes in public healthcare facilities were almost non-existent. The absence of appointment systems forces patients to visit hospitals without prior notice and wait in

long queues from early morning in the hope of consulting with physicians (Kruger 2014). Kruger (2014) also discovered a concerning issue with the manual paper-based filing system for patient files, where filing is irregular, leading to incomplete patient records and inadequate treatment history. Public complaints about public institutions, as mentioned by Maphumulo and Bhengu (2019), include prolonged waiting times, shortage of human resources, adverse events, poor hygiene and infection control measures, increased litigation, preventable errors, lack of medication and equipment, and poor recordkeeping.

Although resource shortages are often the underlying problem, the management of available resources is frequently suboptimal (Price, 2013). Corruption and bad governance has negatively affected the provision of health services at public hospitals (Nwobodo-Anyadiegwu, 2021). Corruption includes the absence of means to investigate corruption, the appointment of unqualified personnel without the required competencies and experience, and failure to discipline those found guilty of corruption.

Fusheini et al. (2017) identified relevant themes in their analysis of issues caused by the dominance of hierarchy, communication, and interaction that have an impact on the management and performance of public hospitals in the North-West province. The themes include:

- Fiscal Performance and Financial Stewardship
- Strategic Planning
- Performance Appraisals
- Clinical Governance
- Accountability to various stakeholder groups.

Rispel (2016) mentions the following three fault lines in public health sector transformation that need to be addressed to achieve desired success:

- Tolerance of ineptitude and leadership, management, and governance failures
- Lack of a fully functional district health system, which is the main vehicle for the delivery of primary health care
- Inability or failure to deal decisively with the health workforce crisis

These are some of the issues and concerns that the present government is still dealing with to address the crisis in the public health systems. In trying to address these issues, the National Health Department used information from patient complaints and satisfaction surveys to develop a plan that is based on the Constitution of South Africa, the Batho Pele principles, and the Patients' Rights Charter (Whittaker et al., 2011). This plan has six priority areas for immediate improvement, and consists of the following (Whittaker et al., 2011):

- Values and attitudes of staff, so that patients are treated respectfully with due respect for patient privacy and choice.
- Reducing waiting times and queues for administration, assessment, diagnosis, pharmacy, surgery, and referral and transfer time.
- Cleanliness of hospitals and clinics, including buildings, grounds, amenities, equipment, and staff.
- Keeping patients safe and providing reliable care by reducing adverse events resulting from the care given, including operations and failures of the system and its workers through ignorance, inadequate inputs, systems failure, or negligence.
- Preventing infections from being passed on in hospitals and clinics, specifically hospital-acquired infections.
- Ensuring that medicines, supplies, and equipment are available and that patients get their prescribed medicine on the same day.

These initiatives showed visible improvement in many public facilities (Whittaker et al., 2011) and it became important to support these initiatives to continuously drive improvement to sustain positive long-term results. For facilities that showed no improvement, self-assessment, development and training, competent and supportive management, and supervision must be put in place to achieve good outcomes (Whittaker et al., 2011).

2.3.3 Lean Healthcare in South Africa

The adoption of Lean in public healthcare is still in its early stages and underdeveloped. As a result, there is a lack of literature on Lean implementations. Most of the previous implementations of Lean have been on isolated sections, using isolated tools, without being linked to the entire organisation. A quote from Price (2013) below illustrates the extent of Lean implementations in South Africa and their effectiveness:

> *"In South Africa, Lean projects have been run in over 20 different health facilities. In 2003, hospice home care nursing used Lean Management to improve reimbursement processes by medical aids for medication distributed by homecare nurses. GF Jooste Hospital in the Western Cape used Lean Management methodologies to improve flow between their casualty department and other wards, while a tertiary hospital in the Western Cape used Lean principles to reduce the waiting time at the outpatient pharmacy from four hours to less than one hour. Other projects have applied Lean Management principles to address problems with accessing patient records and opening new folders, pathology laboratory turnaround times, and medical supply chain issues."*

Available literature mentions some challenges related to Lean implementations in public healthcare. Kruger (2014) encountered resistance from staff during the implementation of Lean. They found Lean to be invasive and lacking significance to staff individually. Additionally, there was a lack of belief in Lean methods, and unions believed that Lean would lead to job loss. Price (2013) conducted a Lean implementation project in a hospital to reduce waiting times and improve patient satisfaction. The project revealed that the average visit lasted 4 hours and 44 minutes, with 3 hours and 56 minutes spent waiting and only 41 minutes spent on value-added activities. The implementation of certain new policies has created further barriers to healthcare, undermined equity promotion, and decreased the quality of care and motivation for healthcare providers (Naidoo and Fields, 2019a). The organisational structures and culture entrenched in the public healthcare system also pose challenges to Lean implementation in public hospitals (Naidoo and Fields, 2019a). According to Nwobodo-Anyadiegwu (2021), corporate governance, mismanagement,

lack of visible leadership, inadequate support, and limited resources are the main challenges faced by Lean healthcare.

However, Lean has proven to be effective in improving the performance of selected areas and has the potential to do even more (Price, 2013). One of the initial Lean implementations in South African hospitals demonstrated that Lean can improve staff morale, patient flow, and waiting times (Nwobodo-Anyadiegwu, 2021). Practical Lean training, support and incentives for staff participation, an internal resource dedicated to Lean, a computerised record management system, addressing clinical staff shortages, and infrastructural maintenance are some of the interventions necessary for successful Lean implementation (Nwobodo-Anyadiegwu, 2021). Price (2013) proposed an alternative solution to better manage the flow of patients in hospitals during her Lean implementation project. By levelling the demand throughout the day, waiting times were reduced by 18% to 39% solely based on the commitment of staff and stakeholders, without any additional funds (Price, 2013). Naidoo (2015) discovered that Lean implementation led to improved staff satisfaction and motivation. Staff felt that things were improving in their department, communication improved, and attitudes toward teamwork significantly improved. Mutingi et al. (2015) identified several success factors for Lean healthcare based on interviews with industry experts:

- It is essential to instil holistic and systems thinking in healthcare organisations, as opposed to hierarchical thinking.
- In carrying out value stream mapping, it is vital to redefine the term customer in the context of Lean healthcare, to include other influential stakeholders such as family members, caregivers, local communities and taxpayers.
- Commitment and full involvement of healthcare staff is essential in the Lean implementation; specialist skills and experience are useful for improvement.
- It is essential to train and develop employees, giving them responsibility to make improvement initiatives.
- Management support at all levels; top-level managers should show interest in Lean and provide sufficient resources for Lean implementation.
- The Lean philosophy should be taught and implemented as a tool for improvement and not as a way of reducing headcount, leading to job losses.
- It is also critical to educate employees at all levels regarding the medium to long-term benefits of Lean healthcare before implementation.

It must be emphasised that if healthcare organisations decide to adopt and implement Lean approaches and its methods, they must pay serious attention to the descriptions and boundaries of the approaches as that is very important from a problem-solving standpoint (Kruger, 2014).

2.3.4 Sustainability of Lean Healthcare in South Africa

The adoption of Lean is increasing in the South African healthcare industry, with some notable positive results in isolated projects as mentioned in the literature. However, there is still a lack of consistency. Currently, there are no official or trusted reports on the success and failure rates of Lean implementations in South African healthcare organisations (Sesane et al., 2019). Furthermore, there is a lack of empirical data to demonstrate how Lean implementation can be preserved and sustained in the long term (Naidoo and Fields, 2019). This lack of evidence highlights the need for more research on Lean management in healthcare, particularly in underdeveloped countries like South Africa, which face unique challenges compared to developed countries (Naidoo and Fields, 2019). Given the current local challenges of limited resources and poor prospects for economic growth, efforts must be made to improve healthcare management based on the philosophy of achieving more with less (Naidoo and Fields, 2019b).

To achieve long-term sustainability, management must be committed to a determined Lean journey (Nwobodo-Anyadiegwu, 2021). A planned approach should be taken to formulate sustainability goals and strategies that align with the organisation's strategic objectives (Nwobodo-Anyadiegwu, 2021). It is essential to continuously monitor and revise both the objectives and strategies when developing and implementing sustainability strategies. Sustainability should not be seen as a final destination, as this approach can hinder early or sufficient sustainability planning but should be prioritised earlier in the adoption process (Sesane et al., 2019). Instead of implementing Lean in isolated sections, it should be spread across the entire organisation (Sesane et al., 2019). Routinisation and institutionalisation are fundamental processes for sustainability (Sesane et al., 2019). However, to make sustainability a routine component, there is a need for greater clarity on the hindrances to sustainability and their causes (Sesane et al., 2019).

2.3.5 Section Conclusion

This section provides insight into the structure of South African healthcare, the issues faced by the public healthcare sector, and the initiatives undertaken by the government to improve performance and provide quality healthcare in South Africa. The literature mentioned that these initiatives have shown progress in some public facilities. However, the implementation of Lean principles has not been applied throughout the entire organisation, which could affect sustainability. The lack of literature on Lean implementation and sustainability is hindering progress in this area. This section also highlights the inherent and political problems within the South African healthcare system.

2.4 Organisational Culture in Healthcare

One of the biggest obstacles encountered in the healthcare sector in adopting or implementing any new organisational change effort is the difficulty in transforming the existing culture (Maramba et al., 2020). Organisational culture (OC) deals with a set of values, beliefs and behaviour patterns that form the core identity of organisations (Jacobs and Roodt, 2008). OC is reviewed in this section because Lean implementations is about culture change. This section will define OC, review it in South African public hospitals, and review its effect in Lean healthcare

2.4.1 Defining Organisational Culture

OC defines real and allowable actions within an organisation and includes the meanings that management and staff assign to their work as mentioned in literature.

> "*OC is the social and normative glue that binds people into collective enterprise; and it defines the way things are done around here*" (Wagner et al., 2014)

The analysis of OC can be done by highlighting certain aspects such as conflict resolution, culture management, customer orientation, disposition towards change, employee participation, goal clarity, human resource orientation, identification with the organisation, locus of authority, management style, organisational focus, organisational integration, performance orientation, reward orientation and task

structure that influence behaviour and subsequently can be considered as the culture of the organisation (Jacobs and Roodt, 2008). OC has four key characteristics (Acar and Acar, 2014):

- is a shared phenomenon,
- has visible and less visible levels,
- each new member of the organisation learns the culture,
- and culture tends to change slowly over time

Positive OC within hospitals that have lower staff turnover had a strong mission, empowerment of leaders, participative management, patient focus, reward orientation (for improvement), visible/accessible leaders and supported education (Jacobs and Roodt, 2008).

2.4.2 Organisational Culture in South African Hospitals

The South African public health services are characterised by conflict, and conflict resolution is seen as an important dimension of OC (Jacobs and Roodt, 2008). Hospital governance calls for cultural change towards openness, participation, staff empowerment, partnership, and collaboration, an essential achievement is to shift from a punitive culture to a culture of learning from mistakes (West, 2001). In healthcare conditions, patient safety, quality, cost-effective patient care and patient satisfaction are some of the most important aspects of their strategic plan (Casida and Pinto-Zipp, 2008). Alignment of the OC with the strategic plan is important in attaining the hospital's goals and objectives (Casida and Pinto-Zipp, 2008).

> "*Strategic situations need adoption of OC with a continuous perception, evaluation, implementation and revision within the balance of internal dynamics rather than a top-down planning*" (Acar and Acar, 2014).

The unique South African cultural diversity in terms of race and ethnicity presents an added challenge in changing the culture of healthcare organisations (Maramba et al., 2020). As per the findings of Maramba et al. (2020), culture is very significant during the implementation of an organisational change effort, and healthcare organisations usually fail to understand the concept of culture change. The main cultural challenges

include commitment, knowledge-sharing culture, medical practitioners' perceptions, complexity, and resistance. (Maramba et al., 2020).

Positive and strong OC can turn an average performer into a top performer and achieve excellent results, thus it contributes to staff performance (Shazali et al., 2013). It has been claimed that culture greatly influences the performance of an organisation through internal integration and external focus (Acar and Acar, 2014). This suggests that a success-oriented organisational culture improves organisational effectiveness. According to Cameron and Quinn's (1999) typology, an organisation's culture can be viewed along two dimensions: a focus on internal maintenance (smoothing and integration) versus external relationships (competition and differentiation), and a focus on organic processes (flexibility and dynamism) versus mechanistic processes (stability and control). Failure to integrate different teams of stakeholders and to fulfil the user groups' needs are the major reasons why different teams are not willing to change and adopt the new working culture (Maramba et al., 2020).

The recent report "Crossing the Quality Chasm" by the Institute of Medicine (IOM, 2001) identified problems with the quality of care as a systemic issue, rather than one of individual competence or incompetence. The report also suggested that the various systems of healthcare delivery are hierarchically organised, with each level affecting the ones below it. Improving healthcare quality requires a comprehensive overhaul of existing care systems at all levels of the system (Hearld et al., 2008). Healthcare organisations face challenges in defining nonfinancial goals and performance due to the ambiguous nature of inputs and outputs (Hearld et al., 2008). They also need to effectively coordinate the activities of a diverse workforce consisting of multiple professional groups. Given these complexities and the fact that healthcare organisations are uniquely positioned to implement solutions that improve care, it is crucial for researchers to better understand and explain the relationships between these organisations and the delivery of care (Hearld et al., 2008). Practitioners and policymakers have a responsibility to find ways to enhance healthcare quality by improving healthcare organisations, considering the complexity of these organisations and their role in shaping the healthcare systems (Hearld et al., 2008). Therefore, healthcare organisations with a strong organisational culture tend to have higher levels of patient satisfaction and loyalty (Shazali et al., 2013).

2.4.3 Organisation Culture in Lean Healthcare

OC is a crucial aspect when implementing Lean in healthcare. According to Erthal et al. (2021), cultural changes begin when the ambiguity caused by Lean is recognised and acknowledged. This recognition then drives the learning and adoption of new behaviours and meanings. The broader sociocultural and organisational context greatly influences the translation of Lean from policy to practical implementation (Erthal et al., 2021). This emphasises the need for a thorough and clear understanding of how Lean interacts with the existing healthcare culture (Joosten et al., 2009).

Erthal et al. (2021) mention several Lean practices that can effectively manage the cultural tensions associated with Lean implementation. These practices include having a continuous improvement mindset, receiving leadership support, using evidence-based and flexible approaches, and promoting engagement, reward, and recognition through internal consultants (Erthal et al., 2021). Implementing Lean introduces new ways of doing things and requires cultural changes. However, if Lean is implemented holistically, its management principles can be used to transform the old culture into a new culture centred around continuous improvement (Erthal et al., 2021)

2.4.4 Section Conclusion

In this section, the organisational culture in healthcare was defined and its role and importance in healthcare were evaluated. The organisational culture (OC) provides the identity of the organisation and defines how things are done. Literature mentions the need to focus on transforming OC for Lean to succeed. The whole implementation of Lean is about changing the OC of the company to reflect Lean thinking and doing.

2.5 Sustainability Science

There is a growing consensus that sustainability issues require new ways of doing things and making decisions. These new ways include the collaboration of different sciences and societies in problem identification and analysis, solutions generation and application that is results-oriented (Brandt et al., 2013). Sustainability science (SS) has emerged as a research field that aims to address natural, social and economic issues in light of cultural, historical and institutional perspectives (Sala et al., 2013).

SS will be reviewed here to assist with the understanding of sustainability and how it can be achieved. This section will define sustainability, review inter- and trans-disciplinary state of sustainability, and also review the key competences for sustainability.

2.5.1 Defining Sustainability Science

SS is a field of science that is interdisciplinary and innovative and focused on doing problem-driven research that connects knowledge to action (Miller, 2013). SS has, as its goal, the integration of science and technology with other social disciplines to provide solutions and to inform decisions (Burns et al., 2006). The development of SS is a response to present and future sustainability problems, and to solve these problems, the field "generates, integrates and links use-inspired knowledge to transformational action in participatory, deliberative, and adaptive settings" (Wiek et al., 2011; Sala et al., 2013). It can be deduced that the challenges of the discipline are not only about better identifying the sustainability problems, but to the actual transition towards solutions by adopting an integrated, comprehensive, adaptive and participatory approach. SS is an emerging field that is still developing and more studies are still conducted to define and refine it.

Martens (2006) referred to central elements of SS as:

- Inter- and intra-disciplinary
- Co-production of knowledge
- Co-evolution of a complex system and its environment
- Learning through doing and doing through learning
- System innovation instead of system optimization.

Further on Spangenberg (2011) used his broad definition of SS to derive three main characteristics as follows:

1. It may be basic or applied research, but it must be purpose-bound, as opposed to the 'value-free' stance of natural sciences: as sustainability is a normative concept, SS must be aimed at action. Methodological pluralism is a necessary

characteristic of sustainability science as a whole, although not necessarily of each research project.

2. SS provides integrated analyses and assessments. Integrated assessment is a reflective and iterative participatory process that links knowledge (science) and action (policy) regarding complex science and technology issues. It is an interdisciplinary process, combining, interpreting and communicating knowledge from diverse scientific disciplines and non-scientific sources in such a way that the whole cause-effect net of a problem can be evaluated from a synoptic perspective, providing added value compared to single disciplinary assessments and offering useful information to decision-makers.
3. SS must be either interdisciplinary or at least 'interdisciplinarity-ready', conducted in a way which allows the integration of its results in an interdisciplinary context, bringing disciplines together to achieve greater consistency in approaches between them.

Later on, Sala (2013) further developed the SS characteristics into the following:

1. Understanding of dynamic interactions of complex systems that requires a holistic approach and perception of reality
2. Trans-disciplinary approach to bring together the different levels of knowledge under a holistic view
3. Normative function as a capability to provide direction through visions and goals
4. Transformational function for the development of joint and coordinated strategies to solve sustainability problems.

SS can be conceptualised to comprise two elements, science for sustainability and science of sustainability (Spangenberg, 2011) - refer to Table 3.

Table 3: Comparison of science for sustainability and science for sustainability (Spangenberg, 2011)

Science for sustainability	**Science of sustainability**
Mode-1 sustainability science	Mode-2 sustainability science
Monodisciplinary	Interdisciplinary and transdisciplinary

Highly-focused	Broadly-based
Normal science	Post-normal science
Curiosity-driven and problem-solving	Critical research
Academic	Academic and social
Academic peers	Extended peer community
Certainty	Uncertainty and ignorance
Hierarchical logic	Relational logic
Scientific proofs, unequivocal results	Discursive processes, ranges of options
Top-down, command and control	Discursive process of opening up and closing down
Stakeholders affected	Stakeholders involved

Science for sustainability is defined by Spangenberg (2011) as a way to reinforce interaction between society and science, it is a service offered by science to society. It consists of more descriptive, analytical and basic science (Sala et al., 2013), and it is a scientific contribution towards sustainability solutions. The science of sustainability should be interdisciplinary ready to be integrated with other disciplines in pursuit of sustainability solutions (Spangenberg, 2011). The science of sustainability deals with understanding the complex dynamics as a result of interactions between humans, science and systems (Spangenberg, 2011).

> "*Science of sustainability is a critical theory, reflective on the process of theorising itself, asking how the situation came about, calling contemporary institutions and power relations into question, and allowing for normative choices of alternatives*" (Spangenberg, 2011).

The science of sustainability requires collaboration between different perspectives and must link theory, practice, and policy (Bettencourt and Kaur, 2011).

SS is an applied science and should contribute directly or indirectly to providing sustainability solutions. The science of sustainability is more focused on science-policy interfaces, and social processes where discussions between scientists, decision-makers and stakeholders happen (Spangenberg, 2011). These social processes grow

into real discussions where knowledge is constructed collectively. Sustainability relies on creating and maintaining the adaptive capacity necessary to handle the situations and long-term systemic transformations faced (Spangenberg, 2011).

An SS project framework should be conceptualised as a dynamic process with a clear vision and goals, without detailing the final state. This should be supported by institutional arrangements providing ways to manage problems along the process. The availability of these backup plans can help with the smooth implementation of adaptive work plans (Spangenberg, 2011). SS can further be defined as follows:

> "*SS is both an interdisciplinary and a transdisciplinary field of research that combines scientific and non-scientific expertise and seeks to understand the complexities of coupled socio-ecological systems and develop practical solutions that promote ecological, economic and social sustainability*" (Dedeurwaerdere, 2014)

2.5.2 Inter-disciplinary

Inter-disciplinary is an SS approach that integrates methods, concepts and theories, across disciplines and social groups to achieve a common understanding of complex problems (Spangenberg, 2011).

Lélé and Norgaard (2005) mentioned four types of barriers to interdisciplinarity:

1. Differences in values embedded within each discipline
2. Differences in theories, explanatory models and underlying assumptions
3. Differences in approach and methods
4. How society interacts with the organisation

2.5.3 Trans-disciplinary

Trans-disciplinarity is an SS approach that involves multiple scientific disciplines (interdisciplinarity) and the active input of practitioners from outside focusing on shared problems (Brandt et al., 2013). As per Lang et al. (2012), key arguments for trans-disciplinary are the following:

- Complex sustainability problems need constructive input from different sources of knowledge to ensure that important knowledge from all involved related to the problem is incorporated.
- Knowledge production for solutions must go beyond problem analysis where vision, goals and norms take the lead for transition and intervention strategies.
- Collaborative efforts amongst all involved leads to “increased legitimacy, ownership, and accountability for the problem, as well as for the solution options”

Trans-disciplinary is broadly defined as a “reflexive, integrative, method-driven scientific principle aiming at the solution or transition of societal problems, and concurrently of related scientific problems, by differentiating and integrating knowledge from various scientific and societal bodies of knowledge” (Lang et al., 2012)

As per this definition, the transdisciplinary approach needs to concur with the following conditions (Lang et al., 2012):

1. Focusing on societally relevant problems.
2. Enabling mutual learning processes among researchers from different disciplines
3. Aim at creating knowledge that is solution-oriented, socially robust, and transferable to both scientific and societal practice.

> “*Trans-disciplinary approach is also characterised by the strong link with the specific social/local context and institutional setting from where sustainability problems originate, the inclusion of all values and common goods perceptions in the identification of the solutions (subjective and normative dimensions); and its application in contexts different from those where they originate*” (Sala et al., 2013)

Scanning these various descriptions for SS, recurring themes are the issues of integration and collaboration. The systemic character of sustainability problems demands an overall perspective that unifies across sectors, problems, methods, disciplines, and time.

2.5.4 Key Competencies in Sustainability

Competence in sustainability means possession of relevant knowledge, skills and attitudes for problem-solving and providing solutions to sustainability challenges (Wiek et al., 2011b). Key competencies are distinguished from regular competencies as being critically important for sustainability without implying that regular competencies like critical thinking and communication skills are not important but rather emphasise the competencies that require special attention (Wiek et al., 2011b).

> "*Key competencies are a critical reference point for developing the ambitious knowledge and skills profile of problem solvers, change agents and transition managers*" (Wiek et al., 2011b).

Because of the distinct nature and characteristics of sustainability problems, identifying, analysing and providing solutions for sustainability problems needs a converging set of interlinked and interdependent key competencies (Wiek et al., 2011b).

Five key competencies and their definitions as per (Wiek et al., 2011b) are as follows:

1. Systems-thinking competence: the ability to collectively analyse complex systems across different domains and scales, thereby considering cascading effects, inertia, feedback loops and other systemic features related to sustainability issues and sustainability problem-solving frameworks.
2. Anticipatory competence: the ability to collectively analyse, evaluate, and craft rich ‘‘pictures’’ of the future related to sustainability issues and sustainability problem-solving frameworks. The term ‘‘pictures’’ has been used (similar to ‘‘stories’’ or ‘‘images’’) as an open notion to include qualitative information, quantitative information, narratives, imagery, etc.
3. Normative competence: the ability to collectively map, specify, apply, reconcile, and negotiate sustainability values, principles, goals, and targets. This capacity enables, first, to collectively assess the (un-)sustainability of current and/or future states and, second, to collectively create and craft sustainability visions.
4. Strategic competence: is the ability to collectively design and implement interventions, transitions, and transformative governance strategies toward sustainability. This capacity requires an intimate understanding of strategic

concepts such as intentionality, systemic inertia, path dependencies, barriers, carriers, alliances etc.; knowledge about viability, feasibility, effectiveness, and efficiency of systemic interventions as well as potential of unintended consequences; as well as methods and methodologies of designing, testing, implementing, evaluating, and adapting policies, programs, and action plans, involving different societal actors, facilitating varying perspectives, and acknowledging inconclusive evidence.

5. Interpersonal competence: the ability to motivate, enable, and facilitate collaborative and participatory sustainability research and problem-solving. This capacity includes advanced skills in communicating, deliberating, negotiating, collaborating, leadership, pluralistic and trans-cultural thinking and empathy

These five key competencies must be jointly used to effectively co-develop knowledge and action for sustainability (Wiek et al., 2011a). The overarching competence in sustainability involves not only the mastery of the single competencies but also the ability to integrate these competencies effectively. Sustainability solutions require linking and activating all of the individual competencies in different and multiple ways (Wiek et al., 2011b). Since the sustainability field is problem-driven and dynamic, problems will continuously evolve so will the understanding of the kind of competencies required (Wiek et al., 2011b). Brundiers and Wiek (2011) mention that some sustainability competencies were further reviewed and grouped into four categories as per below:

1. Problem-oriented and conceptual knowledge,
2. Methodological knowledge,
3. Ability to “link knowledge to action”, and
4. Interpersonal and collaborative skills.

2.5.5 Section Conclusion

The section broadly defines the type of science that SS is. There is a consensus that SS is a unique form of science that is primarily driven by practical applications, while also incorporating both foundational and applied knowledge. Additionally, there is a

strong emphasis on the importance of applying this knowledge to bring about positive changes in society. One of the main characteristics of SS is the integration of knowledge from various disciplines and the collaboration between different sectors and levels of society. To provide clarity on the skills needed to address sustainability issues, this section also highlights key competencies that individuals should possess.

2.6 Systematic literature review

Current existing knowledge should be used as a basis to develop or advance new knowledge. The review of the currently existing literature is necessary to understand the breadth and depth of the available body of knowledge and helps to identify weaknesses, inconsistencies and contradictions to probe (Xiao and Watson, 2019). Scientific literature has two main types of reviews which have different characteristics and goals, namely: narrative and systematic literature reviews (Rother, 2007). A narrative literature review is a review that discusses the state of a specific topic or theme using and citing the published literature randomly without mentioning the databases and methodological approaches used to conduct the review (Rother, 2007). A systematic literature review (SLR) is a comprehensive review of literature conducted in a systematic way to identify, select, and critically evaluate the results of the studies included (Hanley and Cutts, 2013). A Systematic literature review is reviewed here to define it and explain its relevance in the research world. SLR will assist this study in understanding the international depth and understanding of Lean sustainability in healthcare. SLR findings are used in this study to evaluate the interview findings. SLR evaluation will assist this study to identify knowledge gap between South Africa and the rest of the world.

2.6.1 Definition of Systematic Literature Reviews

SLR is defined as a means of appraising and explicating all available research data related to a specific research question, or phenomenon of interest using trustworthy, rigorous and auditable methodology (Stapic et al., 2012). A SLR must follow a methodological approach (systematic), be explicit in detailing methods used, comprehensively include all relevant material and be reproducible by others who would follow the same approach (Okoli, 2015).

2.6.2 Importance of SLR in the research world

The exponential growth, rapid production, and ease of distribution of scientific literature have made the task of reading and making sense of the literature on a particular topic complicated, time-consuming, and stressful. Additionally, the same research question explored by different individuals might not yield the same findings, and it can be unclear why this is the case (Siddaway et al., 2019). A systematic Literature Review (SLR) collects and analyses available literature to provide an overall impression of a particular research question or phenomenon, highlighting present and future knowledge gaps (Siddaway et al., 2019). Researchers are motivated to use SLR to describe available knowledge for professional practice (Okoli, 2015). While these motivations may be largely shared by other types of reviews, the scope and rigour of SLR set it apart, making it a highly cited piece of work (Okoli, 2015). By integrating outcomes from vast independent studies, and synthesising and evaluating them, SLR surpasses what any individual study could achieve because "the whole is far greater than the sum of its parts" (Siddaway et al., 2019).

Undertaking an SLR is a challenging task, and the commitment to do so provides the academic society with a very important service (Okoli, 2015). Any published SLR serves to save the academic society a massive amount of time and effort in searching for and synthesising a large volume of literature. However, published SLRs must be open and transparent regarding the process and procedures used to conduct the review. This transparency is necessary for the academic society to have confidence and assurance that the effort will not be repeated unnecessarily (Okoli, 2015). "*Fundamentally, knowledge advancement must be built on prior existing work. To push the knowledge frontier, we must know where the frontier is. By reviewing relevant literature, we understand the breadth and depth of the existing body of work and identify gaps to explore*" (Xiao and Watson, 2019).

Below are some of the uses of SLR highlighted by Thomé et al. (2016):

1. It integrates critical pieces of information for decision-making, research and policy.
2. It eases the generalisability of findings by regrouping similar results from different populations or interventions.
3. It allows a systematic assessment of relationships among variables.

4. It puts in evidence and helps explain data inconsistency and contradictory findings in a given field.
5. By systematically reporting procedures and methods, it should improve the accuracy or at least allow verification

2.6.3 Section Conclusion

A systematic literature review has been defined in simple terms as a means of appraising and explicating all available research information relevant to a particular research question or phenomenon of interest by using a trustworthy, rigorous, and auditable methodology. The reasons for doing SLR were explained in this section. The importance of rigour and trustworthiness in SLR was shown and emphasised. And the importance of SLR to research world was reviewed.

2.7 Overall Chapter Conclusion

The literature on Lean provides standard definitions and explanations of its applicability, offering a general understanding of Lean as a concept. The review of Lean healthcare and its sustainability demonstrates how Lean should be implemented and sustained in the healthcare industry, while also providing background information on the international status of Lean healthcare. The concept of Lean sustainability and the factors that influence it are examined. Additionally, the South African healthcare system and the challenges faced by public healthcare are discussed. The tools SS, OC, and SLR are reviewed as they will aid in achieving the objectives of this study.

Chapter 3: Research Method

3.1 Introduction

Research is defined in literature as a systematic investigation that uses acceptable scientific methodology to establish facts, find answers to questions, and reach new conclusions by creating new knowledge that is generally acceptable. A Research study must be undertaken within a framework of a set of philosophies, and research methods that can be tested for validity and reliability, and be designed to be objective and unbiased (Goundar 2012).

This study's research focus is to explore the factors affecting the sustainability of Lean healthcare in South African public hospitals and draw lessons that can be used to sustain Lean implementations. This chapter will discuss the methodology as the study of how the research will be done and the data collection methods to be employed by this study. It will also justify and state reasons for all the choices made.

3.2 Research Methodology

Research methodology is defined as a science of studying how research is to be carried out, it aims to give a roadmap or explains the procedures to be followed when conducting research (Creswell, 2003). This research study was carried out by first choosing the research approach that should be followed to answer the research questions and achieve the objectives. There are three components of research methodology (Research design, Philosophical worldview also referred to as paradigm, and strategies of inquiry) as per Figure 3 that were considered to define the research approach (Creswell, 2003) for this study. The three components will be discussed below.

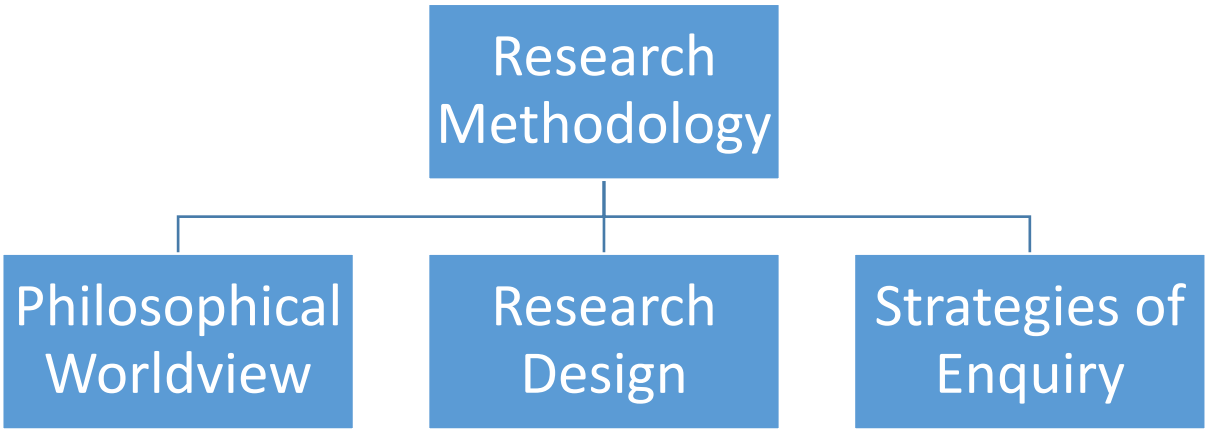

Figure 3: Components of research methodology as per (Creswell, 2003) (created by author)

3.2.1 Philosophical worldview/ Paradigms

The research study began with the researcher taking a stance on the direction of the project, which was influenced by their set of beliefs (Creswell and Poth, 2016). These beliefs, also known as worldviews or paradigms, shape the way the study is conducted and presented. According to Creswell and Poth (2016), there are four paradigms to choose from postpositivism, constructivism, advocacy/participatory, and pragmatism. For this study, constructivism was chosen because it seeks to understand the phenomenon through interaction with the research participants.

The purpose of this study is to explore the factors that impact the sustainability of Lean and to draw lessons that can be applied to sustain Lean implementations. This study was motivated by the shortage of researched literature about Lean healthcare sustainability. The absence of written information led this study to seek information from individuals who have been involved with Lean implementations at public hospitals. Therefore, constructivism was the best fit for this study. Constructivism helped in developing the subjective meaning of the participants' experiences and views regarding the factors affecting the sustainability of Lean healthcare. These meanings were largely influenced by the social, historical, and practical experiences of the participants about Lean healthcare in public hospitals. The study relied heavily on the perspectives of the participants when examining the Lean healthcare situation.

In a constructivism paradigm, the research questions used to gather data should be broad and general, preferably open-ended, allowing participants to construct meaning while the researcher listens attentively (Creswell and Poth, 2016). The researcher should also focus on the specific context that shapes the participants' views. In this paradigm, the researcher's goal is to interpret and make sense of the participants' perspectives on the phenomenon (Creswell and Poth, 2016). The researcher needs to be aware that their background and experiences can influence their interpretation.

3.2.2 Research design

Research design, as described in Abutabenjeh and Jaradat (2018), encompasses research plans and procedures that are based on decisions stemming from philosophical assumptions, research methods, and analysis. Creswell (2008) identified three types of research designs: quantitative, qualitative, and mixed methods, which are elaborated on in Appendix 1. For this study, the most appropriate research design is qualitative research method, as it is specifically designed to help researchers comprehend human beings and their social and cultural perspectives and behaviours (Toloie-Eshlaghy et al., 2011). The relevant characteristics of qualitative research method as per (Creswell, 2003) for this study are:

- They use open-ended questions (Interviews), observational, document, and audiovisual data for data collection
- They use text and images for analysis
- Makes knowledge claims based on constructivist perspectives
- Employs strategies of inquiry such as ethnography, narratives, phenomenology, case studies
- Collects open-ended, emerging data with the intent of developing themes from the data

Qualitative research method was chosen for this study to explore information from participants based on their expertise, experience, and knowledge of the subject or phenomenon. By describing the subject under study, participants helped the researcher gain a comprehensive understanding of the phenomenon being researched, thereby fulfilling the objectives of this study.

The final report on qualitative research method includes participants' views, the researcher's reflexivity, and a description and interpretation of the problem. It also contributes to the existing literature or calls for action (Creswell and Posh, 2016). These elements will enable this study to achieve its research objectives. According to Creswell and Posh (2016), there are five types of qualitative strategies of inquiry that a researcher can choose from, depending on their philosophical worldview and the objectives of the study. These strategies will be discussed in section 3.2.3.

3.2.3 Strategies of Inquiry

Strategies of inquiry refer to different types of qualitative designs that provide guidelines for procedures in a research design. Creswell and Poth (2016) have identified five approaches to inquiry, namely narrative, phenomenological, grounded theory, ethnographic, and case study research. Please refer to Appendix 2 for a comparison of the characteristics of these approaches. For this particular research, the phenomenological approach was chosen. Phenomenological research focuses on understanding the meaning of people's experiences related to a specific concept or phenomenon (Kafle, 2011). Its primary goal is to describe the common experiences people have with a phenomenon and to provide a description of its universal essence. Phenomenology is recommended in fields where there is a limited amount of published material, or when the fields require more in-depth description (Wilding and Whiteford, 2005).

The research investigates the phenomenon of sustainability of Lean healthcare. Its objective is to identify the factors that influence sustainability and to learn from these factors to sustain Lean implementations. The perspectives of practitioners on the factors that affect Lean healthcare were gathered. The researcher then analysed and described the meanings of these perspectives, searched for commonalities among them, and derived lessons that can be used to sustain Lean implementations.

3.3 Data collection methods

The constructivism paradigm, phenomenological approach, and qualitative research methods recommend using broad and general research questions to gather data.

These questions should preferably be open-ended, allowing participants to construct meaning while the researcher listens carefully (Creswell and Poth, 2016). Following research methodology guidance and the study objectives illustrated in Figure 4, the interview method was chosen to gather practitioners' perspectives on the factors affecting the sustainability of Lean healthcare in South African public hospitals, which is the first objective. A systematic literature review (SLR) was conducted to explore factors affecting the sustainability of Lean in healthcare based on the available literature, which is the second objective. The SLR data was used to evaluate the data gathered from the interviews, which is the third objective. This study aims to use the interview data to draw lessons that can be applied by public hospitals to sustain their Lean implementations. This is done to address the lack of information that hospitals can use. To ensure that the interview data provides generally acceptable knowledge, an SLR data was used to evaluate and enforce the validity and reliability of the interview data due to its rigour and reliability. The evaluated interview information will be used to draw lessons for sustaining Lean implementations, which is the fourth objective.

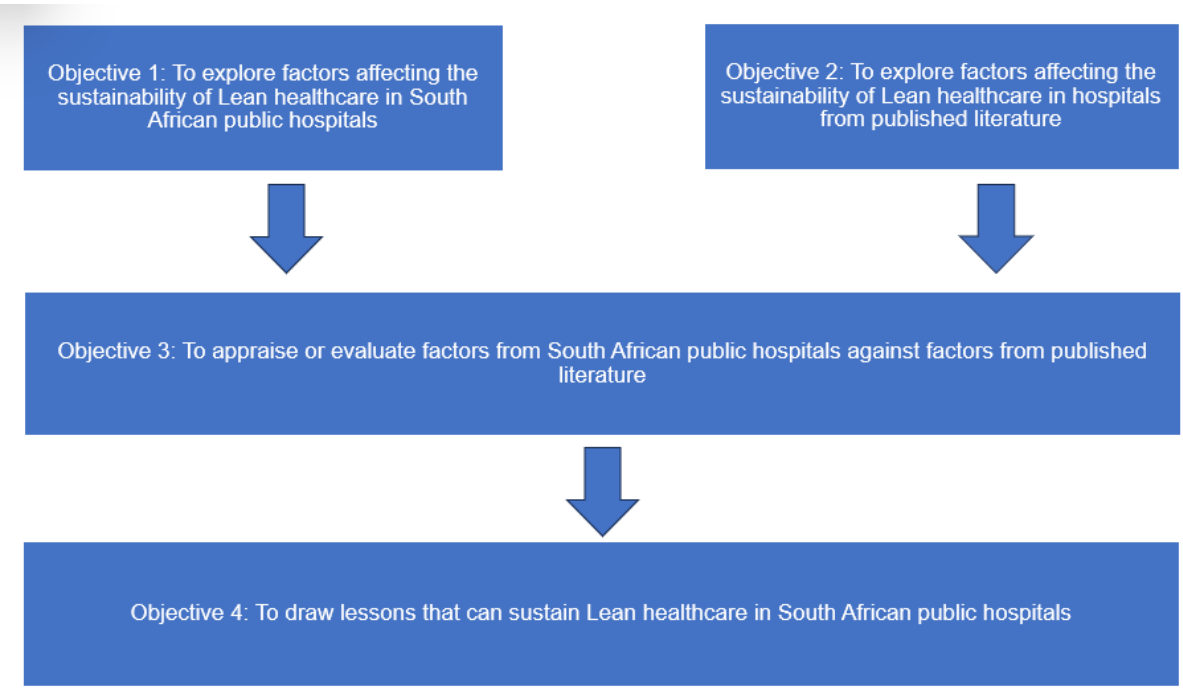

Figure 4: Illustration of the study objectives (created by the researcher)

3.3.1 Interviews

Interviews were used in this study to gather practitioners' perspectives on the factors affecting the sustainability of Lean healthcare in South African public hospitals. The research objectives and the specific information needed to answer the research questions determined the most appropriate type of interviews to be used (Alsaawi, 2014). Three types of interview methods can be utilised to collect data: structured, unstructured, and semi-structured interviews (Gill, 2008). To fulfil the objectives of this study and address research question number one, semi-structured interviews were chosen based on the research methodology. This approach allowed for the exploration of participants' views on the topic and provided them with the freedom to express themselves without limitations. Additionally, the flexibility of this approach, as suggested by Gill (2008), compared to structured interviews, facilitated the discovery or elaboration of information that was deemed important by participants, but may not have been previously considered relevant by the research team.

3.3.1.1 Semi-structured interview question development

Semi-structured interviews involve asking key questions to determine the areas to be explored but also allowing the interviewer or interviewee to deviate and delve deeper into an idea or response (Lancaster, 2007). This format is commonly used in healthcare, as it gives participants some guidance on what to discuss, which many find beneficial (Gill et al., 2008). According to Lancaster (2007), the specific steps in planning and conducting interviews may vary, but several key steps and considerations are common to almost all interview methods for data collection.

Interview questions for this study were developed using the guidelines recommended by (Luo and Wildemuth, 2009) as follows:

- Outlined major topics related to the study’s objectives which is the sustainability of Lean in public hospitals
- Listed the relevant questions that will help to achieve the objectives of the interview. The questions were about participants' views on Lean sustainability, what factors affected it in their experience, and what advice they could provide regarding Lean sustainability.

The interview questions included four types or styles of questions that are recommended for the interviewing process by (Luo and Wildemuth, 2009):

- Throw-away questions were used for introduction and as ice-breakers to create a relationship at the beginning of the interview. Introductory questions were about the participant's personal information, questions were related to the participant's experience with Lean and explanations about how the interview will be conducted. The introductory questions were not recorded because of privacy and confidentiality.
- Essential questions are key questions that address the crux of the interview. Essential questions asked were related to Lean sustainability in public hospitals. Questions range from getting the participants' views on Lean healthcare, views on sustainability, factors affecting sustainability and closing off with advice that participants have regarding sustainability.
- Extra questions were used to rephrase, elaborate, and simplify the essential questions if a study participant did not understand the original question. These questions were not part of the drafted research questions but clarity or rephrasing was provided where necessary.
- Probing questions were used to ask participants to elaborate on their answers to a given question. These questions were also used when the researcher wanted more information from participants

The Interview questions as per Appendix 3 were not revised during all interviews as they provided relevant data as planned and never created any problems during the interview process.

3.3.1.2 Data Sampling

Marshall et al. (2013) state that qualitative inquiry does not have strict rules regarding sample size. Instead, it depends on various factors such as the information needed, the purpose of the inquiry, what is considered useful and credible, and the available time and resources. Alsaawi (2014) also highlights two criteria to consider when determining sample size. The first criterion is sufficiency, which can be subjectively

assessed by the interviewer. The second criterion is saturation, which is reached when no new information is being added as participants are gradually included.

In this study, purposeful sampling was employed to select interview participants. Purposeful sampling was chosen because the study aimed to explore the perspectives and opinions of practitioners who met the inclusion criteria. The sample size was influenced by factors such as the inclusion criteria, participant availability, time constraints, and available resources. Additionally, snowball sampling was utilised, where participants referred other potential participants who also met the selection criteria. Interviews were conducted until the point of saturation was reached, meaning that no new information was being provided and the researcher was satisfied that the data collected was sufficient to achieve the study's objectives.

3.3.1.3 Study population

This study seeks to answer research question 1 using semi-structured interviews to gain perspectives from practitioners on the factors affecting the sustainability of Lean in healthcare in South African public hospitals. For this study, a practitioner can be referred to as an individual who is engaged in the practice of Lean healthcare. A pool of practitioners that were approached as participants had to satisfy the following inclusion criteria:

- Academics, consultants, and practitioners who are involved with Lean healthcare in South African public hospitals.
- Must know and understand Lean, Lean healthcare, and Lean implementation in healthcare.
- Must have first-hand experience and information on Lean healthcare
- Must have been personally and practically involved in Lean healthcare in South African public hospitals

3.3.1.4 Interview participants

In total, nine participants were interviewed. Table 4 below displays the profession and experience of each interview participant.

Table 4: List of interview participants' profession and experience

Interviewee No.	Profession	Field	Lean healthcare Experience	
1	Consultant	Engineering	15 years	Has implemented Lean in both private and public hospitals
2	Healthcare	Medical	10 years	Government employee who has been involved with Lean implementation in Gauteng province public hospitals
3	Academic/ Consultant	Engineering	10 years	Lecturer who has implemented Lean in more than 5 public hospitals
4	Academic	Engineering	6 years	Lecturer who has provided classes about Lean and consulted with public hospitals on Lean implementations
5	Academic	Engineering	5 years	Lecturer who has provided classes about Lean and consulted with public hospitals on Lean implementations
6	Consultant/ Healthcare	Medical	20 years	Has implemented Lean in both public and private hospitals, obtained master's degree in Lean healthcare
7	Healthcare	Medical	10 years	CEO of the hospital, been involved with one hospital, has received international training and exposure to Lean healthcare

8	Academic/ Consultant	Business Management	20 years	Pioneer of Lean implementations in South Africa implemented Lean in more than 5 public hospitals, internationally recognised Lean specialist
9	Consultant	Business management	15 years	Has implemented Lean in both public and private hospitals, obtained PhD in Lean healthcare

The healthcare experience of all interview participants ranges between 5 to 20 years with an average of 12 years. All participants have a minimum of a master's degree in their field of study which includes medical, engineering and business administration fields. The participants met the inclusion criteria set for the study and their professional diversity helps to enrich the findings for this study.

3.3.1.5 Interview process

The researcher conducted interviews with the practitioners who have been involved with Lean Healthcare in South Africa, as mentioned in Chapter 3.3.1.4. Eight interviews were done online through Zoom and lasted between 40 to 60 minutes. One interview was done telephonically and it lasted for 60 Minutes. Despite minor connectivity issues, all interviews were concluded as planned. The interviews followed the process below:

1. Introduction: At the beginning, both participants introduced themselves. The interviewer explained the purpose of the study, described the privacy and confidentiality rules, ensured the anonymity of the user, requested permission to record the interview, and addressed any questions the interviewee might have.
2. Warm-up: The recording started, and interviewees were asked to summarise their understanding of Lean and their involvement in Lean healthcare.

3. Main body of the interview: All questions related to Lean sustainability were asked here. Refer to the interview questions in Appendix 3.
4. Cool off: The recording was switched off, and a general conversation would start, including requests for referrals to other practitioners.
5. Closure: At the end of the interview, the interviewer thanked the interviewee for their time and participation.

After each interview, the researcher reflected on the data collected to evaluate the quality of information received. Interviews were conducted until the saturation point, where no more new information was derived.

3.3.1.6 Reliability and Validity

Creswell and Miller (2000) defined validity as the accuracy of representing the participants' understanding of the phenomena and its credibility to them. They suggest that the choice of validity procedures is determined by two perspectives: the lens of the researcher, the lens of the study participants, and the lens of people external to the study. Researchers select these procedures to validate their research and assumptions of the researcher's paradigm.

To avoid interviewer bias, the research questions, research process, and analysis were clearly outlined. During the interview process, the interactions with participants were standardised and recorded. Interview questions were open-ended and shared with interviewees in advance. Each interview data was coded independently. The interviewer spent sufficient time engaging with the data, using findings from the literature review to explain concepts and challenging independent views to eliminate bias in the findings. Findings were described in detail with evidence provided to support any claims made. The interview findings were evaluated against the findings of the systematic literature review to enhance validity. To eliminate participant bias, all participants were invited in their respective capacities and spoke on their own behalf. The extensive engagement of participants in the field also helped address concerns about validity. The sample of participants adequately represented different sectors involved in Lean healthcare.

3.3.1.7 Analysis

Research analysis encompasses a range of methods used to summarise, integrate, combine, and compare the findings of primary studies on a research question (Cruzes and Dyba, 2011). Alsaawi (2014) identifies three common analysis approaches: quasi-statistical, thematic coding, and grounded theory. In this study, the thematic coding approach was utilised.

This analysis aimed to present data that can support Lean sustainability. Thematic analysis, as a constructionist method, examines how events, realities, meanings, experiences, and other factors influence various discourses. The analysis began by listening to the recorded data from each interview to become familiar with its content. Statements related to sustainability issues were extracted from each interview data and assigned codes. The coded statements were manually recorded on a spreadsheet for each interview refer to Appendix 4. The commonly coded statements from each interview were organised into factors by exploring the relationships between the words and phrases in the data refer to Appendix 5. These factors were further analysed and grouped into analytical themes based on the subject matter they addressed or sought to address. Factors and themes are presented in Chapter 4

3.3.2 Systematic literature review

The two important factors to consider before starting an SLR are determining the type of review to conduct and ensuring that no similar study has been conducted before (Meijer, 2020). The choice of review type will influence the method to be followed, and avoiding similar existing studies will save time and effort in searching and synthesising a large volume of literature. Literature mentioned that SLR is used to appraise and explain all available research data using a trustworthy, rigorous, and auditable methodology. By integrating outcomes from numerous independent studies, and synthesising and evaluating them, SLR surpasses what any individual study could achieve.

When reviewing information about similar reviews conducted on the same topic, it was found that Henrique et al. (2021) conducted a similar review, but their study outcome was based on critical success factors, while this study explores factors affecting the sustainability of Lean implementations. Therefore, their SLR is not exactly like this

review, but it is still part of this review. Apart from Henrique et al. (2021), no other similar studies were found.

This SLR is classified as an extended review because it goes beyond summarising the data and attempts to build upon the existing literature to create new, higher-level constructs (Xiao and Watson, 2019). This type of review is conducive to theory-building. For qualitative literature, techniques often involve extracting concepts and second-order constructs from the literature and transforming them into third-order constructs. This allows for the translation of studies into each other and the exploration of overarching hypotheses and concepts. Extended reviews are typically conducted using qualitative or mixed literature due to their nature of theory-building (Xiao and Watson, 2019). Examples of extended reviews include meta-ethnography, thematic synthesis, meta-interpretation, meta-study, critical interpretive synthesis, and framework synthesis (Xiao and Watson, 2019). The type of extended review suitable for this study is thematic synthesis. Thematic synthesis involves extracting themes from the reviewed literature, organizing them, and synthesising them into analytical themes that are similar in structure to third-order constructs. These analytical themes are then used to address the research question (Xiao and Watson, 2019). (Thomas and Harden, 2008) explained the key difference between analytical themes and third order construct as follows:

> "*It may be, therefore, that analytical themes are more appropriate when a specific review question is being addressed (as often occurs when informing policy and practice), and third-order constructs should be used when a body of literature is being explored in and of itself, with broader, or emergent, review questions*". (Thomas and Harden, 2008)

As per (Thomas and Harden, 2008), the thematic synthesis is carried out in three stages which overlap to some degree:

1. The free line-by-line coding of the findings of primary studies;
2. The organisation of these 'free codes' into related areas to construct 'descriptive' themes which are referred to as factors in this study.
3. The development of 'analytical' themes, which are referred to as themes in this study

The construction of descriptive themes and the development of analytical themes beg for corresponding translation and constant comparison (Cruzes and Dyba, 2011).

3.3.2.1 Methods and methodology

This SLR was conducted using the eight major steps guide as per (Okoli, 2015). And reporting of this study was done using the ENTREQ statement guide as per (Tong et al., 2012). It was necessary to align the conducting guide with the reporting guide as per Table 5, to show that all conducting guides were followed and reported. The alignment was important because the major steps to conduct SLR are very valuable and must be followed for a review to be scientifically rigorous (Okoli, 2015).

Table 5: Integrating SLR guides for conducting and reporting SLR (created by author)

Eight steps guide to conduct SLR by (Okoli, 2015)	**ENTREQ statement guide for reporting SLR by (Tong et al., 2012)**
1. Identify the purpose	Introduction
2. Draft protocol and train the team	Methods and Methodology
3. Apply practical screen	
4. Search for literature	Literature Search and Selection
5. Extract data	
6. Appraise quality	Appraisal
7. Synthesise studies	Synthesis of Findings
8. Write the review	

For this review to be open, transparent, and consistent the written and detailed protocol was drafted. The protocol details the procedure that will be followed to conduct the review. The protocol is included in Appendix 6.

The following practical screens were applied to explain what studies were considered for this review and which ones were eliminated without further examination. During this phase of the review, the focus was to be exhaustive and find as many related articles as possible rather than being restrictive and focusing on relevant articles.

1. Content (topics or variables): this review considered studies that were conducted to analyse or identify factors affecting the sustainability of Lean healthcare in hospitals. The four phrases that defined research questions were used to search for relevant studies. Synonyms were also used to try and get as much information as possible. The following phrases and the related synonyms or related phrases were used:

   a) FACTORS or (issues, causes, elements, components, aspects)

   AND

   b) SUSTAINABILITY or (sustainable, effective, effectiveness, successful)

   AND

   c) LEAN or (Kaizen, improvement, 6 sigma, 5s, Toyota Production Systems)

   AND

   d) HEALTHCARE or (health, hospital)

   Search engine systems were also used for other related terms and equivalent expanders.

2. Publication language: Only considered publications written in English.
3. Journals: This review includes all publications found on available scholarly websites mentioned in section 3.3.2.2.
4. Setting: This review only considered publications done in hospitals or sections of a hospital
5. Date of publication/data collection or duration of data collection: This review had no date restriction because of the limited availability of literature.

3.3.2.2 Literature search and selection

The data search was done after consultation with the departmental librarian using EBSCOhost with the following databases (MEDLINE, Academic Search Complete, Directory of open access journals, ScienceDirect, Business Source Complete, CINAHL with text, Environment Complete, Health Source: Nursing/Academic Edition, Scopus, APA PsycInfo, Springer Nature Journals, Applied Science and Technology Source, Emerald Insight, Journals@OVID, ScIELO, SPORTDiscus with Full Text, JSTOR Journals, Directory of Open Access Books, GreenFILE, MasterFILE Premier, IEEE Xplore Digital Library, Library Information Science & Technology Abstracts). Search phrases (with their synonyms and equivalent expanders) "Lean" and "Healthcare" were used in the title search, and "Factors" and "Sustainability" were used in the abstract search. 750 articles were identified for screening. A further search was done on Google Scholar using the search phrases where only the first 15 pages were screened. For exhaustive search purposes, Google Scholar was also used for forward search (articles citing the reviewed articles) and backward search (articles cited by the reviewed articles) where 273 articles were selected for screening.

Zotero was used as a record-keeping system where all articles were downloaded. Excel spreadsheet was also used to record all steps and actions performed during the process. A data search was done in May 2022.

3.3.2.3 Quality appraisal

Screening for exclusion was done following the criteria used to judge which papers to be excluded for insufficient quality. Below are the exclusion criteria used for this study:

- Studies were excluded if they were not conducted in a hospital or section of a hospital
- Studies were excluded if they were only concerned with the implementation of Lean without researching sustainability.
- Studies were excluded if they did not mention sustainability factors

PRISMA flowchart by Liberati et al. (2019) was used when dealing with the literature search and selection category. Identified articles were screened using the title, and

those not related to Lean and healthcare or hospital were excluded with 90 articles remaining to be screened by abstract. After reading the abstract to determine if the article includes factors and sustainability, 45 articles were excluded with reasons recorded on a spreadsheet. 45 articles remained for full-text reading. Of these 45 articles, 38 were excluded because they were not specific to Lean, focused only on the implementation stage, and did not mention any sustainability factors. Only 7 articles remained and were eligible for review, as illustrated in Figure 5.

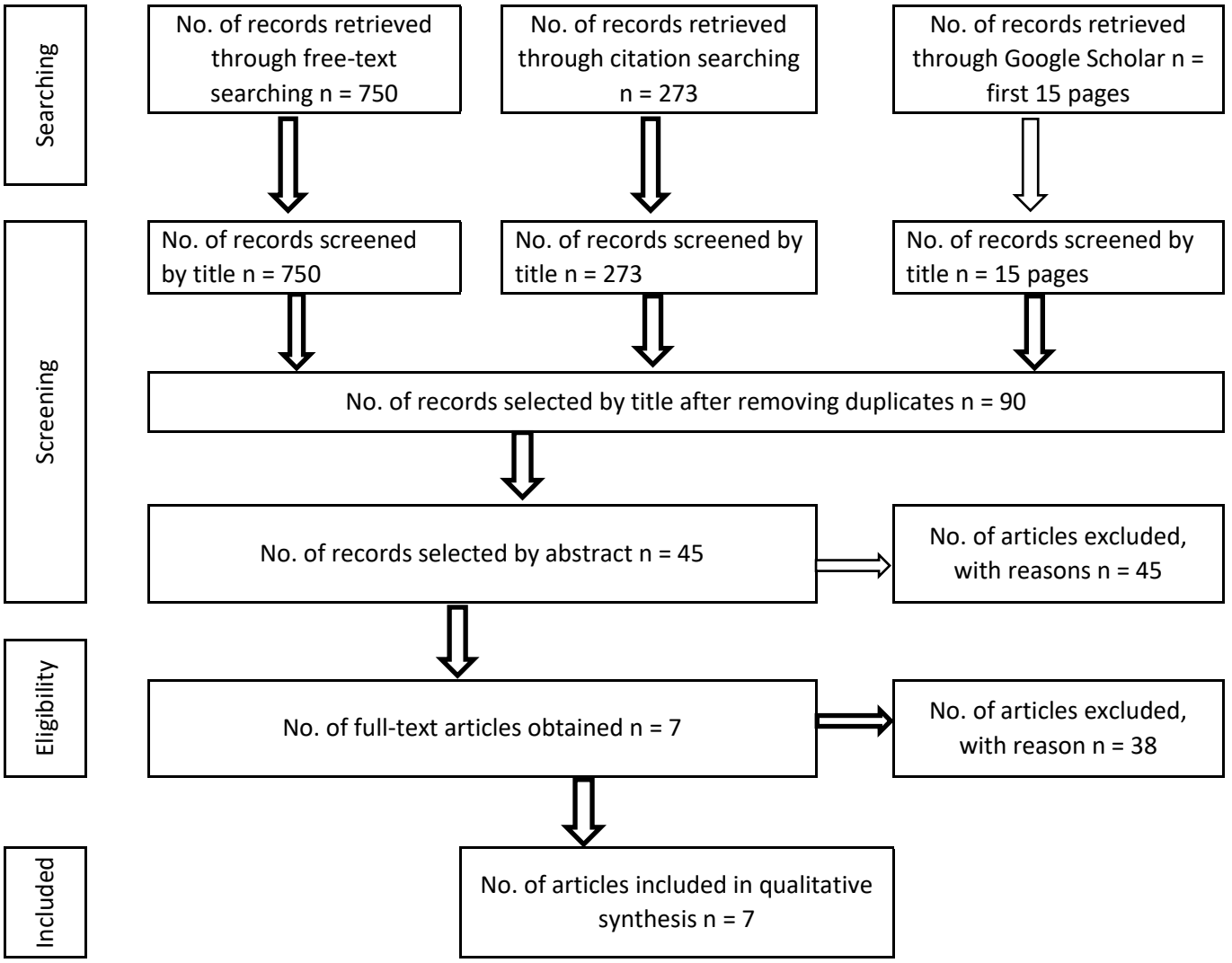

Figure 5. PRISMA flow diagram used for the SLR as per (Liberati et al., 2019) (recreated by author)

3.3.2.4 Synthesis of Findings

For this study, thematic synthesis methods of extracting data were used. Data were extracted into a spreadsheet with the following three kinds of data:

- Publication details (author, year, title, country);
- Context descriptions (subjects, industry, methodology);
- The free line-by-line coding of the findings of primary studies.

In identifying a statement that could potentially be a finding, the following questions were used:

- Does it state the results of measurements?
- Does it summarise raw data?
- Does it highlight some specific characteristic of the raw data?
- Does it provide additional insights about tables or figures?
- Does it summarise the results of analyses?
- Can it be used to answer the research question(s)?
- Does it reflect the main results of the study?

After extracting free codes line by line from the original studies, descriptive themes referred to as factors in this study were constructed as per the thematic synthesis process. Factors were further synthesised and grouped into analytical themes (referred to as themes). From the seven articles reviewed, 115 line-by-line free codes for Lean sustainability were extracted and synthesised refer to Appendix 7. The language and terminology of 115 line-by-line codes were matched, and 46 descriptive themes (factors) were identified. The 46 descriptive themes were put together into 13 distinct analytical themes (themes). Analytical themes were derived from the subject matter that factors were addressing or sought to address. These factors and themes will be discussed in the findings and analysis section.

3.4 Conclusion

This chapter has discussed the research methodology that will be followed to obtain data that will assist this study in answering its research questions. The analysis method to be used has also been discussed. This study adopts a constructivist view and uses a phenomenological research approach as its qualitative method. The data

was collected using a systematic literature review (SLR) and interviews. Finally, thematic analysis was chosen as the tool to analyse the data.

Chapter 4: Findings

4.1 Introduction

This Chapter will present the findings obtained from the two data collection methods that were used in this study separately. The findings will be described to understand the meanings of the experiences of participants. Chapter 5 will provide an analysis of the findings, and Chapter 6 will discuss findings and lessons learned.

This section is organised in the following manner:

4.1 Introduction

4.2 Interview Findings

4.3 Systematic Literature Review Findings

4.4 Conclusion

4.2 Interview Findings

The purpose of the interviews was to identify and explore factors that affect the sustainability of Lean healthcare in South African public hospitals. The participants in the interviews included academic professionals, consultants, and healthcare professionals from various fields such as engineering, business management, and medicine. Academic professionals and consultants have been involved as external consultants who were contracted to teach, train and implement Lean in public hospitals. They were Lean pioneers in the public hospitals they worked with. One participant is the CEO of a public hospital and was involved in the implementation of Lean in the hospital. Another medical professional is employed by the provincial health department and responsible for Lean implementations in the province. All participants have basic training in Lean and fully understand the concept of Lean. All participants have a minimum of a Master's degree and have 5 to 20 years of Lean healthcare experience. They participated in the interviews in their professional capacity. The interviews were conducted in a standardised manner where questions and the approach were the same.

All the statements or lines that were mentioned by each participant to be affecting sustainability were extracted and coded refer to Appendix 4. These coded lines from each participant were grouped and repetition was eliminated, and 118 coded lines remained. The 118 coded lines were aligned according to their meaning and language rephrased into a total of 44 factors that affect the sustainability of Lean healthcare refer to Appendix 5. The 44 factors were synthesised and grouped related to the common subject they are addressing, resulting in 13 analytical themes (as shown in Table 6 below) using Thematic analysis.

Table 6: Synthesised interview themes with corresponding participants.

No.	Theme	Extracted Factors	Participants
1	Long-term philosophy	Continuous process	1, 5, 6
		Lean thinking	1
		Lean understanding	4, 5, 6
2	Lean alignment	Lean adaptation	3, 4, 7, 9
		Lean Integration	5, 6, 8, 9
		Language adaptation	1, 3, 4, 7, 9
		Organisational readiness	3, 4, 5, 6, 7
		Strategic alignment	3, 5, 9
3	Implementation Phase	Staff engagement	3, 4
		Implementation plan	1, 2
		Implementation process	1, 2, 4, 6, 9
4	Leadership	Change management	3, 4, 6, 7
		Gemba walk	2, 3,4, 6, 7,8
		Leadership involvement	6, 8
		Leadership quality	2, 7, 8, 9
5	Commitment	Leadership commitment	2, 3, 4, 5, 6, 8, 9
		Long term commitment	1, 2
		Personnel commitment	1, 2, 4, 5, 6, 7, 8, 9
6	Training	Coaching and guidance	5, 6, 7
		Lean training	1, 2, 6, 8, 9
		Personnel training	2, 3, 4, 7
7	Teamwork	Collaboration	3, 6, 7, 8, 9
		Integrated teams	3, 4, 6, 9
		Multi-disciplinary approach	2
		Personnel involvement	2
8	Support	External support	1

		Lean champions	1, 4, 6, 7, 8
		Personnel support	2, 5, 6, 7
		Resources	2, 5, 7, 9
9	Motivation	Acknowledgement and recognition	2, 6
		Perception	7, 9
		Personnel benefits	2, 3, 4, 5, 6 8, 9
		Personnel involvement	2, 6
		Staff morale	2
		Success stories	3, 6, 7, 9
10	Communication	Open communication	5, 6, 9
		Visual Communication	6
11	Management	Lean tools	3, 5, 6, 7, 8
		Management competence	3
		Performance management	2, 3 5, 6, 7, 8
		Staff engagement	2, 3, 6, 7, 8
12	Empowerment	Staff empowerment	2, 5, 6, 7, 8
13	Healthy competition	Creating competition	6, 7
		Benchmarking	2,7,8

These findings will be described per theme in the following sub-sections.

4.2.1 Long-term Philosophy

Data explored from interviews yielded **Continuous process, Lean thinking, and Lean understanding** as long-term philosophy factors. (P4, P5, P6) stress the importance of understanding Lean as a philosophy that has a long-term view that must not be used as just a quick-fix solution to achieve quick results. Early results or successes must not be misinterpreted or confused as Lean objectives if they are not continuously achieved or improved long-term. Lean should not be understood as a project with a start and end period but a continuous process with no end (P5). Lean should not be understood as just about tools but as a philosophy that influences the thinking for continuous improvement (P1). Once Lean philosophy is well understood, then the thinking and application should reflect that understanding. (P1) refers to Lean as a religion, a set of beliefs, and a way of thinking. If the implementation of Lean does not come from a philosophical perspective, then sustainability will not be possible (P1).

To achieve sustainability the **understanding of Lean** as a **long-term philosophy** enables **Lean thinking** in the hospital where Lean will be implemented as a **continuous process**.

4.2.2 Lean Alignment

Lean alignment deals with how Lean and the organisation should be aligned and readied to be integrated sustainably. **Lean adaptation, Lean Integration, Language adaptation, Organisational readiness, and Strategic alignment** are five Lean alignment factors derived from the interview process.

Organisational readiness deals with an understanding of the hospital environment and its context to prepare for Lean implementation and avoid unintended consequences (P3, P4, P7). It also deals with conducting due diligence and establishing the status quo before embarking on the implementation of Lean to sustain the implementation (P3).

Understanding the hospital environment will assist in the adaptation of Lean practices to a hospital context (P3, P7). Adapting Lean practices will help avoid a plug-and-play approach to implementing Lean (P4, P9). Lean is foreign to healthcare (originating from the Japanese automotive manufacturing sector) and requires context, content, and language adaptation before implementation. Hospitals should translate the Lean language into simple and understandable terms for workers to prevent confusion (P1, P7, P9). The language used during implementation should be aligned with the healthcare context (P1, P3, P4, P7) to capture the attention of healthcare workers. Adaptation is not only about aligning Lean with the healthcare context but also aligning healthcare processes and approaches with Lean philosophy and principles in the pursuit of sustainability. The entire process of aligning Lean and healthcare organisations leads to a cultural shift towards a new Lean culture. Introducing a new Lean culture requires aligning Lean with the organisation's strategic direction and planning (P3, P5, P9).

The Lean integration factor refers to seeing Lean as an internal management system rather than an intervention (P5). Lean should not be perceived as an external project, but should be integrated into the hospital's management systems (P6, P8). The

essence of integration is to ensure that Lean is not viewed as separate from the hospital. By integrating Lean into management systems, the culture and identity of the hospital transform into a Lean hospital. Lean should also be integrated into job profiles and performance agreements (P9). This should be done so that employees do not perceive it as an external or additional responsibility.

4.2.3 Implementation Phase

The implementation phase is a sustainability theme with three highlighted factors: **staff engagement, implementation plan, and implementation process**. Concerns about sustainability challenges that arise from implementation without thorough planning were raised during interviews. Hospitals need to develop a well-thought-out implementation plan with clear goals and intentions (P1, P2). The plan must include a set of steps that implementers must strictly follow. Additionally, the implementation must be executed according to the plan and monitored thereafter (P2). Implementation plans should be developed in a way that minimises disruption to workflow, and staff engagement and meetings should take place in their working areas (P2).

The implementation should have an optimal process layout to ensure seamless operation (P5). It should begin with simple tools that are easy to understand and implement (P9) to achieve early wins and motivation. Furthermore, it should start in the least clinical area (intrusive or sensitive area) to introduce and promote the concept, and then gradually expand to more clinical areas (P6). It should prioritise small interventions that can quickly improve and showcase early results (P2, P4, P6, P9). Early results should be continuously improved and be used as a build-up or stepping stone to more areas and sections to achieve sustainability.

Staff engagement and buy-in are crucial because they are the agents of change. It is important not to impose Lean implementation on staff, as this can create resistance and result in a lack of interest and participation (P4), ultimately leading to implementation failure (P3). Staff involvement is necessary for a successful Lean implementation strategy because a successful implementation phase is where the Lean implementation process allows staff to fully participate and implement Lean as per the implementation plan.

4.2.4 Leadership

The interview participants emphasised the importance and role of leadership in sustaining Lean. They highlighted that without leadership buy-in and commitment, Lean will not only fail but also struggle to be sustained. The theme of leadership comprises four factors: **change management, Gemba walks, leadership involvement and leadership quality.**

Leaders should possess specific qualities that shape the culture and way things are done in the organisation. Leaders should possess qualities such as humility, positivity, and consistency, which instil confidence and drive Lean interventions (P2, P7, P8). Leaders must align with the values and philosophy of Lean. Effective Lean leadership involves asking questions and avoiding the imposition of solutions (P8). The success of Lean is determined by leadership commitment, availability, and behaviour (P8).

Leaders who are involved in the process of Lean and spend time where work is done (P7) affect sustainability. According to P6, "management by walking around (Gemba walks)" is preferable to management by objectives. Gemba walk is where leaders visit areas where work is done and get to understand what happens on the floor. Leaders become part of the working teams identify problems firsthand, and discuss potential solutions (P2, P3, P4, P7, P8).

Change management is a systematic approach to dealing with the transformation of an organisation’s goals or processes. Transforming an organisation into a Lean organisation requires a change in organisational culture, as Lean implementation impacts the entire company system (3, 6, 7). Leaders play a critical role in managing this change effectively to prevent unintended consequences (6, 7). Continuous improvement necessitates continuous change management.

4.2.5 Commitment

Commitment from leadership, government, management, and staff is the cornerstone for the sustainability of Lean in healthcare, as mentioned in interviews. This commitment includes both time and resources. Three factors derived from the interviews are **leadership commitment, long-term commitment, and personnel commitment.**

Leadership commitment involves leadership and government buy-in into Lean implementation (P3, P4, P5, P6, P9). In South Africa, government buy-in is particularly important, as they have the authority to give permission and provide the necessary resources for Lean implementation. Once Lean implementation is authorised, leadership must commit to making Lean work (P2). Interviewees emphasised the importance of leadership commitment as the driver for Lean sustainability, as explained under the leadership theme. One participant indicated that the absence of a leader is the leading cause of failed Lean implementations (P8).

Personnel commitment is another key factor for sustainability. Buy-in from middle management and staff, where everyone has a place in the team and plays their role, is crucial for the sustainability of Lean projects (P1, P2, P4, P5, P6, P7, P8, P9). Lean is a continuous, long-term process driven by staff, which requires their commitment to achieve sustainability. It is important to specifically get buy-in from physicians to help promote Lean. Physicians are highly regarded and respected in hospitals, and obtaining buy-in from them would greatly contribute to sustainability (P4).

The last factor is a long-term commitment, which aligns with the long-term philosophy of Lean. (P2) emphasises the need to persevere, not lose focus or direction, and avoid leaving things unfinished. (P1) mentions that starting Lean is a lifelong pursuit of growth.

4.2.6 Training

Interviews have identified training as a key factor in ensuring the long-term success of Lean practices in hospitals. Training not only enhances the knowledge and competence of leadership and staff but also equips them with the necessary skills and attitudes to effectively solve problems and address sustainability challenges. To achieve this, it is important to analyse factors such as continuous **coaching and guidance, Lean training, and personnel training**.

Continuous coaching and guidance from management and champions play a crucial role in the implementation of Lean practices. This ongoing support helps to continuously build and update the knowledge of staff and also encourages collaboration and the breaking down of silos (P5, P6, P7).

Personnel training is another important aspect that should be prioritised. This includes allowing staff members to train and orientate each other (P2, P7), which fosters a culture of continuous improvement and collaboration (P3). Furthermore, personnel training helps to address any knowledge gaps that may arise due to staff movement or turnover (P2). By developing a deep understanding of Lean concepts and providing coaching, staff members can improve their competence and drive Lean practices more effectively (P7).

Additionally, interviews have highlighted the importance of Lean training in hospitals. Lean training not only provides staff and management with knowledge about Lean principles but also helps them understand how to apply these principles in their day-to-day work (P6). The first step in implementing Lean is to provide training that introduces and aligns staff with Lean practices, while also clearly communicating the objectives and processes of the implementation (P2).

To successfully provide training in the workplace, it is advisable to consider the following recommendations from the interviews:

- Continuous workshops to introduce new entrants (P2)
- Grow Lean knowledge over time to capacitate staff (P6)
- Invest in proper Lean training (P1), (P2), (P8), (P9)

People must be taught to see waste as a start and allow them to come up with solutions (P1). Once people can see waste or a problem through, then the Lean philosophy culture has been absorbed.

4.2.7 Teamwork

Teamwork has been identified as a factor that influences the sustainability of Lean in healthcare in this study. Teamwork is where a group of interdependent individuals work together towards a common goal or to complete a task effectively and efficiently. The factors related to teamwork include **collaboration, integrated teams, a multi-disciplinary approach, and personnel involvement.**

The healthcare sector is known for its political nature and power dynamics, with silos, bureaucracy, and hierarchy (P3). This often leads to a lack of communication and coordination between different departments (P3). However, creating integrated teams

promotes collaboration and facilitate discussions that move away from blame games and silos, as these hinder continuous improvement efforts (P6, P9). Collaborating across different sections and levels also helps in spreading Lean practices throughout the entire organisation (P3, P7, P8).

To achieve sustainability, hospitals must adopt a multidisciplinary approach that fosters respect among team members (P2). Lean should be everyone's responsibility, and efforts should be made to address problems collectively (P2). By bringing together the knowledge and expertise from different sections or professions, a multidisciplinary approach can be utilised to work towards sustainable goals.

Using the factors mentioned, teamwork can be defined as the **collaboration involving personnel** from different sections to form **integrated teams** that use a **multi-disciplinary approach** to sustain Lean implementations.

4.2.8 Support

Support from management, organisation, external resources, and staff is crucial for sustaining Lean. Several factors influence the sustainability of Lean, including **external support, Lean champions, personnel support, and resources**. One factor mentioned in the interviews is the employment of external consultants to support and guide the implementation of Lean. However, it is important to note that these consultants cannot make the business Lean on their own; it is the responsibility of the staff to think and act Lean (P1). Consultants can only catalyse the Lean process (P1).

Another key support for sustainability is the establishment of a team of dedicated champions who are committed to implementing and promoting Lean (P4). These Lean champions should be skilled problem solvers and should be deployed within the organisation to take charge of Lean projects (P1, P6, P7, P8). Other support (personnel and resources) should come from the following:

- Government for cooperate sponsorship (P6, P7)
- Management to drive implementation (P5, P6)
- Management to provide resources required based on demand (P2, P5, P7, P9)
- Staff in implementing Lean and engaging other departments (P2)

Hospitals should develop a supportive culture to assist staff sustain Lean implementations.

4.2.9 Motivation

Motivation is the process or event that initiates, guides and maintains goal-oriented behaviours. Interviews revealed that several factors contribute to motivation, including **acknowledgement and recognition, perception, personnel benefits, personnel involvement, staff morale, and success stories**.

Staff must be motivated and engaged to make a difference, allowing them to express themselves and propose solutions for waste elimination (P2). It is important to keep the Lean process interesting to maintain staff engagement and interest (P2). The enthusiasm shown by middle management and frontline staff affect the motivation in the organisation (P6). The interviews suggest that personnel involvement in the success of Lean is partially driven by motivation.

Sharing and showcasing success stories of Lean was found to be effective in encouraging and motivating staff to embrace Lean practices and achieve sustainability. It is essential to display successful and tangible results to promote the benefits of Lean (P3, P6, P7, P9), and to enhance operational efficiency (P3). Additionally, (P3) highlights that improved patient outcomes have a positive impact on both patients and staff morale. Below are some of the personnel benefits that boost the staff morale and improve motivation:

- Possibilities to grow for outstanding personnel (P6)
- Lean helps staff to achieve their targets and be rewarded (P9)
- Tangible benefits and results of Lean implementation (P4, P5, P8)
- Stability and mental safety of staff, and job security (P8, P9)
- Respect for each other (P2, P8)

Hospitals are encouraged to praise, recognise and reward their employees for good performance to keep them motivated to do more (P6). Acknowledgement and recognition should be on an individual basis and team basis (P6). (P2) emphasises that staff morale should be kept high to achieve the long-term sustainability of Lean.

4.2.10 Communication

Communication in this study refers to the interaction between the hospital society and Lean. The hospital society includes the staff, management, and patients. During interviews, participants identified two key factors for communication: **open communication** and **visual communication**.

Open and purpose-driven discussions about Lean are essential for sustainability (P5, P6, P9). Open communication means providing information in a transparent and accessible manner. This allows information to flow across all levels and departments, facilitating a better understanding of Lean and promoting better interactions among staff members (P5). All Lean-related data should be communicated throughout the organisation without any exclusions. The communicated information should be useful and valuable. Visual communication, on the other hand, involves using pictures or sketches as a means of effective communication (P6). Visual management boards are utilised to display information in their respective areas.

4.2.11 Management

Management is how the entity organises and directs work operations, processes and staff to achieve goals. Interviews identified **Lean tools, competence, performance management, and staff engagement** as management factors that affect the sustainability of Lean. The role of management is to manage the performance of Lean and staff in achieving the objectives of the organisation.

Initially, management must set goals and evaluate them later, not for punitive reasons, but for learning (P3). Learning by doing is one of the best training methods encouraged in Lean, and management must allow staff to fail and initiate learning from their mistakes instead of using punitive measures (P7, P8). Management must be transparent and communicate the reasons and objectives to be achieved within each section (P2). Performance must be openly measured, analysed, and feedback provided because feedback is the most powerful driver for improvement (P3, P5, P6, P8). When improvement has been achieved, it should be evaluated and standardised (P6, P7). Part of performance management is to openly and visibly showcase success and results for all to see and learn from (P2, P8).

The interviews recommend using Lean tools in managing Lean implementation and its performance. (P3, P6) emphasises the importance of value stream mapping to help with the patient journey. Visual management boards should be used to display process charts, work standards, targets, and results (P8). These boards should be placed where work is done and must be frequently updated to provide reliable and accurate information (P8).

Management refers to accessible management that engages each staff member on the value of Lean goals, the implementation of Lean, and each staff member's responsibilities to achieve those goals (P2, P7). Employee engagement should include unions as representatives of staff well-being and rights, to promote the benefits of Lean and alleviate fears (P3). Listening to staff and paying attention to what Lean implementers are saying or raising (P2) should be part of staff engagement.

The last factor of management is competence. P3 raised the concern that most healthcare management lacks operational management skills, and instead of managing the operation of the hospitals, they end up intervening in clinical work. This is mainly because most of them are trained in medicine without any operational management training.

4.2.12 Empowerment

Staff empowerment as the only factor for empowerment theme refer to the issues, opportunities, and platforms that the implementation of Lean provides to staff to drive sustainability. Staff must view Lean as a means of empowerment, allowing them to fully participate in their work (P9). In turn, this empowerment, based on Lean principles, should help staff improve their work (P3). The success of Lean is directly linked to the performance of staff, as it is measured by the improved performance and results achieved by staff members (P9). For an organisation to sustain Lean, there must be an understanding of how it can enhance staff performance and lead to better results (P9).

Staff should have the authority to make decisions regarding Lean implementation (P2, P8) because waste can only be detected and addressed on the patient journey where staff members are actively working and responsible. Process ownership should reside

with the frontline staff who are directly involved in decision-making and problem-solving (P2, P5, P6, P7, P8). Management must engage with staff members and give them a platform to voice their opinions and suggestions as key drivers of Lean implementation (P2, P7, P8). Empowering the staff has a direct impact on the sustainability of Lean practices, as it is ultimately the people, with the support of management, who drive the long-term success of Lean initiatives (P5).

4.2.13 Healthy Competition

Healthy competition theme emphasises the importance of encouraging competition among staff, teams, and departments to sustain Lean practices. **Creating a healthy competitive** environment and **benchmarking** are two factors for this theme.

Hospitals should establish internal competition programs where teams compete for rewards based on achieving improvement goals (P6, P7). These programs provide opportunities for different teams to learn from one another. Competition programs must be kept healthy and not cause conflict, destructive habits, or sentiments. By continuously benchmarking with other departments (P2, P7, P8), teams can further promote healthy competition and support the sustainability of Lean practices. These programs allow teams to showcase their progress in understanding and implementing Lean principles, as well as demonstrate the level of improvement they have achieved.

4.3 Systematic Literature Review Findings

Systematic literature review (SLR) data collection and selection of articles to be reviewed was done as explained in Chapter 3. From the 7 articles (refer to Table 7) that were selected for review, 115 code lines were extracted. The language, meaning and terminology of 115 line-by-line codes were matched and 46 factors were identified and are presented in Appendix 7. The 46 factors were further synthesised according to the subject matter they are addressing into 13 analytical themes (referred to here as themes) as presented in Table 8. SLR findings will be presented as factors and described under each theme.

Table 7: Details of articles selected for review

Author	Title	Year	Country	Methodology
Henrique et al	A framework to assess sustaining continuous improvement in Lean healthcare	2021	USA	Mixed methods: Systematic literature review and Case study
Flynn et al	A realist evaluation to identify contexts and mechanisms that enabled and hindered implementation and had an effect on the sustainability of a Lean intervention in pediatric healthcare	2019	Canada	Case study
Flynn et al	The sustainability of Lean in pediatric healthcare: a realist review	2018	Canada	Systematic literature review
Andersen et al	Lean thinking in hospitals: is there a cure for the absence of evidence? A systematic review of reviews	2014	Norway	Systematic literature review
William James Wilson et al	The effect of contextual factors on quality improvement success in a Lean-driven New Zealand healthcare environment	2018	New Zealand	Survey
Hallam and Contreras	Lean healthcare: scale, scope and sustainability	2018	USA	Systematic literature review
Trakulsunti et al	Lean Six Sigma implementation and sustainability roadmap for reducing medication errors in hospitals	2020	UK	Systematic literature review

Table 8: Synthesised SLR themes with corresponding references

Theme	Factors	Authors
Long-term philosophy	Continuous improvement	Andersen et al., 2014; Henrique et al., 2021
	Vision	Andersen et al., 2014; Hallam and Contreras, 2018
Lean alignment	Healthcare alignment and adaptation	Flynn et al, 2019; Trakulsuti et al., 2020; Andersen et al., 2014
	Institutionalising Lean	Trakulsunti et al., 2020
	Personnel alignment	Flynn et al, 2018
	Sense making	Flynn et al., 2018; Flynn et al., 2019
	Strategic alignment	Andersen et al., 2014; Henrique et al., 2021; Trakulsunti et al., 2020
	Value alignment	Andersen et al., 2014
Implementation phase	Implementation process	Flynn et al., 2019; Henrique et al., 2021
	Implementation plan	Henrique et al., 2021
	Innovation fatigue	Flynn et al., 2019
	Perception	Flynn et al., 2019
Leadership	Gemba walk	Henrique et al., 2021
	Leadership approach	Flynn et al., 2018
	Leadership participation	Flynn et al., 2018; Henrique et al., 2021
	Stakeholder involvement	Hallam and Contreras, 2018
Commitment	Commitment to Lean tools	Henrique et al., 2021
	Continuous focusing	Trakulsunti et al., 2020
	Personnel commitment	Hallam and Contreras, 2018; Trakulsunti et al., 2020; Flynn et al 2018
Training	Lean training	Henrique et al., 2021; Andersen et al., 2014; Hallam and Contrares, 2018
	Competence	Andersen et al., 2014; Trakulsunti et al., 2020; Flynn et al., 2018
	Training plans	Hallam and Contreras, 2018; Trakulsunti et al., 2020
Teamwork	Collaboration	Hallam and Contreras, 2018; Andersen et al., 2014; Flynn et al., 2018
	Inclusive decisions	Henrique et al., 2021
	Integrated teams	Henrique et al., 2021; Hallam and Contreras, 2018
	Multidisciplinary teams and interventions	Hallam and Contreras, 2018; Andersen et al., 2014
	Personnel involvement	Andersen et al., 2014; Trakulsunti et al., 2020; Henrique et al., 2021; Flynn et al., 2018

	Team spirit	Flynn et al., 2018; William James Wilson et al., 2018
Support	Lean champions	Hallam and Contreras, 2018; Henrique et al., 2021; Trakulsunti et al., 2020
	Resources	Andersen et al., 2014; Flynn et al., 2018
	Supportive culture	Andersen et al., 2014; Hallam and Contreras, 2018; Flynn et al., 2019
Motivation	Reward and recognition	Henrique et al., 2021; Trakulsunti et al., 2020
	Morale	Flynn et al., 2018; Flynn et al., 2019
	Motivators	William James Wilson et al., 2018; Flynn et al., 2018
	Respect for people	William James Wilson et al., 2018
	Staff and patient benefits	Andersen et al., 2014; Flynn et al., 2018
	Success stories	William James Wilson et al., 2018; Andersen et al.,2014; Trakulsunti et al., 2020
Communication	Communicate better and simpler	Henrique et al., 2021; Hallam and Contreras, 2018
	Communication plan	Hallam and Contreras, 2018
	Communication to all stakeholders	Andersen et al., 2014; Henrique et al., 2021; Flynn et al., 2018
Management	Implement change, control plans and activities	Hallam and Contreras, 2018; Andersen et al., 2014; Henrique et al., 2021
	Performance management	Hallam and Contreras, 2018; Henrique et al., 2021
	Lean tools	Hallam and Contreras, 2018; Henrique et al., 2021
Empowerment	Staff empowerment	Trakulsunti et al., 2020; Flynn et al., 2019
Auditing	Audit Process	Henrique et al., 2021
	Regular audits	Andersen et al., 2014

4.3.1 Long-term Philosophy

The two factors related to the long-term philosophy of Lean deal with understanding Lean philosophy as a long-term approach and basing all planning and decisions on this philosophy to sustain Lean. The two factors are long-term **vision** and **continuous improvement**.

The first factor of the long-term philosophy is the organisation's long-term vision. Hallam and Contreras (2018) mention that organisations should have a vision

statement based on departmental values. This vision statement should include goals of speed and purpose with genuine, uncomplicated, and pragmatic solutions (Andersen et al., 2014). The company's vision encompasses the strategy, plans, and goals that need to be implemented and achieved.

The second factor of the long-term philosophy is continuous improvement. According to Henrique et al. (2021), organisations should create a culture of continuous improvement by making decisions based on the long-term philosophy. This culture should be established to sustain the improvements that have already been achieved. Continuous improvement involves enhancing previous improvements to reach a higher level. Henrique et al. (2021) also mentioned that fostering a culture of continuous improvement will enhance employee confidence in the strategic direction of the organisation. Andersen et al. (2014) note that continuous improvement must include a long-term plan and ongoing consideration.

4.3.2 Lean Alignment

Lean alignment factors refer to the integration of Lean into all activities, visions, and strategies of an organisation. **Healthcare alignment and adaptation, institutionalising Lean, personnel alignment, sense making, strategic alignment,** and **value alignment** are six factors related to Lean alignment theme.

One Lean alignment factor is healthcare alignment and adaptation. According to Flynn et al. (2019), while healthcare workers value efficiency, waste elimination, and patient safety, it is crucial to align Lean principles with the healthcare context during training to change their attitudes towards Lean and gain their continued support. Healthcare is a complex field that requires a family-centred and flexible approach to care, which should be aligned with Lean (Flynn et al., 2019). Any misalignment can result in staff negativity and lack of support for Lean sustainability (Flynn et al., 2019). Failure to adapt Lean interventions to the local context can lead to disconnect, discordance, and negative attitudes towards Lean (Andersen et al., 2014; Flynn et al., 2019). Since Lean is a long-term and continuous process, continuous adaptation to new trends is important for healthcare organisations to improve their Lean approach and application (Trakulsunti et al., 2020).

Another factor is institutionalising Lean, which contributes to sustaining the Lean process in the organisation (Trakulsunti et al., 2020). This means embedding Lean as part of the hospital culture (Trakulsunti et al., 2020).

Sense-making is also a factor in the Lean alignment theme and refers to the process through which people assign meaning to their Lean experiences (Flynn et al., 2019). The language used in Lean training by external consultants should connect Lean to the healthcare context so that it makes sense to the workers (Flynn et al., 2019). If the language used is not aligned with the healthcare context, staff may feel disconnected and not actively participate in Lean processes. Since Lean principles originate from the manufacturing sector and may not naturally align with healthcare, it is important to translate them and their meanings to a healthcare perspective to ensure that workers understand and engage with Lean (Flynn et al., 2019).

> "*The continuation of Lean efforts and the normalisation of Lean in everyday practice relied on how staff 'made sense' of Lean and whether the values of Lean aligned with their own personal and/or professional values These were core mechanisms to the sustainability of Lean that were important from early stages of Lean implementation."* (Flynn et al., 2019).

Strategic alignment is another factor of Lean alignment theme that emphasises the need for consistency in strategic objectives and priorities of strategic importance (Andersen et al., 2014). Healthcare organisations should ensure that Lean is integrated into their strategic plans, as well as their operating and financial plans so that the Lean implementation is aligned with the entity's strategy (Trakulsunti et al., 2020). According to Henrique et al. (2021), "When Lean initiatives are aligned with the strategic objectives of the company, all efforts are moving in the same direction and the results have a global impact."

Values alignment is another factor that affects the sustainability of Lean in healthcare. Andersen et al. (2014) mention that Lean should represent the entire value system, championing daily improvement. To achieve sustainable implementation of Lean, healthcare workers and leaders should align their values, as well as the values of the organisation, with the values of Lean (Flynn et al., 2019).

The last factor, personnel alignment, deals with the level of conformity between the Lean concept and the values of the entity's leaders (Flynn et al., 2018). It includes "the

degree of congruency between the Lean philosophy and the personal-level reasoning of the clinical leaders and front-line healthcare providers" (Flynn et al., 2018).

4.3.3 Implementation phase

The implementation phase addresses issues and factors related to the Lean implementation process. This theme emphasises the impact of these factors and issues on the sustainability of Lean, which is the focus of this study. **Implementation process, implementation plan, innovation fatigue,** and **perception** are four factors under implementation phase theme.

The implementation plan plays a significant role in the successful implementation of Lean. Henrique et al. (2021) discuss the importance of having a well-defined implementation plan with criteria or guidelines that must be followed to ensure that no step is overlooked or skipped, which could jeopardize long-term sustainability.

Another factor that influences sustainability is the implementation process itself, which must be carried out correctly according to the plan. "The Lean implementation process aims to create a well-executed pilot where various tools are implemented initially, followed by the dissemination of Lean tools and principles throughout the organisation" (Henrique et al., 2021). This factor focuses on the purpose or intentions of each step in implementing Lean. Some hospitals mistakenly focused their initial Lean implementation on information or material flow instead of patient flow, which had a negative impact on the process and hindered sustainability prospects (Flynn et al., 2019). Flynn et al. (2019) also mention that implementing Lean in areas that undergo constant change will hurt sustainability.

Persistent change overwhelmed staff and created innovation fatigue as a factor that affected the implementation phase. When change is not carefully planned and managed, it causes discomfort and distress for staff. Lean, as a philosophy, involves terminology and tools that can easily overwhelm unprepared staff. "The ongoing changes in the work environment led to feelings of confusion and uncertainty about whether the changes were a result of Lean implementation or something else" (Flynn et al., 2019). The level of constant change also created a perception that Lean would not be sustainable and was just another passing trend.

The feelings of innovation fatigue and uncertainty resulted in a negative perception of Lean among staff. Perception is the final factor in the implementation phase that affects the sustainability of Lean. The top-down, mandated, and externally led implementation was viewed negatively by staff. "Some staff felt that Lean was a cost-cutting measure, a passing trend, something that was imposed on them, with a rushed implementation and without a clear purpose" (Flynn et al., 2019).

4.3.4 Leadership

The leadership theme encompasses factors related to the role, behaviour, and quality of top management in guiding the Lean organisation towards long-term sustainability. **Gemba walk, leadership approach, leadership participation,** and **stakeholder involvement** are four factors under Leadership theme.

One of the factors is leadership participation, which has an impact on the sustainability of Lean healthcare. Active involvement of leadership in all Lean and continuous improvement activities has a positive effect on sustainability (Henrique et al., 2021). Senior leaders must dedicate their time to promoting and prioritising Lean initiatives (Flynn et al., 2018) (Henrique et al., 2021).

Another factor within this theme is the leadership approach adopted within the organisation. The choice between a hierarchical and distributive approach will influence the sustainability of Lean (Flynn et al., 2018). Lean requires a participative leadership style in which leaders encourage staff to suggest and initiate Lean activities. If the leadership approach is not aligned with Lean principles, sustainability will be compromised.

Additionally, the Gemba walk is an essential activity that should be carried out by leadership. As stated by Henrique et al. (2021), "There must be Gemba walks in place, performed by the management team, as a meeting routine where all levels of the organisation go where things happen to see the problem for themselves and develop action plans." Gemba walks enable leadership to be involved in problem identification, solution creation, and implementation of corrective actions. This practice aligns with Lean principles, as leaders actively participate and engage in Lean activities at the workplace.

In summary, the leadership theme revolves around the approach adopted by leadership to achieve sustainability, as well as their participation in all Lean activities, including Gemba walks.

4.3.5 Commitment

This theme discusses the commitments required from the organisation, individuals, and management to sustain Lean. **Commitment to Lean tools, continuous focusing,** and **personnel commitment** are three factors for commitment theme

Personnel commitment is crucial for ensuring the sustainability of Lean in healthcare. This includes commitment and buy-in from executives, middle management, and staff to achieve Lean sustainability. Executive commitment is key and imperative for sustaining Lean in healthcare (Hallam and Contreras, 2018). According to Trakulsunti et al. (2020), "ensuring continued leadership buy-in for Lean and long-term leadership commitment is a key factor for sustaining Lean when the leaders who understand Lean projects have left the hospitals". Staff commitment involves ensuring their consistent use of Lean tools and methodologies to improve the medication process (Trakulsunti et al., 2020).

Another factor under commitment is the commitment to Lean tools. It is important to use Lean tools correctly to implement planned changes quickly and address sustainability issues (Henrique et al., 2021).

Finally, the continuous focus is another factor for commitment. The sustainability of Lean can be achieved by "continuously focusing on identifying problems in the medication process and waste, then identifying root causes and developing solutions to minimize them continuously" (Trakulsunti et al., 2020).

4.3.6 Training

This theme explores factors related to the provision of Lean information, the level of competency within the organisation, and the upskilling or development of staff. It encompasses strategies that empower staff with relevant information. **Lean training, competence,** and **training plan** are three factors under training theme.

Training plan is the first factor within the training theme. It is crucial during the implementation of Lean to have a training plan that outlines who will deliver the training, who must attend, and where it will take place. Continuous training plans are essential for sustainability, as staff turnover requires ongoing re-education (Hallam and Contreras, 2018). These plans should also include refresher workshops to update the staff's knowledge of Lean (Trakulsunti et al., 2020).

Another factor in training is Lean training, which involves training on Lean transformed processes. According to Andersen et al. (2014), Lean training should be accessible, substantial, practical, and relevant for immediate use. Staff involved should be constantly trained on Lean concepts, from basic tools to the philosophy of Lean thinking, as part of a continuous learning process (Henrique et al., 2021). Lean training helps staff understand the Lean philosophy and adapt it to the healthcare context as mentioned in Lean alignment theme. It also introduces Lean thinking and changes the way things are done. A well-designed training plan and effective Lean training content will continuously improve the competency levels of staff.

Competency is another factor within the training theme. Competence in using Lean tools, and applying principles and methodology, ensures capability and is crucial for driving Lean sustainability (Andersen et al., 2014; Trakulsunti et al., 2020). The sustainability of Lean is influenced by the degree of Lean training that clinical leaders and frontline staff receive, as well as their ability to drive or lead Lean efforts at the unit level (Flynn et al., 2018). This also includes the degree and nature of Lean leadership training provided to organisational leaders.

4.3.7 Teamwork

Teamwork is defined in literature as the collaboration of multi-skilled and multi-disciplinary teams, making decisions that span across different departments and functions. This concept focuses on the factors that impact how teams work together to sustain Lean practices. **Collaboration, inclusive decisions, integrated teams, multidisciplinary teams and interventions, personnel involvement,** and **team spirit** are six factors under teamwork theme.

One of the factors is collaboration, which plays a crucial role in ensuring the sustainability of Lean in healthcare organisations. To achieve this, hospitals should adopt a collaborative approach instead of a siloed approach, fostering relationships and promoting collaboration between different structures and professions (Flynn et al., 2018). Hallam and Contreras (2018) emphasise that collaboration between teams enhances productivity and efficiency. Andersen et al. (2014) also include collaboration as one of the factors affecting the sustainability of Lean. According to Flynn et al. (2018), the degree of collaborative team-building and the use of a multi-disciplinary approach to Lean activities are crucial in sustaining continuous improvement.

Another factor identified in this study is the importance of multi-disciplinary teams in ensuring Lean sustainability in healthcare. Hallam and Contreras (2018) state that involving multidisciplinary teams and promoting concurrent involvement from all departments is essential for sustaining Lean practices. Likewise, Andersen et al. (2014) highlight the significance of multifaceted interventions that bridge silos and functional divides. Lean encourages organisations to gather team members from different disciplines to encourage knowledge sharing and cooperation.

An integrated team, consisting of individuals with diverse skills from different departments, is another crucial factor in Lean sustainability. They utilise organised frameworks to identify improvement solutions for Lean projects (Henrique et al., 2021). According to Hallam and Contreras (2018), implementing new Lean processes with the presence of process owners, executives, and representation from all teams, including different shifts, demonstrates teamwork and inclusivity.

Additionally, involving personnel who assist healthcare organisations in fostering a culture of teamwork is another important factor. Quotes below from different authors emphasise the effect played by personnel involvement:

- “IT professionals are involved in improving activities and help to simplify and automate complex processes” (Henrique et al., 2021)
- “The degree that clinical leaders play an active role in promoting, participating, and investing their own time in Lean assessment and improvement activities” (Flynn et al., 2018)

- “Physicians participated in all phases of the project to contribute to give credibility to the project, engage other professionals and contribute to the generation of solutions” (Henrique et al., 2021)
- “Commitment, engagement and empowerment by staff participation” (Andersen et al., 2014)
- “Staff buy-in is very essential for teamwork” (Trakulsunti et al., 2020)
- “Health professionals, such as nurses and pharmacists, actively participate in continuous improvement activities” (Henrique et al., 2021)

William James Wilson et al. (2018) defined teamwork as the quality of relationships within teams, extending beyond work or project responsibilities.

Another factor that contributes to the effectiveness of teamwork is team spirit, which refers to the quality of relationships among team members. Flynn et al. (2018) also mentioned the impact of team spirit on teamwork, noting that positive or negative relationships, such as trust and communication, between clinical leaders and front-line staff can influence teamwork.

In addition, inclusive decision-making is another important factor for effective teamwork. According to Henrique et al. (2021), inclusive decisions involve consensus rather than a top-down approach, giving people the freedom to generate new ideas for improvement and discuss them to determine the best course of action for the organisation.

4.3.8 Support

This theme explores the external and internal factors that support Lean activities and processes in the organisation to achieve sustainability. **Lean champions, resources, and supportive culture** are three support theme factors.

The first factor is Lean champions, who are essential for the sustainability of Lean. Lean champions are a group of employees dedicated to implementing Lean and continuous improvement activities (Henrique et al., 2021). It is important to select Lean champions from different levels and sections to enhance their acceptance and effectiveness. Developing champions among clinical and mid-level management is crucial for sustaining the change (Hallam and Contreras, 2018). Increasing the number

of champions can improve the level of Lean competence in hospitals (Trakulsunti et al., 2020). The literature emphasises the need, composition, and responsibilities of Lean champions in supporting Lean activities.

The second factor is resources. Resources include time, staff, facilities, equipment, policies, and procedures necessary for sustainability (Flynn et al., 2018). Adequate and accessible resources should be provided to support Lean sustainability (Andersen et al., 2014). It is essential to obtain the relevant and sufficient resources to support any initiative. Without resources and support, Lean may not be sustainable, as mentioned in the literature.

The third factor is a supportive culture. Supportive culture refers to the views, norms, and beliefs that promote continuous improvement (Andersen et al., 2014). Organisations should develop a supportive culture to facilitate the implementation and long-term sustainability of Lean. Hospitals need to seek support from IT, administrative staff, external stakeholders, and others to assist with continuous improvement activities. Supportive culture entails adopting behaviours that become the norm throughout the company.

4.3.9 Motivation

Motivation deals with issues or factors that promote or boost the morale of the team. **Morale, Motivators, respect for people, staff and patient benefits, success stories,** and **reward and recognition** are six motivation theme factors.

The success of Lean depends on the morale of the team which boosts the motivation to support continuous improvement. The below quotes represent factors that affect the morale at the workplace as mentioned by reviewed articles:

- “Staff were overwhelmed and staff engagement in Lean was a challenge” (Flynn et al., 2019).
- “Lack of follow-up regarding the Lean changes implemented” (Flynn et al., 2019).
- “The degree of staff turnover, staff morale, type of unit culture, and level of innovation fatigue” (Flynn et al., 2018).

These quotes discuss the morale issues that arise as a direct result of Lean implementation. These issues address the fundamental principles of Lean, which involve identifying and resolving problems throughout the process.

According to Flynn et al. (2018), factors such as the alignment or hindrance of core values among front-line healthcare providers, their pre-existing levels of empowerment, job satisfaction, attitudes and buy-in of clinical leaders, and the relationships between clinical leaders and front-line healthcare providers all play a role in motivating or impeding motivation. These motivators impact the sustainability of Lean in the healthcare setting. The authors hypothesize that motivation acts as an amplifier or attenuator of Lean actions. In other words, certain motivators, such as belief in the end goal, can positively influence Lean actions, while others, such as lack of management support, can have a negative effect.

Respect for people is another motivational factor, as it signifies a strong organisational commitment to developing the independent improvement capabilities of operational staff (William James Wilson et al., 2018). Sharing and showcasing success stories is a way to motivate and inspire staff to strive for more (Trakulsunti et al., 2020).

Motivation in the workplace is also enhanced by the benefits that staff and patients derive from Lean implementation. These benefits include creating value for patients and the workforce, as well as making improvements (Andersen et al., 2014). Benefits to staff and patients foster willingness and motivation. The visibility of the benefits to patients, staff, and the organisation as a result of Lean implementation also impacts its sustainability (Flynn et al., 2018).

The assessment, reward, and recognition system introduced by the company is another motivational factor. According to Trakulsunti et al. (2020), rewards and recognition systems are important for motivating staff to continue implementing Lean in organisations. Staff should be evaluated and rewarded through competitive programs based on implemented improvement ideas or achieved performance goals (Henrique et al., 2021). Highlighting and disseminating success stories of Lean initiatives across all departments of the hospital also boosts staff motivation to carry on with the Lean project (Trakulsunti et al., 2020; Andersen et al., 2014; William James Wilson et al., 2018).

4.3.10 Communication

This theme focuses on factors that impact the exchange and dissemination of information. **Communicate better and simpler, communication plan,** and **communication to all stakeholders** are three communication theme factors.

The first factor to consider is the communication plan. It is crucial for the sustainability of Lean practices that hospitals have a communication plan in place to ensure that improvements are maintained (Hallam and Contreras, 2018). The communication plan should align with the implementation plan, facilitating the distribution of Lean-related information regarding implementation, successes, challenges, and outcomes.

Another factor within the realm of communication is the need for clear, effective, and simplified communication. As stated by Henrique et al. (2021), Lean communication tools play a vital role in enhancing communication clarity and simplicity.

> "*A3 method is currently used to communicate better and simpler the process of change of projects on a single sheet, containing the objective, the current situation with the problems, the projected situation, the action plan outlined and the monitoring indicators*".

The third factor is communication with stakeholders**,** which involves communicating with and between patients and staff, as well as providing feedback to both (Andersen et al., 2014). Leaders and management should communicate the value and purpose of Lean to the entire organisation (Flynn et al., 2018). "Kaizen events, aligning and engaging people in charge, and sharing the results of Lean implementation must be communicated throughout the entire organisation" (Henrique et al., 2021). Communication with stakeholders highlights the importance of being transparent and keeping them informed about Lean activities.

4.3.11 Management

Management, as a theme, encompasses the openness and transparency of management concerning Lean. **Implement change and control plans and activities, performance management, and Lean tools** are three factors under management theme.

Within this theme, there are several key aspects. Firstly, management must be able to implement change and establish control plans and activities that will ensure the sustainability of Lean in healthcare. To do this effectively, management must use accurate, robust, evidence-based, and timely data for continuous improvement (Andersen et al., 2014). Furthermore, management should develop implementation control plans based on documented standards and processes (Hallam and Contreras, 2018). For an organisation to successfully implement Lean, it is important to have documented work standards that serve as the approved way to carry out specific tasks (Henrique et al., 2021). Additionally, improvement and problem-solving activities should follow structured steps, such as DMAIC or PDCA, which involve defining the problem, setting goals, assessing the current state, identifying root causes, envisioning a future state, implementing changes, standardizing processes, and establishing control measures (Henrique et al., 2021). Documenting standard work is crucial to ensure that changes are sustained over time.

Another crucial factor in management is monitoring, measuring, and evaluating performance. After implementing Lean interventions, management needs to have a well-defined follow-up routine to closely monitor any issues that may arise (Henrique et al., 2021). Management should also introduce charts to track key performance indicators that accurately measure process performance and align with the desired goals of improved value streams (Henrique et al., 2021).

Effective utilisation of Lean tools is also important in management. Value stream mapping, for example, is a valuable Lean tool for understanding the patient value stream from the beginning of treatment until the end. This tool helps identify task time, cycle time, and waste and aids in the design of a future state goal (Henrique et al., 2021). Moreover, visual management boards can be used to display system-integrated standard procedures, performance indicators, sustainability assurance notes, A3 projects, value stream maps, and goals to be achieved (Henrique et al., 2021).

4.3.12 Empowerment

Staff empowerment is the only factor under empowerment theme, and it highlights the necessity and rationale behind management's need to empower staff for the sustainability of Lean. According to Flynn et al. (2019), staff engagement and

empowerment are crucial mechanisms for determining the sustainability or non-sustainability of Lean efforts. Creating a Lean culture involves both encouraging and empowering staff throughout the hospital (Trakulsunti et al., 2020). Staff empowerment encompasses assigning Lean responsibilities to staff, granting decision-making authority, fostering open expression, and providing support. The focus is on enabling staff to fulfil their Lean sustainability roles and recognising their contributions.

4.3.13 Auditing

Auditing is a theme that addresses the necessity for organisations to regularly conduct audit processes to assess their performance. Although auditing is not frequently mentioned in the articles, its significance to sustainability should not be underestimated. **Audit Process,** and **regular audits** are two factors under auditing theme.

Henrique et al. (2021) emphasise the importance of an audit process and checklists carried out by management after Lean activities to ensure that improvements are implemented and work standards are adhered to. The audit process provides management with evidence of what has occurred, how it happened, and who was involved. This process gauges the progress made in implementing Lean and the improvements achieved through Lean.

Regular audits as the other factor must be conducted to provide evidence that continuous improvement events have taken place. As Andersen et al. (2014) state, "Regular local audits and measurements are related to the organisation's structural capability, which strengthens the evidence for Lean interventions."

4.4 Conclusion

Findings from interviews and SLR data were presented in this chapter. Factors identified from SLR represent universal or international information as SLR includes all available published information (refer to Chapter 3). The SLR factors were necessary because the study wanted to compare and verify if South African factors are comparable with the rest of the world. The SLR factors will assist this study by

evaluating and validating interview factors in Chapter 5. The two sets of factors were found to be comparable to each other except for three issues. The first issue regards government involvement in the running of the South African public hospitals. As mentioned in the literature review the South African government is very involved with the governance of the public hospitals and this delays the decision making. Decisions and the thinking of non-Lean government departments are different and not aligned with the needs of Lean hospitals. Secondly, SLR has an auditing theme that did not feature in the interview data. Lastly, interviews have a healthy competition theme that did not come out from the SLR as a theme but came out as a factor under the motivation theme.

Chapter 5: Analysis

5.1 Introduction

This chapter will analyse themes by subject matter that factors sought to address. Participants' experiences will be reduced to descriptions of universal essence and intentionality. The analysis will use SLR findings to evaluate interview findings as per research objective three. Sustainability science (SS) will be used to explain or emphasise the sustainability concept or intention.

5.2 Analysis

Themes from the SLR and interviews have been described in Chapter 4. It can be concluded that both findings are similar, as shown in Table 9. It is worth noting that "Healthy Competition" does not appear as a theme in the SLR, but it is included as a factor under the Motivation theme. The auditing theme from SLR findings will not be discussed further, as it does not pertain to the themes that affect sustainability in South African public hospitals because it is not mentioned by interviewees.

Table 9: Comparison of interview and SLR factors and corresponding themes

Theme	Interview factors	SLR factors
Long-term philosophy	Continuous process	Continuous improvement
	Lean thinking	Vision
	Lean understanding	
Lean alignment	Lean adaptation	Healthcare alignment and adaptation
	Lean Integration	Institutionalising Lean
	Language adaptation	Personnel alignment
	Organisational readiness	Sense making
	Strategic alignment	Strategic alignment
		Value alignment
Implementation phase	Staff engagement	Innovation fatigue
	Implementation plan	Implementation plan
	Implementation process	Implementation process
		Perception

Leadership	Change management	Leadership approach
	Gemba walk	Gemba walk
	Leadership involvement	Leadership participation
	Leadership quality	Stakeholder involvement
Commitment	Leadership commitment	Commitment to Lean tools
	Long term commitment	Continuous focusing
	Personnel commitment	Personnel commitment
Training	Coaching and guidance	Competence
	Lean training	Lean training
	Personnel training	Training plans
Teamwork	Collaboration	Collaboration
	Personnel involvement	Personnel involvement
	Integrated teams	Integrated teams
	Multi-disciplinary approach	Multidisciplinary teams and interventions
		Inclusive decisions
		Team spirit
Support	External support	Supportive culture
	Lean champions	Lean champions
	Resources	Resources
	Personnel support	
Motivation	Acknowledgement and recognition	Reward and recognition
	Perception	Motivators
	Personnel benefits	Staff and patient benefits
	Personnel involvement	Respect for people
	Staff morale	Morale
	Success stories	Success stories
Communication	Open communication	Communicate better and simpler
	Visual Communication	Communication plan
		Communication to all stakeholders
Management	Lean tools	Lean tools
	Management competence	Implement change, control plans and activities
	Performance management	Performance management
	Staff engagement	
Empowerment	Staff empowerment	Staff empowerment
Auditing		Audit Process

		Regular audits
Healthy competition	Create competition	
	Benchmarking	

5.2.1 Long-term Philosophy

Long-term philosophy is at the core of Lean's objectives. This philosophy plays a crucial role in promoting sustainability by emphasising the implementation of Lean with a long-term perspective. It is important for hospitals to fully understand and embrace this long-term philosophy before implementing Lean. By doing so, they can avoid treating Lean as a quick-fix project with a short-term endpoint. Instead, Lean should be seen as a continuous improvement process that enhances performance over an extended period (P1, P6). This long-term philosophy cultivates a Lean thinking mindset, which encourages the maintenance and further improvement of achieved fixes. The goal is to establish a new current state and baseline, enabling the organisation to continuously strive for even higher levels of performance (Womack, Jones, and Roos 1990). This creates an ongoing cycle of improvements, leading to the sustainability of Lean. Both the SLR and interviews support the notion that the long-term view is not solely focused on immediate results, but rather on embedding a culture of continuous improvement within the organisation's operations and processes, to be better each day.

The application of Lean as a long-term philosophy transforms the entity's vision and strategic planning, placing a strong emphasis on the continuous improvement process. This process, driven by Lean thinking, is what ultimately leads to sustainability, as highlighted by P1:

> "*Lean is not about the tools but mentality to improve efficiency. If it comes from mind and philosophy then sustainability is possible".* P1

The (P1) quote emphasises the sustainability necessity to change the way organisations think and influence the decisions during the Lean implementation process, as supported by (Henrique et al., 2021) below:

> "*Decisions should be based on a long-term philosophy, even to the detriment of short-term financial losses, to help to establish a culture of continuous*

improvement and making employees more confident about the organisation's strategic alignment." (Henrique et al., 2021)

SLR and interviews both agree that Lean thinking is a factor that influences the vision and goals of the organisation to achieve long-term sustainability. The concept of long-term philosophy involves understanding Lean as a philosophy, embracing Lean thinking, and applying Lean principles from a philosophical perspective.

5.2.2 Lean Alignment

Lean alignment factors broadly encompass the incorporation of Lean philosophy and principles into the activities, visions, and strategies of a healthcare organisation, as discovered through interviews and the SLR. The process of institutionalising Lean, or fully integrating Lean throughout the entire organisation, requires significant organisational and process changes that may conflict with the existing organisational culture (OC) (Erthal et al., 2021). Achieving Lean alignment establishes an environment conducive to institutionalising Lean and fostering a new Lean-based organisational culture (OC) (P5). The OC serves as the binding force uniting individuals within the organisation and reflects the organisation's practices and procedures (Wagner et al., 2014). Aligning the OC with the Lean-based strategic plan is crucial for the hospital to achieve its sustainability goals and objectives (P3, P5, P9), (Casida and Pinto-Zipp, 2008). Supporting this idea, Sustainability Science (SS) mentions that:

> *"Strategic situations need adoption of OC with a continuous perception, evaluation, implementation, and revision within the balance of internal dynamics rather than a top-down planning"* (Acar and Acar, 2014).

Lean and hospitals must be aligned to successfully integrate and achieve long-term sustainability. Lean, a concept originating from the Japanese automotive industry, needs to be adapted to fit the healthcare context during the implementation phase (P1, P3, P4, P7). Aligning Lean with the healthcare context enables healthcare workers to understand and embrace it. It also entails aligning the hospital and its culture, preparing them for the significant organisational and process changes that Lean implementation brings. Before implementing Lean, it is important to thoroughly

understand the hospital environment and culture (P3, P4, P5, P7). Continuous alignment of Lean is necessary because it ensures ongoing success and effectiveness. As explained in SS:

> *"Sustainability is not a destination, but a dynamic process of adaptation, learning, and action. Sustainability is a shared ethical belief. It is about recognizing, understanding, and acting on interconnections." (Sala et al., 2013)*

Lean alignment is essential not only during the implementation phase but also for the ongoing adaptation to new Lean developments. A Lean organisation must be dynamic and able to adjust accordingly (P3, P7). By successfully aligning Lean with the organisational structure, and defining new strategic directions, goals, and objectives, the implementation process becomes more successful and the long-term sustainability of Lean is ensured. This has been emphasised in interviews and the SLR.

5.2.3 Implementation Phase

The implementation phase is crucial for sustainability because successful implementation leads to sustainability (Flynn et al., 2018). During the implementation phase, issues that impact sustainability are addressed. It is essential to prioritise sustainability during this phase, as many hospitals have seen initial success with Lean practices but failed to sustain those achievements, leading to regression to the original state (Henrique et al., 2021). This study highlights that factors such as the implementation process, plan, and staff engagement influence sustainability.

While the implementation process poses various challenges, the most significant obstacle to Lean sustainability is transforming the existing organisational culture (Maramba et al., 2020). Sustainability science emphasises the importance of removing organisational barriers to adopting a focused, iterative, and integrative approach when dealing with complex sustainability issues (Dedeurwaerdere, 2014). Transitioning hospitals to a Lean culture is crucial because the overall organisational culture distinguishes short-term improvements from long-term Lean organisations (Liker and Morgan, 2006). Introducing new values, beliefs, ways of thinking, and behaviours within an organisation requires a challenging, sustainable, and long-term process,

rather than a one-time event. Proper planning, execution, and monitoring are necessary during the Lean implementation phase (P2).

The implementation process should include a well-thought-out plan with a set of steps that must be strictly followed (P1, P2). This is important to ensure that the implementation team does not neglect any steps that could undermine sustainability in the future (Henrique et al., 2020). It is crucial not to impose the implementation but rather engage staff to gain their buy-in (P4). Forcing Lean onto staff can create resistance and result in their participation only because they have to, without genuine interest (P3).

This study found that a successful implementation phase, where staff members were engaged and there was a plan for the implementation process, leads to sustainability. This finding is supported by the SLR, which shows that the sustainability of Lean healthcare is the extent to which Lean healthcare approaches continue to operate after the implementation efforts have ended (Flynn and Scott, 2020).

5.2.4 Leadership

The importance and role of leadership were emphasised by all interviews and supported by the SLR. Leadership approach, availability, commitment and buy-in to Lean are key to the long-term sustainability of Lean (P1, P2, P4, P5, P6, P7, P8, P9) even when previous leaders who understood Lean projects have left the organisation (Trakulsunti et al., 2020). Leaders must show their commitment by being seen as promoting and investing their own time in Lean efforts (Flynn et al., 2018), (Henrique et al., 2020). Leading by walking around (Gemba walk) is preferred against leading by objectives (P6). Leadership to participate in Lean activities by doing the Gemba walk (P3, P4, P7, P8) because the Gemba walk provides them with an opportunity to meet with all start from different organisational levels where things happen to see the problems for themselves and deliberate on solutions going forward (Henrique et al., 2021).

The quality and competence of leadership determine the extent to which Lean can be sustained. Humble and positive leadership instils confidence in the organisation (P2, P7, P8). Sustainability science recommends that leaders possess the following

categories of sustainability competencies to understand and solve sustainability issues:

1. Problem-oriented and conceptual knowledge,
2. Methodological knowledge,
3. Ability to link knowledge to action, and
4. Interpersonal and collaborative skills.

These sustainability competencies are supported by the leadership factors identified in this study. Respect for people, which is one of the basic principles of Lean, includes the development of leaders who understand Lean and teach it to others. Leadership should adopt an engaging approach towards staff instead of imposing themselves, as mentioned by Andersen et al. (2014). Leadership engagement is crucial for Lean sustainability.

5.2.5 Commitment

The commitment theme addresses the importance of commitment from stakeholders involved in Lean implementation, which has an impact on sustainability. Commitment is a characteristic of the organisational culture that must support the organisation in achieving Lean sustainability. Leadership, government buy-in, commitment, and vision are essential for Lean sustainability (P3, P4, P5, P6, P9). Government commitment to authorise and fund the Lean project provides hospitals with the necessary resources to initiate and maintain Lean implementation. Government resource support affects the sustainability of Lean, as executive commitment and stakeholder support are crucial tactics for the success of Lean healthcare (Hallam and Contreras, 2018).

Leadership commitment to Lean is key to its sustainability, as a project is more likely to be sustained if there is leadership support (P9). Ensuring ongoing leadership buy-in for Lean and long-term leadership commitment is a critical factor in sustaining Lean when the leaders who understand Lean projects have left the hospitals (Trakulsunti et al., 2020). Management and staff buy-in to Lean implementation affect sustainability because the unsuccessful implementation can result from workforce behaviours, including a lack of trust and commitment displayed by management (Čiarnienė and Vienažindienė, 2012). Both interviews and SLR indicate that commitment from leadership and staff is crucial for the sustainability of Lean in healthcare.

Since Lean is based on long-term visions and goals, long-term commitment is the driving factor for sustainability. Ensuring consistent daily use of Lean methodologies to solve problems and improve the medication process requires a commitment to Lean (Trakulsunti et al., 2020). Both interviews and SLR studies agree that the commitment of resources, time, personnel, and management lays the foundation for sustainable Lean implementation.

5.2.6 Training

Training is crucial for the sustainability of Lean in hospitals because it equips staff with the necessary knowledge and skills to sustain Lean practices. It is an essential element of the organisational Lean culture, as highlighted by Liker and Morgan (2006), who emphasise the importance of being a humble and learning organisation. The purpose of training is to introduce a culture of continuous learning within the organisation, facilitating the transformation from the existing culture to a new Lean culture during the implementation phase. Prioritising training is necessary to promote continuous improvement (P3, P7), as all personnel should undergo training in Lean concepts as part of an ongoing learning process (Henrique et al., 2020). Training not only enhances Lean knowledge over time but also empowers staff (P6), as the benefits of Lean can only be realized when individuals possess the necessary skills and capabilities to perform their tasks effectively (Liker and Morgan, 2006). Lean training is essential in helping hospital staff understand the Lean philosophy and align it with the hospital environment. By teaching individuals to identify waste (P1), Lean training forms the foundation of Lean implementation.

To ensure the sustainability of Lean, guidance from management and champions, as well as periodic Lean refresher training sessions, are crucial for enhancing and updating staff's Lean knowledge (Flynn et al., 2019). Coaching and guidance, integrated into the training process, contribute to sustainability by breaking down silos (P5, P6, P7) and promoting collaboration and teamwork. Continuous intervention and on-the-job training (P4) address the erosion of knowledge that can occur due to staff movement (Andersen et al., 2014). Staff should be trained to understand the philosophy of Lean thinking (Henrique et al., 2020) and be equipped with the methods and tools to enhance their technical capabilities (Trakulsunti et al., 2020). Staff

knowledge and understanding of Lean methodology are critical factors in driving Lean sustainability (Trakulsunti et al., 2020).

Systematic literature reviews and interviews highlight the importance of combining continuous training in a classroom setting with on-the-job training, alongside continuous improvement efforts. Continuous training should be accessible, substantial, practical, and immediately applicable (Andersen et al., 2014).

5.2.7 Teamwork

Teamwork, as defined in Chapter 4, describes the quality of interactions within teams, beyond the work tasks and the quality or effectiveness of the tasks themselves. Teamwork assists hospitals by promoting collaborative efforts to achieve sustainability. The collaboration between teams helps leaders break down silos and hierarchies in hospitals (P3) and improves productivity and efficiency (Hallam and Contrares, 2018). Lean implementation in hospitals is focused on improving customer journeys, ensuring that no customer moves through isolated departments (P9). Collaboration will help sustain the customer journey and the value offered by Lean implementation. Collaborative efforts among all involved parties lead to increased legitimacy, ownership, and accountability (Lang et al., 2012).

The creation of multidisciplinary teams, in an attempt to implement Lean solutions (Miller, 2013), affects sustainability. A multidisciplinary approach brings together knowledge and skills from different sections or professions that can be used to achieve sustainability goals. Multidisciplinary teams also help improve staff's understanding of other sections they do not work in. Failure to integrate different teams is a major reason why some teams are resistant to change and adopting the new working culture (Maramba et al., 2020). Sala et al. (2013) mention that sustainability challenges are not only about identifying problems but also about moving towards solutions using an integrated, comprehensive, and participatory approach.

Staff and management engagement, involvement, buy-in, collaboration, and participation in continuous improvement processes will enable the long-term sustainability of Lean as agreed by interviews and SLR.

5.2.8 Support

The support theme focuses on the factors that provide material assistance to the sustainability of Lean. This study demonstrates that support from management, organisation, external resources, and staff is essential for sustaining Lean. Support is a characteristic of the organisational culture where attitudes, norms, and beliefs are developed to promote quality improvement (Andersen et al., 2014). A supportive culture creates an environment where employees can freely express their skills and creativity, take initiative, explore, and achieve results (Andersen et al., 2014).

Hospitals need to select enthusiastic champions who are dedicated to promoting and implementing Lean (P4), (Henrique et al., 2020). Developing champions is a crucial requirement for sustaining Lean (Hallam and Contreras, 2018), and the number of champions should continuously increase to enhance Lean competence across hospitals (Trakulsunti et al., 2020).

Support from external consultants offers the knowledge that organisations should utilise to sustain Lean (P1). External consultants guide and impart Lean knowledge to staff. Hospitals should understand that external consultants are there on a short-term basis to train, guide, and implement Lean, but the long-term sustainability of Lean (a philosophy) depends entirely on internal staff with management support.

SLR support interviews that relevant, sufficient, and accessible resources are necessary to support and sustain Lean implementation. Other departments such as administration, IT, and finance should provide support to Lean activities based on their responsibilities within the company. Involving other personnel leads to the formation of multidisciplinary teams. Resources support teamwork and impact sustainability.

5.2.9 Motivation

The motivation theme comprises factors that affect the willingness or courage of personnel to execute duties in pursuit of Lean sustainability. Motivation was theorised as an intensifier or attenuator of Lean activities because motivators can either have a positive or negative influence on Lean actions (William James Wilson et al., 2018). Staff perception of Lean and its effectiveness affect sustainability because staff may see Lean as extra work (P7, P9) if not informed correctly. Employee engagement,

including unions, to sell the benefits of Lean and alleviate fears, manages the perception of Lean (P3). A challenge in staff engagement and lack of follow-up regarding Lean effects in the organisation may overwhelm staff and create a wrong perception (Flynn et al., 2019). Management should control the perception of Lean at the implementation phase for Lean to be accepted by staff and staff motivated to participate.

An engaging environment where staff engage in free will with motivation to make a difference (P2), without punitive consequences but an opportunity to learn, motivates staff to express themselves and suggest solutions to eliminate waste. Sustainable Lean implementation is where staff is empowered to fully participate in the first implementation step where Lean healthcare culture is developed (Dahlgaard et al., 2011). Staff empowerment theme integrates with motivation theme to sustain Lean.

Motivation comes from sharing and showing success stories of Lean to promote the benefits of Lean (P3, P6, P7, P9). It is a source of motivation for staff to maintain Lean intervention and achieve sustainability. Both interviews and literature agree that improved patient outcomes influence the morale of patients as beneficiaries of value-add and staff by fulfilling their duties.

Recognition and rewards induce motivation (P2, P6) because rewards and recognition systems are motivating factors to inspire staff to persevere with implementing Lean in hospitals (Trakulusunti et al., 2020). Staff is recognised and rewarded through healthy competition (Henrique et al., 2020). Healthy competition theme integrates with motivation theme to sustain Lean.

Staff benefits include growth in the organisation, job security, and achieving targets through the use of Lean motivation to sustain Lean (P6, P8, P9). In staff and patients, benefits encourage willingness and motivation (Andersen et al., 2014) to the extent that the benefits to patients, staff, and the organisation due to Lean implementation are visible (Flynn et al., 2018).

SLR and interviews agree on all the motivation factors and are aligned on the reasons why motivation is important for Lean. The essence of motivation factors is to make sure people are engaged and drawn into Lean by what Lean can do for them.

5.2.10 Communication

The communication theme examines the impact of open and visual communication on the sustainability of Lean in public hospitals. Effective communication contributes to a smooth flow of information (P5) among patients and staff, including feedback for both parties (Andersen et al., 2014). This study highlights that a lack of communication within an organisation leads to a situation where different departments are unaware of each other's actions, ultimately undermining teamwork. Sustainability science (SS) emphasises the need for constructive input from diverse knowledge sources to incorporate important insights from all stakeholders involved in addressing sustainability issues (Lang et al., 2012). The communication theme integrates with the teamwork theme to support the sustainability of Lean.

Open and purpose-driven communication regarding Lean philosophy (P5, P6, P9) assists organisational leaders in conveying the value and purpose of Lean to the entire organisation (Flynn et al., 2018). Hospitals should prioritise understanding Lean philosophy (P4, P5, P6) because when it is deeply ingrained in the mindset and philosophy of the organisation, sustainability becomes achievable. The sustainability of Lean depends on how staff members perceive Lean and whether its values align with their own personal and/or professional values. The communication theme synergizes with long-term philosophy and Lean alignment themes to sustain Lean. Clear and honest communication by leadership when engaging with staff (including unions) is crucial for fostering staff commitment and addressing any fears and doubts.

Visuals, such as pictures, are an effective means of communication (P6) because they simplify and enhance understanding of change processes within projects on a single sheet (Henrique et al., 2020). Visual management boards display performance indicators, work standards, sustainability assurance notes, and goals to be achieved (P6, P7, P8), (Henrique et al., 2020), (Hallam and Contreras, 2018), (Andersen et al., 2014). Communication is not solely about the content being conveyed but also about how it is delivered. Communication aligns with management to sustain Lean.

Communication serves as a crucial link between the organisation, individuals, and the concept of Lean. It is important that communication is inclusive and does not discriminate against any individuals within the organisation. For communication to

positively impact the sustainability of Lean in healthcare, it should be accurate, precise, timely, usable, sufficient, and accessible.

5.2.11 Management

The management theme revolves around the level of competence that management must possess to sustain Lean. Lean sustainability requires management that utilises Lean tools, engages staff, and effectively manages performance. However, the medical orientation of most healthcare management often leads them to interfere in surgical matters, rather than focusing on operational management (P3). This lack of operational management skills negatively impacts Lean sustainability, as it results in the neglect of operational issues that management should prioritise instead of interfering in medical matters.

Management plays a crucial role in ensuring the correct utilisation of Lean tools throughout the Lean journey. Improvement and problem-solving activities follow a structured approach, which includes defining the problem, goals, current state, root causes, future state, implementation, standardisation, and control (P3, P6, P8), (Henrique et al., 2020). Furthermore, management influences sustainability by ensuring the implementation of documented work standards, monitoring adherence to those standards, and continuously striving for the best way to perform tasks (P7), (Henrique et al., 2020). The documentation of work standards is essential for sustainability, as it ensures that any changes made remain in place.

Additionally, management must measure performance, analyse it, and provide feedback to staff, as feedback is a powerful driver for improvement (P5, P6, P8). "Key performance indicators are formulated and designed to accurately measure the current state process performance and the target goals of an improved value stream" (Henrique et al., 2020).

Lean management systems must prioritise the documentation and updating of work standards, as every task should be executed according to those standards, which represent the best-known method at that time (P8), (Henrique et al., 2021). Developing a habit of documenting standard work and establishing a consistent communication

plan is necessary to ensure the long-term sustainability of improvements (Hallam and Contreras, 2018).

5.2.12 Empowerment

The empowerment theme focuses on empowering staff to play a meaningful role in sustaining Lean in public hospitals. Hospitals need to allow staff to drive Lean implementations (P2, P8) because sustainable Lean implementation occurs when staff are empowered to fully participate in the initial implementation step, where a Lean healthcare culture is developed (Dahlgaard et al., 2011). During the implementation phase, developing a Lean culture involves encouraging and empowering staff throughout the hospital (Trakulsunti et al., 2020), as staff empowerment is a key mechanism for the sustainability of Lean interventions (P5), (Flynn et al., 2019). The staff empowerment theme is integrated into the implementation phase theme to sustain Lean.

Full participation of staff is crucial for sustainability, as excluding or limiting staff involvement in the implementation phase creates a sense of disconnect, fallout, and demoralization in the organisation, resulting in staff disengagement and a lack of responsibility for their roles in continuous improvement (Nwobodo-Anyadiegwu, 2021). Staff empowerment serves as motivation for them to perform better (P3). The staff empowerment theme is also interconnected with the motivation theme to sustain Lean.

Staff empowerment is one of the characteristics of the new OC that contributes to achieving sustainability.

5.2.13 Healthy Competition

The theme of healthy competition focuses on promoting healthy competition among staff, sections and departments within hospitals (P6, P7). Competition programs should be developed to encourage staff participation in Lean continuous improvement projects and should include recognition and rewards for the winners. The evaluation and reward system should be based on the implementation of improvement ideas or the achievement of performance goals that contribute to Lean sustainability (Henrique

et al., 2021). Rewards and recognition systems are important motivators for encouraging staff to continue implementing Lean in organisations (P2, P6), (Trakulsunti et al., 2020). The theme of healthy competition aligns with the theme of motivation in the pursuit of Lean sustainability.

Staff participation in Lean activities, driven by recognition and rewards, helps them develop Lean knowledge and understanding through hands-on learning during competitions (P4). The knowledge and understanding of Lean staff members are factors that impact Lean sustainability (P6), (Trakulsunti et al., 2020). The theme of healthy competition works in conjunction with the training theme to provide staff with the knowledge needed to sustain Lean.

Additionally, the theme of healthy competition addresses benchmarking as a factor that affects the sustainability of Lean. Benchmarking allows staff members or teams to learn from what others are doing (P2, P7, P8). Understanding what other teams are doing helps break down silos and improves the quality of interactions between staff members or teams. Breaking down silos and fostering interactions among staff members are factors that contribute to the sustainability of Lean (P6, P9). The theme of healthy competition also integrates with teamwork in sustaining Lean implementation. Healthy competition is one of the characteristics of an organisation that influences sustainability.

5.3 Conclusion

Factors affecting the sustainability of Lean in healthcare were explored from the interviews and SLR, and described in Chapter 4. All the themes from the interview processes were analysed to highlight the essence and intentionality of factors affecting sustainability. SS was used to emphasise the meaning of sustainability and the effects that themes and factors have on the sustainability of Lean. SLR findings were used to evaluate and validate interview factors. The findings from interviews were from experienced practitioners who have been involved in Lean implementations in South African public hospitals. It should be noted that interview data is raw, spontaneous and not reviewed as compared to data from the SLR which is from the published and reviewed literature. The use of SLR was because of its scope and rigour. SLR was used as a means of appraising and explicating all available research data using

trustworthy, rigorous and auditable methodology. Finding that interview factors are comparable to SLR data legitimises the interview findings and lessons that can be drawn from that data.

Chapter 6: Discussion

6.1 Introduction

This chapter will discuss the findings of this study and extract lessons that can be used to improve the sustainability of Lean healthcare in South African hospitals. This will be done to assist this study to answer the research question number 2 below:

> *What lessons can be drawn to improve the sustainability of Lean healthcare in South African public hospitals?*

Lessons will be drawn from interview data and substantiated by the systematic literature review (SLR) data, and other literature reviewed in trying to make sense of any assertions made.

6.2 Discussion

This study through interviews has found 44 factors synthesised into 13 themes as described in Chapter 4 and analysed in Chapter 5. These findings assist this study to answer the research question 1 below:

> *What factors affect the sustainability of Lean healthcare in South African public hospitals?*

The themes will be presented visually to provide one overall picture for ease of reference and usability. The themes are grouped into the Sustainability Foundation, Concepts of Lean, People, and Organisational Culture, as shown in Figure 6. These groupings are referred to as the pillars of sustainability. The goal of this study is to provide information that will assist public hospitals in achieving sustainability of Lean. Sustainability, as defined in sustainability science (SS), involves transitioning towards solutions by adopting an integrated, comprehensive, adaptive, and participatory approach. This study has found that to achieve sustainability, foundation, Lean, people, and organisational culture must be integrated into a coherent system to sustain Lean. Each pillar of sustainability will be discussed below:

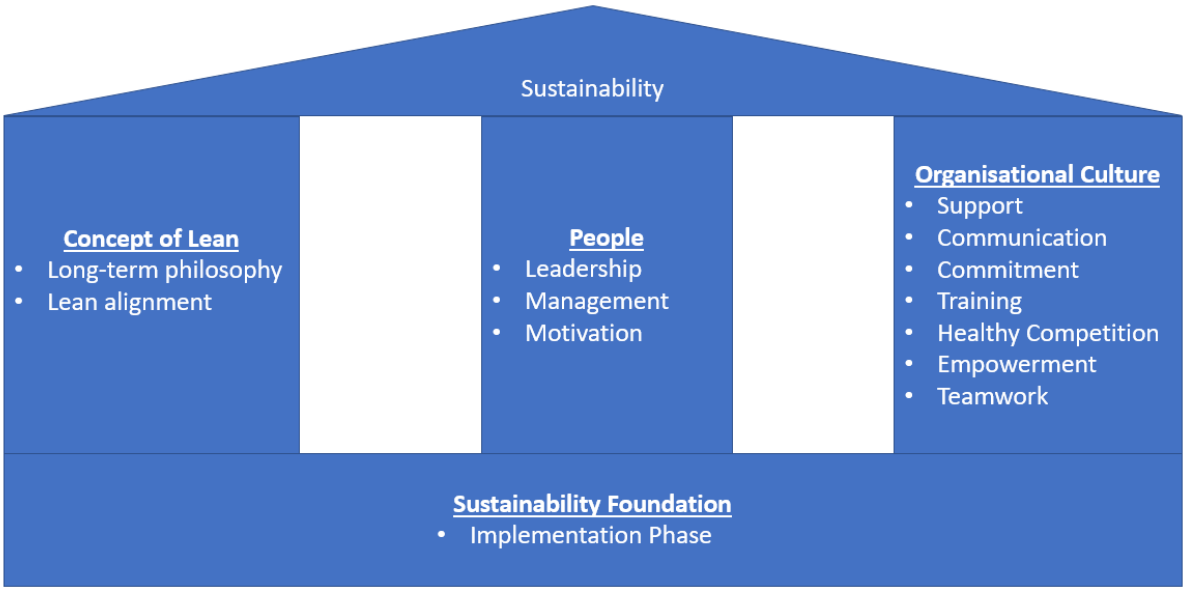

Figure 6: Illustration of the thirteen themes (created by author)

Pillar 1: Sustainability Foundation. The implementation phase lays the foundation and significantly influences the sustainability of Lean implementations in public hospitals. The implementation phase is the initial step in ensuring the sustainability of Lean healthcare. Sustainability in this context refers to the extent to which Lean healthcare practices continue to function even after the implementation process has been completed (Flynn and Scott, 2020). The progress made through Lean implementation phase serves as the current state and the foundation for further enhancements to achieve even higher levels of performance (Womack, Jones, and Roos, 1990). The effectiveness and success of the implementation phase rely heavily on following a detailed plan for implementing Lean. This plan is informed by first understanding the concept of Lean, and organisation and subsequently aligning Lean practices with the organisation's goals and objectives. People within the organisation play a crucial role in shaping the quality of the implementation phase as they drive the implementation of Lean principles. It is during the implementation phase that the organisational culture is transformed into a Lean culture. Some of the themes from the three pillars of people, concept of Lean, and organisational culture do not only contribute to sustainability but form part of essential ingredients during implementation phase.

Pillar 2: Concepts of Lean. Lean alignment and the long-term philosophy are concepts of Lean that are interconnected and interdependent, but they were isolated in this study to be understood separately. Both concepts of Lean discuss the understanding and compatibility between Lean and healthcare organisations. Concepts of Lean establish the relationship between Lean and healthcare organisations, and this relationship should be established in a way that the program and people are emotionally connected (D'Andreamatteo et al., 2015). Lean brings significant changes to the organisation and its culture, introducing new ways of thinking, planning, and achieving goals. The long-term philosophy is not about achieving specific results at a particular time in future, but rather about the mentality and culture of continuously improving the level of performance all the time. Lean, as a philosophy, introduces a new strategic direction that requires the organisation to be thoroughly prepared in advance and ready for implementation. Sustainable Lean implementation requires that Lean be first understood and aligned with the organisation because technologies that do not align with the process or enable activities of the people will not lead to any progress (Liker and Morgan, 2006). To achieve maximum benefits in any way, there is simply no shortcut to understanding the long-term philosophy and aligning Lean with the organisation (Radnor et al., 2012).

Pillar 3: People. Leadership, management, and motivation are the three people-based themes that impact the sustainability of Lean implementations in public hospitals. Leadership, management, and motivation themes are essential aspects of people's behaviour, roles, and responsibilities in achieving Lean sustainability in public hospitals. These themes highlight the importance of competent individuals sustaining Lean initiatives. To successfully implement Lean principles, it is crucial to have skilled individuals who can perform their tasks at the right time (Liker and Morgan, 2006). This requires the organisation to align the skills, practices, and organisational characteristics of its employees to sustain Lean practices Liker and Morgan (2006). To achieve sustainability, an organisation must create a cohesive system that integrates people, organisational characteristics, and Lean principles in a mutually supportive manner, as noted by Liker and Morgan (2006). Drotz and Poksinska (2014) emphasise that factors such as the Lean process, employee roles, behaviour and engagement,

organisational characteristics, and leadership significantly contribute to the sustainable implementation of Lean principles.

Pillar 4: Organisational Culture. Support, communication, commitment, training, healthy competition, empowerment, and teamwork are seven organisational-based themes that affect the sustainability of Lean implementations in public hospitals, which are the characteristics of the transformed Lean organisational culture. Lean implementation brings new dimensions to the way things are done, which requires cultural changes. The establishment of a Lean culture is just as important as Lean principles, techniques, processes, and tools for successful implementation (Čiarnienė and Vienažindienė, 2012). The broader sociocultural and organisational context has a significant impact on the translation of Lean from policy to practical implementation (Erthal et al., 2021).

6.3 Lessons from this study

> "*What can other companies learn from the Toyota Way? The journey is far more complex than applying a few tools or holding some classes. It truly is a cultural transformation. You need to start on the learning journey and then keep going and never stop. You need to practice deep reflection and learn. Toyota is continually learning. They are far from perfect and would become very nervous if anyone thought they were. What we can take away from Toyota is the importance of becoming a humble, learning organisation."* (Liker and Morgan, 2006)

The four pillars of sustainability will be used to discuss lessons drawn from this study that can be used by public hospitals to sustain Lean healthcare in South Africa. These lessons will assist this study to answer research question 2 as stated in the introduction. The drawing of lessons will demonstrate that the pillars do not contribute to sustainability in isolation or independently, but they are interdependent and co-contribute to the creation of a coherent system for sustainability.

6.3.1 Sustainability Foundation

The findings of this study emphasise the importance of a successful implementation phase to sustain Lean practices in public hospitals. The implementation phase serves as the foundation on which efforts to sustain Lean can be built. The success of this phase is contingent upon the implementation process that is followed. The lessons from this study related to implementation phase are as follows:

The implementation process must include a detailed and clear plan (P2) with a set of steps to be followed, ensuring that sustainability is not compromised in the future (Henrique et al., 2021). The plan should aim to integrate Lean with people and organisational culture, providing solutions and informing decisions (Burns et al., 2006).

Among other lessons, the well-planned and successful implementation phase relies on the commitment of leadership, management, and staff (P1, P2, P4, P5, P6, P7, P8, P9), (Čiarnienė and Vienažindienė, 2012). In the context of South African public hospitals, initial commitment should come from government officials as well. The support and commitment of leadership during the implementation phase of Lean are crucial, as noted by (P9), who states that leadership vision and commitment are key drivers of sustainability. When leadership is fully behind a project, it is more likely to be sustained. Ensuring ongoing leadership buy-in and long-term commitment is essential for sustaining Lean practices, even when leadership positions change hands (Trakulsunti et al., 2020). Leadership should dedicate their time, resources, and support to the successful implementation of Lean, as highlighted in this study.

Another lesson for the implementation phase is to obtain staff support and buy-in. Management must engage staff (including unions) from the beginning to sell the benefits of Lean, address their questions and concerns, and ensure their commitment. Without the commitment of staff, Lean will not be successful (P3). If staff support and commitment are not obtained, there will be resistance from staff, which will hinder sustainability. The literature review indicates that staff did not support Lean intervention because they perceived it as invasive, irrelevant to their roles, lacked belief in Lean methods, and unions believed it would lead to job losses (Kruger, 2014). Management is advised to be sincere and transparent when engaging staff in the implementation of Lean (P3). Ambiguous statements and undertones will undermine the true intentions and cause staff to distrust the purpose of implementing Lean.

This study highlights the importance of fostering a deep understanding of the long-term philosophy of Lean during the implementation phase. Hospitals should not view Lean as a quick-fix project with a finite endpoint, but rather as a continuous improvement process that enhances performance over an extended period (P1, P6). Additionally, alignment with Lean principles should be prioritised during the implementation phase. It is crucial to emotionally connect the program with the people involved (D'Andreamatteo et al., 2015) as sustainability depends on building and maintaining the adaptive capacity needed to facilitate long-term transformations (Spangenberg, 2011) as explained in SS.

It is noted in this study that healthcare has a highly political, complex, and regulated work system. This system is characterised by powerful and respected professional groups, which makes it difficult to use management techniques compared to other industries (P1), (Radnor et al., 2012). These deeply ingrained or institutionalised ways of functioning may hinder the adaptation and implementation of Lean in the healthcare sector (Radnor et al., 2012). According to this study, hospitals are advised to first spend time learning and understanding cultural and structural preconditions before implementing Lean (P4), (Dahlgaard, Pettersen, and Dahlgaard-Park, 2011).

The study also notes that the majority of Lean consultants who provide external support during the implementation phase have a high level of Lean knowledge but lack sufficient understanding and knowledge of the healthcare context (P1). This lack of understanding creates negativity among healthcare staff (Drotz and Poksinska, 2014). To avoid unintended consequences, external consultants must conduct due diligence and establish the core status of the organisation and its culture (P3). According to (Arfmann and Barbe, 2014), it is not just knowledge of Lean methodologies, tools, and procedures that improves performance, but also an understanding of daily business reality that allows people to act and enhance performance. Knowledge of business realities will assist in avoiding the use of Lean tools produced elsewhere and not adapted to the current situation (P9).

Understanding Lean and the organisation, as well as subsequent alignment, are all part of the first training required during the implementation phase. This training should be helpful since it helps to gain staff buy-in and gives them a morale boost and confidence (motivation) to begin Lean implementation. This study discovered that

training gives employees knowledge power, and when employees are empowered, they perform better (P3).

Another lesson from this study is that Lean implementation should take place in a climate where failure is viewed as a learning opportunity rather than a punishment (P4). Management is urged to let employees launch Lean interventions without fear of failure because it is better to get people to try something, learn from it, and do it again if it works (P8). This is because it is simpler to persuade individuals to act their way into better thinking than to think their way into better acting (P8). Practical experience is an effective kind of training since learning through doing is one of the core pillars of sustainability in sustainability science.

This study highlights that Lean implementation initially begins as a project. However, since Lean is a continuous improvement methodology, it is necessary for implementation to gradually transition into a continuous process to ensure sustainability (P6). From this study, it can be learned that Lean should be implemented in stages, each building upon the success of the previous stages. It is crucial to commence implementation in areas where there is a high likelihood of success, as tangible results are essential to maintain motivation. Hospitals should refrain from initiating implementation in complex and wide-ranging areas, opting instead for less disruptive areas and conducting small interventions that yield quick results, as suggested by the interviewees:

> "*Start with tools that are simple to understand and easy to implement."* P9
>
> "*Start at the least clinical area to sell the concept of Lean and migrate to more clinical areas*." P6
>
> "*Don't try and boil the ocean but choose something specific that can give you early results, because early results motivate people*." P9

The implementation phase should achieve early, successful and tangible results to promote Lean and gain the trust of the other members who were in doubt. Early positive results motivate staff and create a good foundation for continuous improvement.

The lessons learnt from this study show that implementation phase theme has to integrate with some of the themes from other three pillars in creating a sustainability

foundation pillar. This study mentioned that pictures as part of visual communication are an effective means of communication because they simplify and enhance understanding on a single sheet. Figure 7 represents the core theme and integrating themes with their corresponding factors in one sheet to enhance the understanding of how sustainability foundation is constructed.

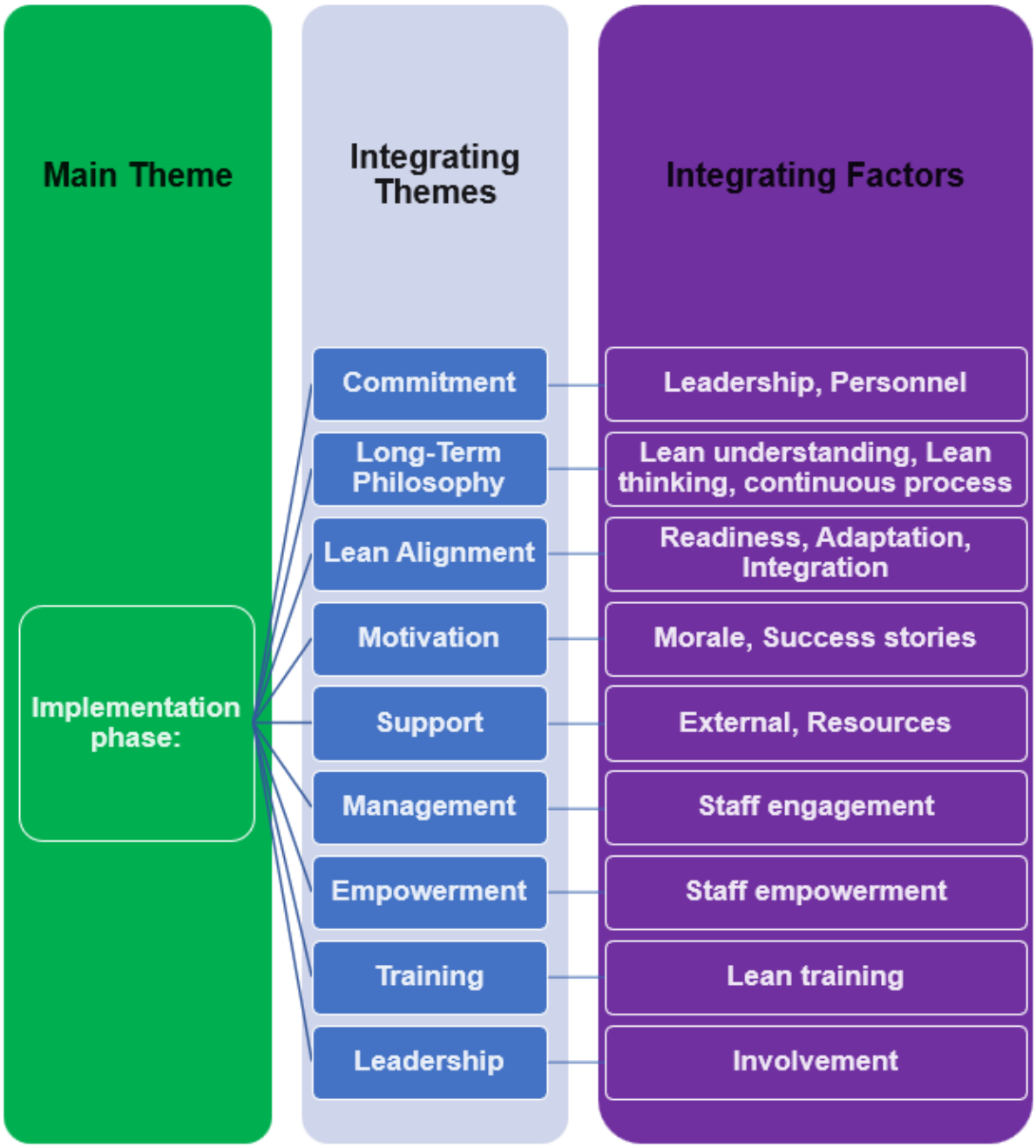

Figure 7: Integrated themes of the Sustainability Foundation pillar (created by author)

These summary lessons can be used as guidelines when creating a Lean foundation or as checkpoints to verify if the foundation has been created correctly to achieve sustainability.

6.3.2 Concept of Lean Pillar

This study has shown that successfully implementing Lean requires a thorough understanding of its long-term philosophy (P1) and how it aligns with the organisation. Prioritising the understanding of the long-term philosophy is crucial because there are no shortcuts to comprehending the fundamental principles and underlying assumptions of Lean (Radnor et al., 2012). This understanding allows hospitals to apply Lean from a philosophical perspective (P1).

Hospitals must recognise that Lean philosophy involves a shift in mindset towards Lean thinking in the workplace (D'Andreamatteo et al., 2015). Lean thinking involves adopting and consistently applying a strategic direction throughout the entire company, with a clear focus on the value to be achieved (P3, P5, P9). For example, interviews have highlighted the importance of this approach:

> "*Change mindset as in: "keep the hospital clean instead of clean the hospital*" P7

Communication regarding Lean should be in a language that the hospital workforce can understand. Hospitals are advised to translate Lean language into simple, comprehensible hospital language (P7). Once the language has been translated, Lean must be adapted and aligned with the organisation. Aligning Lean prepares it to be integrated into the organisational systems, transforming the current organisational culture into a new Lean-based culture. Sustainability science (SS) emphasises that Lean should be interdisciplinary and able to be integrated with other disciplines in pursuit of sustainability (Spangenberg, 2011). Lean should be integrated into the organisational systems to prevent it from being seen as extra work or a burden (P4). Lean should be aligned with job agreements and performance agreements so that people can view it as a new and efficient way of carrying out their work (P9).

While this study encourages hospitals to initially implement Lean in isolated small sections to achieve early success, it is important to note that sustainable benefits can

only be achieved if it is consistently applied throughout the hospital in a holistic and cross-sectional manner (Kilpatrick, 2003). Implementing Lean in small segments should be a short-term strategy to establish best practices, attain early successes, and motivate staff (P9). Selectively implementing Lean in small segments may yield short-term success, but in the long run, it would be detrimental to the entire organisation or value chain (Pakdil et al., 2020). Long-term sustainability can only be attained when the implementation has been holistically spread across all sections of the organisation, and early successes are continuously improved upon.

In conclusion, the concept of Lean pillar lessons from this study show that long-term philosophy and Lean alignment themes have to integrate with motivation and communication themes to effectively contribute to the sustainability of Lean. Figure 8 represents the core themes and integrating themes with their corresponding factors in one sheet to enhance the understanding of how the concept of Lean pillar is constructed.

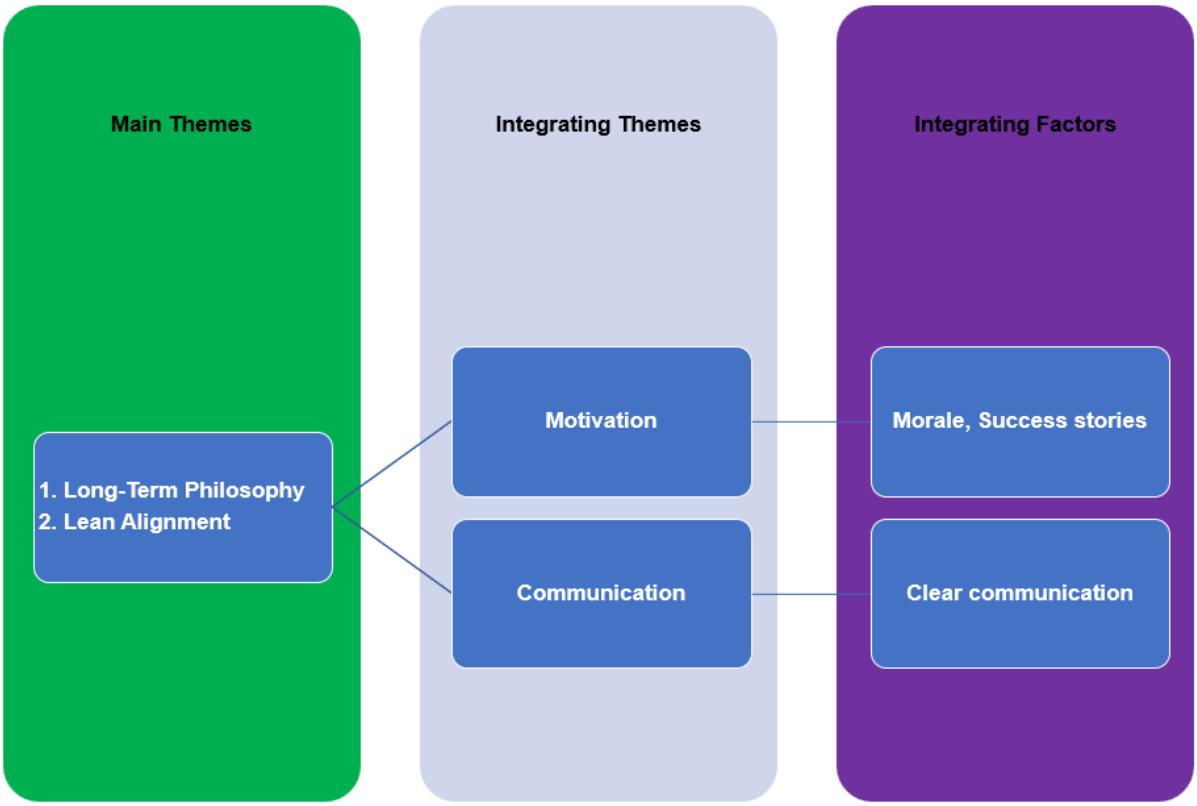

Figure 8: Integrated themes of the Concept of Lean pillar (created by author)

These summary lessons can be used as guidelines or as checkpoints to verify if the Lean concept has been dealt with correctly to achieve sustainability.

6.3.3 People

This study mentions the importance of hospitals having competent individuals who can effectively implement Lean and sustain it in the long term. Without the right people with the necessary skills, Lean cannot bring any benefits to the organisation (Liker and Morgan, 2006). The study highlights that implementing Lean requires a cultural change, involving the transformation of soft management qualities such as leadership, people management, and teamwork, to develop a new organisational culture (OC).

To manage the cultural change and avoid conflict and confusion, hospitals must have individuals who can grasp and understand the long-term philosophy of Lean and the ambiguity it brings to the organisation. Hospitals must have leaders with strong management qualities who can navigate the challenges of Lean alignment and integration into the organisation. Achieving sustainability in Lean healthcare is not just about identifying the problems, but also about undergoing a transformation process that adopts an integrated, comprehensive, and participatory approach (Sala et al., 2013).

Leadership and management positions require individuals who not only claim to accept Lean but also actively participate in Lean events (P4). To ensure the sustainability of Lean, hospitals need committed leaders who are actively engaged throughout the Lean process. The behaviour of the leader is the single and necessary, but insufficient, condition for Lean sustainability (P8). The leader sets the tone, opens doors, and drives progress (P8). This study advises hospitals to maintain competent leadership in place, as the departure of a leader, whether mentally or physically, is a major contributor to Lean failure and the lack of sustainability (P8). The study recommends that leadership should assist hospitals in gaining government approval for Lean intervention and securing resources for implementation. Leadership should also work towards obtaining buy-in from the management team and staff to support and actively participate in the implementation of Lean.

Sustainability requires that management integrate themselves into the teams and participate in the Lean journey (P4). This study teaches about the responsibility of management to drive participation, collaboration, and teamwork to achieve the sustainability of Lean. Successful implementation of Lean relies on empowering employees to become change agents through a team-based approach (P3, P9), (D'Andreamatteo et al., 2015). Additionally, management must actively engage in teamwork by conducting Gemba walks on the work floor, where discussions about waste, solutions, and continuous improvements take place. Failure by management to integrate different teams of stakeholders and to fulfil the needs of user groups are major reasons why teams are resistant to change and adopting a new working culture (Maramba et al., 2020). Staff members play a crucial role in optimising the patient journey process and possess valuable insights on how to achieve customer satisfaction. To drive Lean implementation, it is essential to empower staff with support from management (P5).

The study highlights that Lean implementation has resulted in improved staff satisfaction and motivation (Naidoo, 2015). Therefore, the study recommends that hospitals should keep their employees motivated to sustain Lean implementation, as motivation instils confidence and encourages ongoing implementation of Lean (P2). To maintain motivation, it is crucial to recognise and praise employees for their good performance, as a lack of acknowledgement can lead to demoralisation (P2). Additionally, staff motivation can be enhanced by sharing success stories and offering personal rewards and benefits.

Fusheini et al. (2017) identified several problems facing public healthcare in South Africa, including skills gaps, managerial competencies, and teamwork issues between clinical and administrative leadership. The lack of operational management skills often leads to management interference in medical matters instead of focusing on operational governance (P3), resulting in conflicts. Therefore, the study recommends providing adequate and relevant training to individuals to enhance their knowledge and enable them to meet job requirements (P6).

This study suggests that leadership, management, and staff should have a level of competence that aligns with their positions to effectively perform their jobs (Andersen et al., 2014). Competence in sustainability refers to possessing the necessary

knowledge, skills, and attitudes for problem-solving and finding solutions to sustainability challenges (Wiek et al., 2011b). Given the unique nature of sustainability problems, it is crucial to have a set of interlinked and interdependent key competencies for identifying, analysing, and addressing these issues (Wiek et al., 2011b). The field of sustainability science emphasises the importance of these key competencies in determining the knowledge and skills profile of problem solvers, change agents, and transition managers. Specifically, the literature highlights the significance of systems-thinking competence, anticipatory competence, normative competence, strategic competence, and interpersonal competence for effective management in sustainability (Wiek et al., 2011a). These competencies should serve as the foundation for acquiring problem-oriented and conceptual knowledge, methodological knowledge, the ability to apply knowledge in practice, and interpersonal and collaborative skills necessary for sustainability in Lean.

In conclusion, the people pillar lessons from this study show that core themes of the pillar have to integrate with some themes from organisational culture and concept of Lean pillars to effectively contribute and drive the sustainability of Lean. Figure 9 represents the core themes and integrating themes with their corresponding factors in one sheet to enhance the understanding of how the people pillar is constructed.

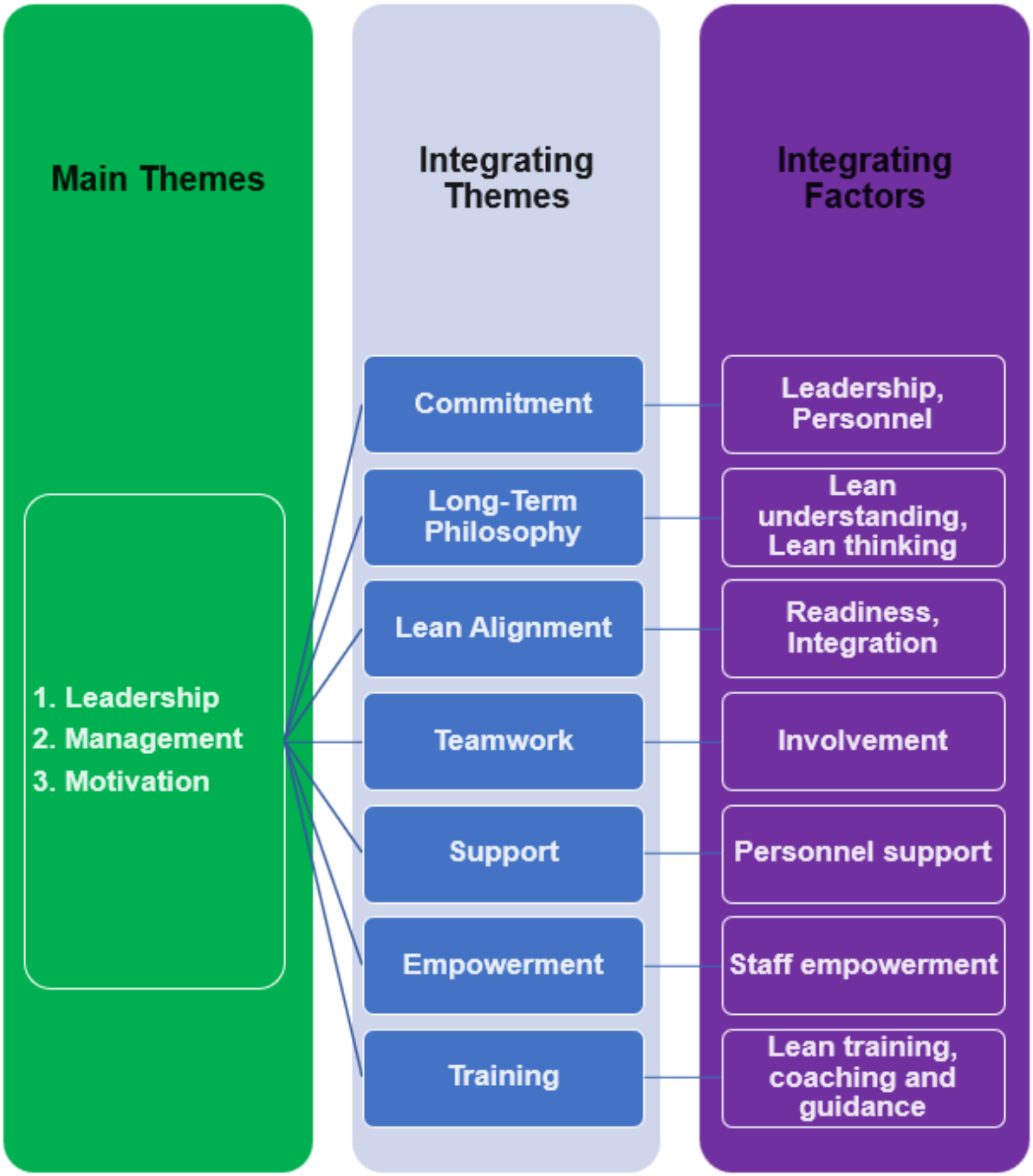

Figure 9: Integrated themes of the People pillar (created by author)

These summary lessons can be used as guidelines to verify the quality and competency of people in the organisation. They also include items that can verify the state people should be in when implementing Lean to achieve sustainability.

6.3.4 Organisational Culture

To transform the strategic direction and planning of a hospital, Lean must be integrated into the entire process (P3, P5, P9). According to Hallam and Contreras (2018), a successful Lean transformation requires strategic adoption of Lean tools and changes in culture. Implementing Lean leads to a new culture of continuous improvement (Radnor et al., 2012), which is often the biggest challenge in healthcare. This highlights the importance of understanding how Lean interacts with the existing healthcare culture (Joosten et al., 2009) to establish a new Lean culture. According to this study, a new Lean culture in an organisation should embody the following characteristics to ensure sustainability: support, commitment, teamwork, empowerment, healthy competition, communication, and training.

It has been found in this study that healthcare organisations should have a supportive culture to achieve sustainability. Hospitals must seek support from the government to obtain the necessary resources such as funds and personnel (including external consultants) to initiate and maintain Lean long-term. Without government support, Lean intervention will fail because public hospitals face inadequate resource distribution (Maphumulo and Bhengu, 2019), and the government controls the running of the hospitals.

Another lesson from this study is the role of external consultants in providing support to organisations during Lean implementation. Hospitals should note that external consultants cannot make the business Lean, but they can mentor and help staff think and act Lean (P1). Consultants can initiate the Lean process, but implementation and sustainability depend on the internal staff within the organisation (P5, P6). External consultants possess high-level knowledge of Lean but limited knowledge of the organisation and its people (Drotz and Poksinska, 2014). External consultants support sustainability goals by imparting Lean knowledge to staff through training, coaching, and mentoring.

Additionally, this study highlights the importance of internal Lean champions who can learn from external consultants and support the implementation process (P6). Champions should be recruited from different sections and departments to promote teamwork and collaboration. To foster a supportive culture, all departments and

personnel must be involved, support each other, and work as a team in sustaining the Lean journey.

Hospitals should aim to create a culture of teamwork to sustain Lean. This study reveals that the complexity of hospitals is a result of the health system but does not contribute to the patient journey (P9). To break down silos, hospitals should establish cross-functional Lean teams to encourage collaboration and teamwork. According to sustainability science (SS), collaborative efforts among all stakeholders lead to increased legitimacy, ownership, and accountability for both the problem and the solution options (Lang et al., 2012). Teamwork ensures that Lean becomes everyone's responsibility and is approached in a multidisciplinary manner where everyone is respected and considered equally important. Sustainability requires new approaches that involve collaboration among different disciplines and societies in problem identification, analysis, solution generation, and results-oriented application (Brandt et al., 2013). As stated in SS, sustainability is characterised by the integration of knowledge and collaboration across different sections and levels of society.

Commitment is an integral part of the Lean culture that affects its sustainability, as revealed by this study. Hospitals should commit to Lean implementation, even at the expense of short-term financial losses or failures, to establish a culture of continuous improvement. Hospitals must persevere and stay focused on growth and continuous improvement (P1, P2). Leadership commitment is the most critical factor mentioned in this study. If leadership is committed to a project, it is more likely to be sustained (P9). The culture of commitment requires commitment and buy-in from leadership, middle management, and staff, where everyone has a role to play in the team.

Staff empowerment is a key factor in the sustainability of Lean efforts (Flynn et al., 2019). In a study by Dahlgaard et al. (2011), it was found that a progressive implementation strategy involves empowering individuals to fully participate in the initial step of developing a Lean healthcare culture. Empowering staff is beneficial (P3) and they must view Lean implementation as a means of empowering themselves to perform better (P9). Hospitals must engage their staff and encourage them to take the lead in implementing Lean (Čiarnienė and Vienažindienė, 2012). This can be achieved by providing staff with adequate training, coaching, and support (P5, P6, P7).

Additionally, hospitals should create an environment that allows staff to express their skills and creativity, take initiative, explore new ideas, and achieve results.

Communication is another crucial characteristic identified in this study for the sustainability of Lean (Sobek and Lang, 2010). Hospitals should communicate about Lean in an open and purpose-driven manner (P5, P6, P9), using language and context that is easily understandable and relatable for staff. Effective communication supports teamwork by facilitating interaction and collaboration across different sections of the organisation. It is important to establish honest communication from the implementation phase, soliciting buy-in from the government, and gaining commitment from management and staff. This study also recommends using visual communication to convey Lean activities and results, as pictures are universally understood (P6).

The study also highlights the importance of fostering healthy competition among staff, different sections, or even hospitals as an organisational characteristic that promotes the sustainability of Lean. Internal healthy competition encourages relationship building, interaction, and learning among staff. Competition between departments helps foster understanding of different functions and breaks down silos. This competition can be used as a benchmark to identify and share best practices among different sections (P6, P7).

Furthermore, this study emphasises that Lean implementation is just the beginning of a continuous learning journey for hospitals (Liker, Morgan, 2006). Hospitals should invest in proper Lean training (P1, P2, P8, P9) to build Lean knowledge over time and empower their staff (P6). Lean training should teach individuals to identify waste and take action (P1). Coaching and guidance from external consultants, champions, leadership, and management also play a crucial role in training and can help break down silos (P5, P6, P7). To sustain Lean knowledge, hospitals should conduct continuous workshops to introduce new staff members (P2).

6.4 Conclusion

This chapter discusses the findings and creates a relationship between different themes. It also discusses lessons learned from this study that can assist South African hospitals in achieving Lean sustainability. These lessons are based on creating a

foundation and integrating people, Lean and characteristics of OC to achieve Lean sustainability. The study also demonstrates that themes derived from factors affecting the sustainability of Lean are interconnected and coexist within different pillars.

Chapter 7: Conclusion

This chapter will conclude this study by first summarising the study using research questions and objectives. This will be followed by reviewing the study's purpose and aim if they were achieved. Then will discuss study limitations and lastly deal with recommendations for future research.

7.1 Summary of the Study

The summary will be done by verifying if the research objectives of the study were achieved.

Objective 1: To explore factors affecting the sustainability of Lean healthcare in South African public hospitals.

A semi-structured interview method was used to explore factors from nine practitioners who have been involved with Lean in South African public hospitals. Data from the interviews were described and synthesised into 44 factors and 13 themes. The interview findings are described in Chapter 4.

Objective 2: To explore factors affecting the sustainability of Lean healthcare in hospitals from published literature.

This study used a systematic literature review (SLR) to collect data from the literature to identify factors affecting the sustainability of Lean in healthcare. Data collected was restricted to hospitals only. The shortage of literature resulted in only seven articles that were available for review. 46 factors that affect the sustainability of Lean in healthcare were identified by reviews and synthesised into 13 themes. Findings from SLR are described in Chapter 4.

Objective 3: To appraise or evaluate factors from South African public hospitals against factors from published literature.

Factors from practitioners were analysed and evaluated against factors identified from the SLR in Chapter 5. Interview factors were found to be comparable to international

factors except for a few differences related to government and unions that are unique to the South African environment.

Objective 4: To draw lessons that can sustain Lean healthcare in South African public hospitals.

Lessons were drawn and discussed in Chapter 6 under the foundation, people, the concept of Lean and organisational culture as four sustainability pillars.

It can be concluded that this study answered all researched questions and fulfilled the objectives.

The study aimed to identify factors that affect the sustainability of Lean healthcare in South African public hospitals as prompted by the problem statement. The aim of the study has been achieved by achieving all the research objectives. This study provides research information that can be used by South African public hospitals to sustain Lean implementations.

7.2 Limitations and Recommendations for Future Research

The phenomenon researched by this study is the sustainability of Lean healthcare: A practitioner's perspective. The study was limited to South African public hospitals, and there is room to expand it to include private hospitals and other healthcare centres including primary healthcare centres.

This study was limited by the extent to which lean has been implemented in South Africa. The spread of the Lean introduction will provide more experience and perspectives that practitioners would have about sustainability.

To control the scope of this study, it only presented, described and illustrated its findings, there is room to create and design a scientific framework that can be used to achieve sustainability.

The study was limited to A practitioner's perspective, so there is room to include hospital staff to get first-hand information from implementers. There is also an opportunity to involve patients as beneficiaries of Lean value creation in the interviews.

7.3 Concluding Researcher remarks

The sustainability of Lean in healthcare is not yet understood and there is little research done on it. Implementation of Lean is done out of frustration and hospitals expect results immediately without understanding the basic concept of Lean. Sustainability depends on understanding the basic meaning of what Lean is and how it should be applied. It also depends on the understanding of the organisation and its people before implementation. Lean and organisation should be properly aligned to allow for their integration to be successful. Lean should not be defined outside the organisation and be seen as foreign. The process of sustainability depends on the mindset and the intentionality of changing the organisational culture. The focus of implementations should not be on results but on getting the process right. It is about learning every day and making today better than yesterday.

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Appendix 1

Table of types of research design methods as per (Creswell, 2003)

Types of research methods as per (Creswell, 2003)		
Quantitative	**Qualitative**	**Mixed**
Predetermined methods	Emerging methods	Both
Instrument-based questions	Open-ended questions	Both
Performance, attitude, observational and census data	Interview, observational, document and audiovisual data	Multiple forms of data drawing on all possibilities
Statistical analysis	Text and image analysis	Statistical and text analysis
Uses postpositivist claims for developing knowledge	Makes knowledge claims based on constructivist perspectives	Bases knowledge claims on pragmatic grounds
Employs strategies of inquiry such as experiments and surveys	Employs strategies of inquiry such as ethnography, narratives, case studies	Employs strategies of inquiry involving either the simultaneous or sequential collection of data
Collects data on predetermined instruments that yield statistical data	Collects open-ended, emerging data with the intent of developing themes from the data	Collects both numeric information and text information

Appendix 2

Table of qualitative approaches of enquiry as per (Creswell and Poth, 2016)

Contrasting Characteristics of Five Qualitative Approaches (Creswell and Poth, 2016)					
Characteristics	**Narrative research**	**Phenomenology**	**Grounded theory**	**Ethnography**	**Case study**
Focus	Exploring the life of an individual	Understanding the essence of the experience	Developing a theory grounded in data from the field	Describing and interpreting a culture-sharing group	Developing an in-depth description and analysis of a case or multiple cases
Type of problem best suited for design	Needing to tell stories of individual experiences	needing to describe the essence of a lived phenomenon	Grounding a theory in the views of participants	Describing and interpreting the shared patterns of culture of a group	Providing an i-depth understanding of a case or cases
Descipline background	Drawing from the humanities including anthropology, literature, history, psychology, and sociology	Drawing from philosophy, psychology, and education	Drawing from sociology	Drawing from anthropology and sociology	Drawing from psychology, law, political science, medicine
Unit of analysis	Studying one or more individuals	Studying several individuals that have shared the experience	Studying a process, action, or interaction involving many individuals	Studying a group that shares the same culture	Studying an event, a program, an activity, more than one individual
Data collection forms	Using primary interviews and documents	Using primary interviews with individuals, although documents, observations, and art may also be considered	Using primary interviews with 20-60 individuals	Using primary observations and interviews, but perhaps collecting other sources during extended time in field	Using multiple sources, such as interview, observation, documents, artifacts
Data analysis strategies	Analysing data for stories, "restorying" stories, developing themes, often using chronology	Analysing data for significant statements, meaning units, textural, and structural description, description of the essence	Analysing data through open coding, axial coding, selective coding	Analyzing data through description of the culture-sharing group, themes about the group	Analysing data through description of the case and themes of the case as well as cross-case themes
Written report	Developing a narrative about the stories of an individual's life	Describing the "essence" of the experience	Generating a theory illustrated in a figure	Describing how a culture-sharing group works	Developing a detailed analysis of one or more cases

Appendix 3

Interview Questions

Introductory questions

Please introduce yourself and give a short overview of your experience in Lean healthcare

- What was your role?

How many years of experience do you have in Lean healthcare?

- Do you have any Lean-specific training?

Please summarise your involvement in Lean healthcare

Research Questions

Note: Please answer according to your own experience.

1. What would be the highs and lows of your Lean healthcare involvement?
2. What is your view on Lean healthcare sustainability?
3. What would be the factors that you think positively affected the sustainability of Lean healthcare?
4. What would be the factors that you think negatively affected the sustainability of Lean healthcare?
5. What would be your advice on Lean healthcare sustainability?
6. What would be your conclusion on Lean healthcare sustainability?
7. Do you have anything more to say about the study or this interview?

Closing remarks

Appendix 4

Table of Interview Coded Data

No	Evidence statement	Coded Lines
1	Lean implementation should be driven from the philosophic perspective and owned by everyone	Lean implementation
1	Life-long pursuit of growth	Long term commitment
1	Create the value system within the organisation	Value system
1	The language used should be aligned with the health	Language adaptation
1	Using the correct language	Language adaptation
1	Consultant not doing it correctly by implementing Lean as a tick box exercise	Lean implementation
1	Consultants tend to focus on tools instead of philosophy	Long-term philosophy
1	Implementation should be well thought of	Implementation plan
1	Lean cannot be commissioned like a machine where it is plugged and switched on to run then make sure it keeps running with maintenance when needed.	Lean implementation
1	Lean is not branded correctly	Lean understanding
1	Accepting there is no completeness stage	Long-term philosophy
1	If it comes from mind and philosophy then sustainability is possible	Lean thinking
1	It is not about the tools but the mentality to improve efficiency.	Lean thinking
1	Lean as a philosophy is about seeing waste first and then using tools to eliminate it	Lean thinking

1	Lean is a religion and set of beliefs (philosophy) it is a value system. Lean is a way you think	Lean thinking
1	Deployment of champions in the organisation	Lean champions
1	External consultants can not make business lean but can only mentor and help staff to think and act lean.	External support
1	Leveraging on consultants to transfer information to staff	External support
1	Doctors are complicated and certain about their competence.	Personnel involvement
1	Health is very political and power-driven	Silos
1	No buy-in from staff	Staff buy-in
1	Invest in Lean Training	Lean training
1	Teach people to see waste as a start and act on it	Training
2	Commitment from the CEO to make Lean work	Leadership commitment
2	Buy-in from management and support	Teamwork
2	Management support	Support
2	Perseverance, start projects to the end	Lean commitment
2	Don’t lose focus or direction and leave things unfinished	Commitment
2	Management to participate by doing a Gemba walk	Gemba walk
2	Management to listen to staff and implementers	Listening management
2	Management humility (humble) to be maintained	Humble management

2	There must be proper planning, execution and monitoring	Planning, execution and monitoring
2	Sell Lean as a mistake eliminator	Lean thinking
2	Focus on what you can influence or change	Implementation
2	Clear goals and intentions of implementation	Lean implementation
2	Staff morale was high	Staff morale
2	Staff engage at free will with motivation to make a difference	Personnel involvement
2	Praise good performance to improve motivation	Performance appraisal
2	Keep the process of Lean interesting and keep staff engaged	Personnel engagement
2	Engage staff and provide them platform to express their views and suggestion	Staff empowerment
2	Allowed staff to drive implementation	Staff empowerment
2	Decisions should be made where work is done	Staff empowerment
2	Responsibility remains with the staff	Staff empowerment
2	Management to provide resources required based on demand	Resources
2	Support staff - engage other departments	Personnel support
2	Staff resistance and ill-discipline will negatively affect sustainability	Personnel involvement
2	Respect for each other and create a multi-disciplinary approach	Multi-disciplinary approach
2	Respect for each other	Motivation
2	Teamwork where all are important in addressing issues	Personnel involvement
2	Make Lean everybody's business	Personnel involvement

2	Proper training	Proper training
2	Staff train each other	Staff training
2	Continuous workshops to introduce new entrants	Continuous workshops
2	Continuous benchmarking, learning from others	Healthy competition
2	Process plan to show success and results	Results and success
2	Show reasons and objectives to be achieved within silos	Management
2	Engage each staff on the goals and their responsibilities	Engage staff
2	Open reporting	Open reporting
2	Must not disturb the flow but engage staff at their own meetings and working area	Lean implementation
3	Leadership buy-in and commitment	Leadership commitment
3	Employee engagement including unions to sell the benefits of lean and alleviate fears	Staff engagement
3	Overemphasis on some issues (results) including cost confuses the purpose of Lean	Implementation challenges
3	Lack of operational management skills where they intervene in medicine instead of management	Management skills
3	Gemba	Gemba walks
3	Change management	Management skills
3	Performance management and feedback are important to help improve	Performance management
3	Job profiles and responsibilities should be explicit and clear	Performance management

3	Understanding the Lean language	Language adaption
3	Flexibility and adaptability of Lean practices	Adaptability
3	Align Lean with strategic planning	Strategic alignment
3	Implementation challenges have a negative effect	Implementation challenges
3	Resistance from staff makes the implementation to fail	Staff resistance
3	Misapplication of Lean	Lean application
3	Misunderstanding of the hospital environment to avoid unintended consequences	Organisational readiness
3	Do due diligence, establish status core	Organisational readiness
3	Improved patients outcomes influence the morale of patients and staff	Morale
3	Improved operational efficiency	success stories
3	Staff empowerment helps them to work better	Staff empowerment
3	Silos and bureaucracy and hierarchy, the right-hand doesn't know what the left is doing	Collaboration
3	Culture and size of the hospital where staff are involved in some of the things outside their work eg research	Staff involvement
3	Attitude of doctors and their status	Staff involvement
3	Lack of integration within or across sections	Integration
3	Collaboration and teamwork	Collaboration
3	Lean must be spread across different section	Collaboration
3	Prioritise Training to foster continuous improvement	Training

3	Successful and visual results should be shown to promote the benefits of Lean	success stories
3	Value stream mapping to help with the patient journey	Lean tools
3	Set goals and evaluate them later not for punitive reasons but to learning	Performance management
4	Tangible benefits and results of Lean implementation	Success stories
4	Leadership buy-in in commitment	Leadership commitment
4	Don't impose implementation but engage employees voluntarily (forcing Lean into staff will create resistance and only do it because they have to without interest	Staff engagement
4	Gemba	Gemba walks
4	Organisational structure	Readiness
4	Align Lean language to healthcare	Language alignment
4	Understanding of hospital by consultants	Readiness
4	Avoid plug-and-play strategy without adaptation	Adaptation
4	Avoid wide but choose small interventions and show results	Lean implementation
4	Prioritise philosophy understanding and tools later	Lean understanding
4	Motivation - personal benefits derived from Lean	Benefits
4	Choose willing champions and participants to help promote the implementation	Lean champions
4	Leadership participation and involvement	Personnel involvement
4	Buy-in from staff	Personnel involvement

4	Buy-in from physicians, get a few to buy in and help promote Lean	Personnel involvement
4	Management must not impose themselves but rather gain staff buy-in and integrate themselves into the team	Integrated teams
4	Continuous Training on the floor	Training
4	Continuous intervention and training	Training
5	Commitment from management and government	Leadership commitment
5	Open communication	Open communication
5	Lean must be integrated into the whole hospital process but not as an intervention	Lean integration
5	Lean aligned to the strategic direction	Strategic alignment
5	Get the basics right	Readiness
5	Human involvement, how are they involved in this journey	Personnel involvement
5	Shouldn't be an event but a never-ending process	Continuous process
5	Understanding of philosophy	Lean understanding
5	Returns on Lean implementation	Success stories
5	Empower staff to make decisions	Staff empowerment
5	Continuous Guidance on Lean	Continuous guidance
5	Sustainable budget and resource allocation	Resources
5	Support structures	Support structures
5	Support from management	Personnel support
5	Sustainability is driven by people with support from management	Staff empowerment

5	Teamwork	Teamwork
5	Staff buy-in	Staff involvement
5	Management buy-in	Management involvement
5	Staff involvement	Staff involvement
5	Teamwork	Teamwork
5	Training and guidance is needed for Lean implementation	Lean training
5	Optimum process layout to allow seamless operation	Management
5	Measure, analyse and feedback	Performance management
5	Performance management	Performance management
5	Good information flow	Information flow
5	Lean can only be sustained by the people within the organisation, not outside consultants.	Personnel involvement
6	Leadership commitment	Leadership commitment
6	Leadership involvement and leading from the top is a must	Leadership involvement
6	Open communication	Open communication
6	Create internal healthy competition	Create competition
6	Management by objectives vs by walking around (Gemba)	Gemba walks
6	Walk the talk	Leadership involvement
6	Change management	Change management

6	Fostering change within people	Change management
6	Leadership/ vertical. Ownership/ horizontal	Change management
6	Succession planning	Succession planning
6	Must not be treated as an external project	Integration
6	Understand organisational structure	Readiness
6	Get early wins	Success stories
6	Start at the least clinical area to sell the concept and migrate to more clinical areas	Lean implementation
6	Least intrusive area, or sensitive area	Lean implementation
6	A long-term view of Lean and not to be used as a quick fix	Long term philosophy
6	Understanding the full picture	Lean understanding
6	Acknowledge and recognition	Acknowledge and recognition
6	Success is the biggest motivation	Success stories
6	Team-based recognition vs individuals	Recognition
6	Possibilities to grow should be there for outstanding personnel	Encourage growth
6	Enthusiasm from middle management and frontline	Personnel involvement
6	Involve frontline staff	Personnel involvement
6	Process ownership to be left on the floor	Staff empowerment
6	Engage people	Personnel engagement
6	Having champions	Lean champions
6	Continuous support from management	Management support
6	Corporate sponsorship and leadership	Cooperate sponsorship

6	Buy-in from staff	Personnel involvement
6	Consultants can only ignite the process but Lean fully depends on the internal staff	Personnel involvement
6	Interrelationships in a value stream	Interrelationships in the team
6	Move discussions from silos or blame games into teamwork	Teamwork
6	Cross-functional team, kaizen points in the value streams	Cross-functional teams
6	Guidance from management and champions	Guidance
6	Train and capacitate	Training
6	Grow-Lean knowledge over time	Lean training
6	Share wins with the broader audience	Success stories
6	Value stream mapping	Lean tools
6	Visual management	Lean tools
6	Pictures are the best way to communicate	Communication
6	Measuring performance, analysing,	Performance management
6	Continuous project management	Performance management
6	Pause evaluate and standardise the improvement	Performance management
7	wrong perception	Perception
7	Responsibility remains on the floor	Staff empowerment
7	Benchmark from outside	Benchmark
7	Understanding of the organisation	Readiness

7	Go with a blank mind	Perception
7	Install confidence	Instill confidence
7	Gemba	Gemba walk
7	Visit areas that have done the work	Gemba walk
7	Translate Lean into healthcare language	Lean alignment
7	Sell the value of Lean	Engage staff
7	Change management/ mindset change/ understand the reasons	Change management
7	Decode the Lean language into simple understandable language	Lean alignment
7	Adaptation	Adaptation
7	Pride of success and results	Success stories
7	Motivated staff	Motivation
7	Allow staff to fail and or initiate	performance management
7	The decision should be taken on the floor	Staff empowerment
7	Support from Leadership	Leadership support
7	Resources and support	Resources
7	Need champions to take responsibility	Lean champions
7	Buy-in from Leadership	Personnel involvement
7	Expand cross-sectional	Cross-sectional
7	Create a healthy competition between departments	Create healthy competition
7	Coaching allows management to break silos	Coaching
7	Involve everyone	Personnel involvement

7	Everybody has a place in the team and they play their role	Personnel involvement
7	Train and coach frontline staff	Training
7	Train the trainer	Training
7	Develop people to understand Lean, coach them and graduate them	Training
7	Visual management	Lean tools
7	standardisation and predictability	Work standardisation
7	Give staff the floor and the opportunity to present their work	Staff empowerment
7	Orientation to fellow staff	Orientation
8	Leadership availability, behaviour and buy-in	Leadership commitment
8	Allow staff to implement change	Staff empowerment
8	Gemba	Gemba walks
8	Involved in problem identification and solution	Gemba walks
8	Leadership consistency	Leadership quality
8	Leadership being part of the team	Personnel involvement
8	People's management, no command and control	Management style
8	Succession planning	Succession planning
8	Positive management	Leadership quality
8	Learn from mistakes instead of punitive measures	Performance management
8	Lead with humility	Leadership quality
8	Involved CEO	Leadership involvement
8	Leaders must facilitate problem solving	Leadership involvement

8	Lead by asking questions and not imposing solutions	Leadership involvement
8	Treat Lean as a management system	Integration
8	Staff must see the benefits of Lean interventions	Success stories
8	Stability of staffing and job security	Motivation
8	Respect every individual	Respect for people
8	Develop problem solvers	Lean champions
8	Learn from each other and compete	Create competition
8	Buy-in from middle management and staff	Personnel involvement
8	Collaborative exercise	Collaboration
8	Problems are solved on the floor	Staff empowerment
8	Understanding across different sections	Cross-sectional
8	Training	Training
8	The routine of recording important things	Performance management
8	Make results visible	Performance management
8	Visual management	Lean tools
8	Open and visualise results	Performance management
8	Updated visual management board	Lean tools
8	Feedback is the most powerful drive for improvement	performance management
9	Leadership vision and commitment	Leadership commitment
9	Start with tools that are simple to understand and easy to implement	Lean implementation

9	Fix simple processes first to get early wins	Lean implementation
9	Change must be seen early and maintained	Lean implementation
9	Managing for unintended consequences	Leadership quality
9	Lean should be aligned with the strategic direction of the institution	Strategic alignment
9	Lean should be integrated into job profiles and performance agreement	Integration
9	Avoid cutting and pasting lean tools	Adaptation
9	Use simple language to avoid confusion	Adaptation
9	Staff must see lean as empowerment to do their work	Staff empowerment
9	Lean must not be seen as more work	Perception
9	Staff psychology safety and job security	Perception
9	Lean helps staff achieve their targets and be rewarded	Rewards
9	Staff satisfaction	Benefits
9	Use early wins to promote Lean	Success stories
9	Resource constraints and limitations	Resource support
9	Buy-in from staff	Personnel involvement
9	Silos work against improvement	Collaboration
9	Integration across different sections	Integrated teams
9	involve stakeholders in identifying waste	Personnel involvement
9	Training	Training
9	Open and purpose-driven discussion around lean	Communication
9	Understand how Lean can help staff to better perform and achieve better results	Lean understanding

Appendix 5

Table of Interview factors identified

Participants	Line by Line codes	Extracted Factors	Theme
2	Commitment from the CEO to make Lean work	Leadership commitment	Commitment
3, 4, 5, 6,9	Leadership and government buy-in, commitment and vision	Leadership commitment	Commitment
8	Leadership availability, behaviour and buy-in	Leadership commitment	Commitment
2	Perseverance, start projects to the end	Long term commitment	Commitment
1	Life-long pursuit of growth	Long term commitment	Commitment
2	Don't lose focus or direction and leave things unfinished	Long term commitment	Commitment
4	Buy-in from physicians, get a few to buy in and help promote Lean	Personnel commitment	Commitment
1, 2, 4, 5, 6, 7, 8, 9	Buy-in from leadership, middle management and staff and everybody has a place in the team and they play their role	Personnel commitment	Commitment
5, 6, 9	Open and purpose-driven discussion around lean	Open communication	Communication
5	Good information flow	Open communication	Communication

6	Pictures are the best way to communicate	Visual Communication	Communication
2, 5, 6, 7, 8	Process ownership is to be left on the floor where decisions are taken and problems are solved	Staff empowerment	Empowerment
5	Sustainability is driven by people with support from management	Staff empowerment	Empowerment
9	Understand how Lean can help staff to better perform and achieve better results	Staff empowerment	Empowerment
2, 7	Engage staff and provide them platform to express their views and suggestion	Staff empowerment	Empowerment
2, 8	Allowed staff to drive implementation	Staff empowerment	Empowerment
3	Staff empowerment helps them to work better	Staff empowerment	Empowerment
9	Staff must see lean as empowerment to do their work	Staff empowerment	Empowerment
6, 7	Create internal healthy competition amongst staff and between departments	Create competition	Healthy competition
2,7,8	Continuous benchmarking, learning from others	Benchmarking	Healthy competition
4	Don’t impose implementation but	Staff engagement	Implementation phase

	engage employees voluntarily (forcing Lean into staff will create resistance and only do it because they have to without interest		
3	Resistance from staff makes the implementation to fail	Staff engagement	Implementation phase
1, 2	Implementation should be well thought out with clear goals and intentions of implementation	Implementation plan	Implementation phase
1	Consultant not doing it correctly by implementing Lean as a tick box exercise	Implementation process	Implementation phase
1	Consultants tend to focus on tools instead of philosophy	Implementation process	Implementation phase
2	There must be proper planning, execution and monitoring	Implementation process	Implementation phase
9	Start with tools that are simple to understand and easy to implement	Implementation process	Implementation phase
1	Lean cannot be commissioned like a machine where it is plugged and switched on to run then make sure it	Implementation process	Implementation phase

	keeps running with maintenance when needed.		
2	Must not disturb the flow but engage staff at their own meetings and working area	Implementation process	Implementation phase
6	Start at the least clinical area (intrusive or sensitive area) to sell the concept and migrate to more clinical areas	Implementation process	Implementation phase
2, 4, 6, 9	Avoid wide but choose small interventions that you can quickly change and show early results	Implementation process	Implementation phase
1	Lean implementation should be driven from the philosophic perspective and owned by everyone	Implementation process	Implementation phase
6	Fostering change within people	Change management	Leadership
6	Leadership/ vertical. Ownership/ horizontal	Change management	Leadership
3, 6, 7	Change management/ mindset change/ understand the reasons	Change management	Leadership
2, 3,4,7,8	Management to participate by doing a Gemba walk	Gemba walk	Leadership

7	Visit areas that have done the work	Gemba walk	Leadership
6	Management by objectives vs by walking around (Gemba)	Gemba walks	Leadership
6, 8	Involved and facilitated problem identification and solution, leading from the top	Leadership involvement	Leadership
8	Lead by asking questions and not imposing solutions	Leadership involvement	Leadership
2, 7, 8	Humble, positive and consistent leadership that instils confidence	Leadership quality	Leadership
9	Managing for unintended consequences	Leadership quality	Leadership
3, 7	Flexibility and adaptability of Lean practices	Adaptation	Lean alignment
4, 9	Avoid plug-and-play strategy without adaptation	Adaptation	Lean alignment
6, 8	Treat Lean as an internal management system	Integration	Lean alignment
5	Lean must be integrated into the whole hospital process but not as an intervention	Integration	Lean alignment
9	Lean should be integrated into job profiles and performance agreement	Integration	Lean alignment

1, 3, 4, 7	The language used should be aligned with the health	Language adaptation	Lean alignment
1, 7, 9	Decode the Lean language into simple understandable language to avoid confusion	Language adaptation	Lean alignment
6	Understand organisational structure	Organisational readiness	Lean alignment
3, 4, 5, 7	Understanding the hospital environment to avoid unintended consequences	Organisational readiness	Lean alignment
3	Do Due diligence, establish status core	Organisational readiness	Lean alignment
3, 5, 9	Align Lean with strategic direction and planning	Strategic alignment	Lean alignment
5	Shouldn't be an event but a never-ending process	Continuous process	Long-term philosophy
1, 6	A long-term view of Lean, with no completeness stage and not to be used as a quick fix	Continuous process	Long-term philosophy
1	If it comes from mind and philosophy then sustainability is possible	Lean thinking	Long-term philosophy
1	It is not about the tools but the mentality to improve efficiency.	Lean thinking	Long-term philosophy
1	Lean as a philosophy is about seeing waste first	Lean thinking	Long-term philosophy

	and then using tools to eliminate it		
1	Lean is a religion and set of beliefs (philosophy) it is a value system. Lean is a way you think	Lean thinking	Long-term philosophy
4, 5, 6	Prioritise philosophy understanding and tools later	Lean understanding	Long-term philosophy
3, 6	Value stream mapping to help with the patient journey	Lean tools	Management
6, 7, 8	Visual management	Lean tools	Management
8	Updated visual management board	Lean tools	Management
5	Optimum process layout to allow seamless operation	Lean tools	Management
3	Lack of operational management skills where they intervene in medicine instead of management	Management competence	Management
3	Set goals and evaluate them later not for punitive reasons but to learning	Performance management	Management
2	Show reasons and objectives to be achieved within silos	Performance management	Management
3	Performance management and	Performance management	Management

	feedback are important to help improve		
7, 8	Allow staff to fail and or initiate to learn from their mistakes instead of punitive measures	performance management	Management
5, 6, 8	Measuring performance, analysing, and feedback, feedback is the most powerful drive for improvement	Performance management	Management
6, 7	Pause evaluate and standardise the improvement	Performance management	Management
2, 8	Open and visible results or reporting	Performance management	Management
2	Process plan to show success and results	Performance management	Management
2	Management to listen to staff and implementers	Staff engagement	Management
2, 7	Engage each staff on the goals and their responsibilities and sell the value of Lean	Staff engagement	Management
3	Employee engagement including unions to sell the benefits of lean and alleviate fears	Staff engagement	Management
6, 8	Succession planning	Staff engagement	Management

6	Acknowledge and recognition	Acknowledgement and recognition	Motivation
7, 9	Wrong perception where Lean is seen as extra work	Perception	Motivation
2	Praise good performance to improve motivation	Acknowledgement and recognition	Motivation
6	Team-based recognition vs individuals	Acknowledgement and recognition	Motivation
6	Possibilities to grow should be there for outstanding personnel	Personnel benefits	Motivation
3	Improved patient outcomes influence the morale of patients and staff	Personnel benefits	Motivation
9	Lean helps staff achieve their targets and be rewarded	Personnel benefits	Motivation
4, 5, 8	Tangible benefits and results of Lean implementation	Personnel benefits	Motivation
8, 9	Stability and mental safety of staff, and job security	Personnel benefits	Motivation
2	Keep the process of Lean interesting and keep staff engaged	Personnel involvement	Motivation
6	Enthusiasm from middle management and frontline	Personnel involvement	Motivation

2	Staff engage at free will with motivation to make a difference	Personnel involvement	Motivation
2, 8	Respect for each other	Personnel benefits	Motivation
2	Staff morale was high	Staff morale	Motivation
3, 6, 7, 9	Successful and visual results should be shown to promote the benefits of Lean	success stories	Motivation
3	Improved operational efficiency	success stories	Motivation
1	External consultants can not make business lean but can only mentor and help staff to think and act lean.	External support	Support
1	Leveraging on consultants to transfer information to staff	External support	Support
4	Choose willing champions and participants to help promote implementation,	Lean champions	Support
1, 6, 7, 8	Develop champions to be problem solvers and deploy them in the organisation to take responsibility for Lean projects	Lean champions	Support

6, 7	Support from corporate sponsorship and leadership	Personnel support	Support
5, 6	Continuous support from management	Personnel support	Support
2	Support staff - engage other departments	Personnel support	Support
2, 5, 7, 9	Management to provide resources required based on demand	Resources	Support
3	Health is very political and power-driven with silos, bureaucracy and hierarchy, where the right-hand doesn't know what the left is doing	Collaboration	Teamwork
3, 8	Collaboration and teamwork	Collaboration	Teamwork
3, 7	Lean must be spread across different section	Collaboration	Teamwork
6, 9	Move discussions from silos or blame games into teamwork because silos work against improvement	Collaboration	Teamwork
4	Management must not impose themselves but rather gain staff buy-in and integrate themselves into the team	Integrated teams	Teamwork

3, 6, 9	Integration across different sections	Integrated teams	Teamwork
2	Respect for each other and create a multi-disciplinary approach	Multi-disciplinary approach	Teamwork
2	Teamwork where all are important in addressing the issues, makes Lean everybody's business	Personnel involvement	Teamwork
5, 6, 7	Continuous coaching and guidance from management and champions help to break silos	Coaching and guidance	Training
2	Continuous workshops to introduce new entrants	Lean training	Training
6	Grow-Lean knowledge over time to capacitate staff	Lean training	Training
1, 2, 8, 9	Invest in proper Lean training	Lean training	Training
1	Teach people to see waste as a start and act on it	Lean training	Training
2, 7	Staff to train and orientate each other	Personnel training	Training
3, 7	Prioritise Training to foster continuous improvement	Personnel training	Training

7	Develop people to understand Lean, coach them and graduate them	Personnel training	Training
4	Continuous intervention and training on the floor	Personnel training	Training

Appendix 6

SLR Protocol.

1. **Identify the purpose:** the purpose of this review is to answer the first research question which seeks to gather information on the factors that affect the sustainability of Lean healthcare in Hospitals. The research question is split into four phrases, “FACTORS” “SUSTAINABILITY” “LEAN” “HEALTHCARE”.

2. Create protocol.

3. Apply practical screen:

    1. Content (topics or variables): this review will consider studies that were done to analyse or identify factors affecting the sustainability of Lean healthcare in hospitals. The four phrases that define research questions will used to search for relevant questions. Synonyms will also be used to try and get as much information as possible. The following synonyms or related phrases will be used

        a) FACTORS or (issues, causes, elements, components, aspects)

        AND

        b) SUSTAINABILITY or (sustainable, sustain, effective, effectiveness, successful)

        AND

        c) LEAN or (Kaizen, improvement, 6 sigma, 5s, Toyota Production Systems)

        AND

        d) HEALTHCARE or (health, hospital)

    Search engine systems will also be used for other related terms and equivalent expanders.

    2. Publication language: Only consider publications done in English as the only language understood by the researcher.

3. Journals: the review's scope might limit itself to select journals and papers that have been published. The quality of the information is very important as this review will conclude by providing evidence-based suggestions on the sustainability of Lean healthcare in Hospitals. Only full-text academic journals and peer-reviewed articles will be considered

4. Setting: this review will only consider publications done in hospitals or sections of hospital

5. Date of publication/data collection or duration of data collection: This review has no date restriction because of the limited number of available information.

4. Search for literature: Will search through EBSCOhost with the following databases (MEDLINE, Academic Search Complete, Directory of open access journals, ScienceDirect, Business Source Complete, CINAHL with text, Environment Complete, Health Source: Nursing/Academic Edition, Scopus, APA PsycInfo, Springer Nature Journals, Applied Science and Technology Source, Emerald Insight, Journals@OVID, ScIELO, SPORTDiscus with Full Text, JSTOR Journals, Directory of Open Access Books, GreenFILE, MasterFILE Premier, IEEE Xplore Digital Library, Library Information Science & Technology Abstracts). Will use Google Scholar for forward search (articles citing the reviewed articles) and backward search (articles cited by the reviewed articles). Search phrases (with their related words and equivalent expanders) Lean and Healthcare will be used in the title search, and Factors and Sustainability will be used in the Abstract search.

5. Appraise quality: Articles that don't meet inclusion criteria as stated above will be excluded. Articles will be screened on the title, if it is not about or related to Lean and Healthcare it will be excluded. After reading the abstract and the article is not, related or mentioning factors affecting the sustainability of Lean Healthcare then it will be excluded. Articles that don't state factors affecting the sustainability of Lean Healthcare will be excluded.

6. Extract data: Factors and supporting statements or evidence will be extracted from each literature review, and factors will be grouped into themes. For any thematic

synthesis, therefore, the extraction of the following three kinds of data is recommended:

• Publication details

• Context descriptions

• Findings

When identifying a statement that could potentially be a finding, the following questions might help

• Does it state the results of measurements?

• Does it summarize raw data?

• Does it highlight some specific characteristic of the raw data?

• Does it provide additional insights about tables or figures?

• Does it summarize the results of analyses?

• Can it be used to answer the research question(s)?

• Does it reflect the main results of the study?

7. Synthesize studies: Will use Thematic synthesis which falls under (Meta-synthesis). Thematic synthesis has three stages: the coding of text 'line-by-line'; the development of 'descriptive themes'; and the generation of 'analytical themes'. While the development of descriptive themes remains 'close' to the primary studies, the analytical themes represent a stage of interpretation whereby the reviewers 'go beyond' the primary studies and generate new interpretive constructs, explanations or hypotheses.

8. Write the review: The review will be reported as per ENTREQ guidelines.

A systematic review protocol is important for several reasons: (1) it allows systematic reviewers to plan carefully and thereby anticipate potential problems; (2) it allows reviewers to explicitly document what is planned before they start their review, enabling others to compare the protocol and the completed review (that is, to identify selective reporting), to replicate review methods if desired, and to judge the validity

of planned methods; (3) it prevents arbitrary decision making concerning inclusion criteria and extraction of data; and (4) it may reduce duplication of efforts and enhance collaboration, when available. (Shamseer et al., 2015)

Appendix 7

Table of SLR factors identified

Author	Fact statement	Theme
Henrique et al., 2021	There is an audit process and check-lists that are done by management after kaizen events to make sure that the improvements are being implemented and work standards are in place	Auditing
Andersen et al	Audits local performance metrics regularly as evidence	Auditing
Henrique et al	The kaizen event is used to quickly implement the planned changes.	Commitment
Trakulsunti et al	continuously focusing on identifying problems in the medication process and waste, then identifying root causes and developing solutions to minimize them on a continuing basis	Commitment
Hallam and Contreras	executive commitment stakeholder support, and a vision statement based on departmental values are key tactics necessary to make Lean healthcare successful.	Commitment
Trakulsunti et al	Ensuring continued leadership buy-in for LSS and long-term leadership commitment is a key factor for sustaining LSS when	Commitment

	the leaders who understand LSS projects have left the hospitals.	
Trakulsunti et al	Leaders committed towards LSS is a key factor for the sustainability of LSS	Commitment
Flynn et al	Competing demands on the clinical leader and their workload, affecting time commitment to Lean.	Commitment
Trakulsunti et al	Ensuring staff use LSS methodology every day to solve problems and improve the medication process requires behavioural change, long-term investment, and commitment.	Commitment
Hallam and Contreras	Clear communication	Communication
Henrique et al	A3 method is currently used to communicate better and simpler the process of change of projects on a single sheet, containing the objective, the current situation with the problems, the projected situation, the action plan outlined and the monitoring indicators.	Communication
Hallam and Contreras	a continued communications plan was necessary to ensure that changes stayed in place.	Communication
Andersen et al	Communication: With and between patients and staff, including feedback to both	Communication

Henrique et al	Kaizen events, aligning and engaging people in charge, and sharing the results of the lean implementation are being communicated throughout the whole organization.	Communication
Flynn et al	The degree of messaging about the value and purpose of Lean by organizational leaders to the wider organization.	Communication
Trakulsunti et al	culture involves encouraging and empowering staff across the hospital	Empowerment
Flynn et al	Sense-making (the process through which people assign meaning to experience), staff engagement, and empowerment were identified as core mechanisms to the sustainability or non-sustainability of Lean efforts	Empowerment
Flynn et al	Lean was implemented in areas that experience constant change	Implementation phase
Henrique et al	The initial focus of lean implementation was on the information or material flow, instead of the patient flow	Implementation phase
Henrique et al	The lean implementation process is focused on creating a well-developed pilot where several tools can be implemented first,	Implementation phase

	then spread the lean tools and principles throughout the organization.	
Henrique et al	There is a plan to implement lean, that contains the set of steps to be followed so that the implementation team does not take any risks neglecting any steps that could undermine sustainability in the future.	Implementation phase
Flynn et al	frontline staff felt overwhelmed by the constant change, they were unsure what changes were due to Lean and felt that Lean was the latest fad	Implementation phase
Flynn et al	The constant changes occurring in the work environment led to feelings of confusion and uncertainty about what changes were a result of Lean implementation or something else, such as the changes occurring in relation to the new children's hospital development within this context. The degree of constant change also triggered feelings that Lean would not "stick", and that it was another "make-work" project.	Implementation phase
Flynn et al	The majority of the frontline staff participants viewed the top-down,	Implementation phase

	mandated, and externally-led Lean implementation negatively.	
Flynn et al	Some staff felt that Lean was a cost-cutting measure, a “fashion fad”, something that was pushed on them, where implementation was too quick and did not have a clear purpose.	Implementation phase
Henrique et al	There are Gemba walks in place, performed by the management team, as a meeting routine where all levels of the organization go where things happen to see the problem for themselves and elaborate action plans	Leadership
Flynn et al	Leadership approach used by clinical leaders (hierarchical versus distributive).	Leadership
Flynn et al	The degree of credible and respected senior leaders are seen as promoting and investing their own time in Lean efforts.	Leadership
Henrique et al	Leaders use their time to work and prioritise lean initiatives as well	Leadership
Henrique et al	Senior executives are actively participating in day-to-day continuous improvement activities	Leadership
Hallam and Contreras	About a third of the articles reviewed (35.1 percent)	Leadership

	mentioned stakeholder involvement.	
Flynn et al	This resulted in some negative effects, particularly for frontline staff and their support of Lean continuation. Pediatric healthcare was discussed as a complex field which requires a family-centred and flexible approach to care, which some participants believed did not align with Lean.	Lean alignment
Flynn et al	Lean values of efficiency, patient safety, and waste reduction were congruent with participants' professional values as healthcare providers. However, Lean training failed to translate how the principles of Lean aligned with the context of healthcare.	Lean alignment
Flynn et al	The lack of customization to local context triggered mechanisms of disconnect, lack of coherence and negative perceptions about Lean.	Lean alignment
Andersen et al, 2014	Local translation of the lean intervention	Lean alignment
Trakulsunti et al	LSS is an ongoing improvement process, therefore the future and trends of LSS are vital in helping healthcare organizations to sustain LSS. Healthcare organizations should continuously adapt to the latest	Lean alignment

	trends of LSS because it is very helpful to generate new ideas to improve the process	
Trakulsunti et al, 2020	Institutionalising LSS is a key factor that can sustain the approach in the organizational culture. It means that the hospital should embed LSS as a part of the hospital	Lean alignment
Flynn et al	align their values and the values of the organization to the values of Lean	Lean alignment
Flynn et al	The degree of congruency between Lean philosophy and the values of the organizational leaders and the extent of other contextual forces.	Lean alignment
Flynn et al	The degree of congruency between Lean philosophy and personal-level reasoning of the clinical leaders and front-line healthcare providers.	Lean alignment
Flynn et al	Sense-making (the process through which people assign meaning to experience)	Lean alignment
Flynn et al	Lean training by the consultancy company did not make staff feel involved in Lean changes. The Lean language used by the	Lean alignment

	consultancy company did not make sense for many participants and initial implementation efforts failed to connect Lean to the context of pediatric healthcare	
Flynn et al	Lean principles were primarily viewed as incongruent with healthcare. The training provided failed to translate Lean concepts, principles and their meanings from a manufacturing perspective to a healthcare perspective.	Lean alignment
Flynn et al	The continuation of Lean efforts and the normalization of Lean in everyday practice relied on how staff 'made sense' of Lean and whether the values of Lean aligned with their own personal and/or professional values These were core mechanisms to the sustainability of Lean that were important from the early stages of Lean implementation.	Lean alignment
Andersen et al	Alignment: Consistency to strategic objectives and priorities of strategic importance	Lean alignment
Trakulsunti et al	hospital should ensure that LSS is integrated into existing strategic plans, operating plans and budgets (Michael, 2002) so that	Lean alignment

	the LSS projects are aligned with the hospital's strategy	
Henrique et al	When Lean initiatives are aligned with the strategic objective of the company, all efforts are moving in the same direction and the results have a global impact	Lean alignment
Andersen et al	Lean as an entire value system, embracing everyday improvement	Lean alignment
Andersen et al	Continuous improvement: A long-term plan, securing endured and sustained attention	Long-term philosophy
Henrique et al	Decisions are based on a long-term philosophy, even to the detriment of short-term financial losses, to help establish a culture of continuous improvement and make employees more confident about the organization's strategic alignment	Long-term philosophy
Andersen et al	Vision: Targets of urgency and direction, but realistic, simple and practical solutions	Long-term philosophy
Hallam and Contreras	Vision statement based on departmental values	Long-term philosophy
Andersen et al	Accurate data: Robust and timely, evidence-based data as an impetus to change	Management

Hallam and Contreras	implemented control plans that relied on documented standards and processes,	Management
Henrique et al	Improvement and problem-solving activities use structured steps to define the problem, goals, current state, root causes, future state, implementation, standardization and control, such as DMAIC or PDCA	Management
Henrique et al	There are documented work standards in place (regstered), the work Is being executed according to those standards and the work standard is the best way to perform a certain task known up to the moment.	Management
Henrique et al	The key performance indicators are defined and designed to adequately measure current state process performance and the target goals of an improved value stream	Management
Hallam and Contreras	documenting standard work was necessary to ensure that changes stayed in place.	Management
Henrique et al	The responsible for the sectors/ value streams have well-defined follow-up routines during the post-kaizen phase to closely monitor	Management

	the problems that arise after implementation	
Hallam and Contreras	run-charts tracked key performance indicators.	Management
Henrique et al	Value stream mapping is being used to understand the patient value stream from the treatment beginning to the end, with the identification of task time, cycle time and wastes, and design a future state goal	Management
Henrique et al	performance indicators, sustainability assurance notes, A3 projects, Value stream maps, and goals to be achieved are exposed in the visual management boards.	Management
Hallam and Contreras	Their system integrated standard procedures displayed near the workplace	Management
Henrique et al	Teams of employees are assessed and rewarded through competition programs based on improvement ideas implemented or performance goals achieved	Motivation
Trakulsunti et al	Rewards and recognition systems are important motivation factors to encourage staff to continue implementing LSS in the organizations	Motivation

Flynn et al	Level of morale in the department.	Motivation
Flynn et al	Unit managers expressed that staff were overwhelmed and staff engagement in Lean was a challenge. These challenges were also coupled with a lack of follow-up regarding the Lean changes implemented.	Motivation
Flynn et al	The degree of staff turnover, staff morale, type of unit culture, and level of innovation fatigue.	Motivation
William James Wilson et al	Motivation was hypothesised as an amplifier or attenuator of the activity (lean actions). This is because, depending on the motivators, some motivators (e.g. belief in the end goal) can have a positive interaction effect on lean actions, while other motivators (e.g. lack of management support) can have a negative interaction effect on lean action	Motivation
Flynn et al	Engaged staff. Core values of front-line healthcare providers that align or impede their motivation; pre-existing levels of feeling empowered; pre-existing levels of work satisfaction; pre-existing attitude and buy-in of clinical leader; and pre-existing relationships between clinical	Motivation

	leader and front-line healthcare providers.	
William James Wilson et al	“Respect for people” within the TW goes beyond many organisations’ interpretation of “respect” (Womack, 2007). It represents a deep organisational alignment to develop the independent improvement capability of operational staff	Motivation
Andersen et al	Customer focus: Includes patient and workforce value creation and improvements	Motivation
Andersen et al	In staff and patient, benefits encourage willingness and motivation	Motivation
Flynn et al	The extent to which the benefits to patients, staff, and the organization due to Lean implementation are visible.	Motivation
Andersen et al	Prior quality improvement using a successful, mature method	Motivation
William James Wilson et al	Perceived success	Motivation
Trakulsunti et al	showing and sharing the success stories of LSS throughout the hospital; using a common	Motivation

	language and education and training	
Trakulsunti et al	The number of LSS experts should be increased to enhance the knowledge of LSS across the hospitals.	Support
Henrique et al	There is a group of employees who are dedicated to implementing lean and continuous improvement activities	Support
Hallam and Contreras	Developing clinical and mid-level management champions necessary for sustaining the change	Support
Andersen et al	Resources: Available, sufficient and accessible capacities	Support
Flynn et al	The extent of time, continual resources (e.g., staff, facilities, equipment, policies, and procedures), and staff capacity (training, audit and feedback, communication channels, senior leadership support) provided for sustainability.	Support
Andersen et al	IT systems: Adequate IT support and infrastructure established	Support
Andersen et al	Administrative support: Practical facilitation by a project management	Support

Andersen et al	External support: Expert change agents, networks and sponsorship trigger change	Support
Flynn et al	The consultancy company was viewed as an outsider pushing a message that didn't connect with healthcare. the unit managers also viewed the use of an external consultancy company negatively.	Support
Hallam and Contreras	Stakeholder support	Support
Andersen et al	Supportive culture: Views, norms and beliefs that support quality improvement	Support
Andersen et al	Physicians: Clinical leadership and champions' engagement, support and collaboration	Teamwork
Hallam and Contreras	staff involvement and collaboration between teams improve productivity and efficiency.	Teamwork
Flynn et al	Silo or collaborative nature of the system, degree of relationships and collaboration between various stakeholder professions.	Teamwork
Flynn et al	The degree of collaborative team building and multi-disciplinary team approach to Lean activities.	Teamwork
Henrique et al	Decisions are taken by consensus, not top-down, where people have more freedom to generate new ideas for	Teamwork

	improvement and discuss them to decide the best for the organization.	
Henrique et al	People of different abilities and areas are engaged in the process of implementing change using a structured framework to tackle the root causes of problems	Teamwork
Henrique et al	IT professionals are involved in improving activities and help to simplify and automate complex processes	Teamwork
Hallam and Contreras	Implementing new processes with process owners and executives present, representation from all teams as each shift has different conditions	Teamwork
Andersen et al	System-wide scope: Multifaceted interventions across silos and functional divides	Teamwork
Hallam and Contreras	Multidisciplinary teams and concurrent involvement by all departments	Teamwork
Flynn et al	The degree to which clinical leaders play an active role in promoting, participating, and investing their own time in Lean assessment and improvement activities.	Teamwork

Henrique et al	Physicians participated in all phases of the project to contribute to give credibility to the project, engage other professionals and contribute to the generation of solutions to assist with problems generated by the process	Teamwork
Andersen et al	Staff involvement: Commitment, engagement and empowerment by staff participation	Teamwork
Trakulsunti et al	To achieve this, staff buy-in is very essential.	Teamwork
Henrique et al	Health professionals, such as nurses and pharmacists, actively participate in continuous improvement activities.	Teamwork
Flynn et al	Positive or negative relationships (e.g., trust, communication) between clinical leader and front-line staff.	Teamwork
William James Wilson et al	Teamwork as defined here describes the quality of interactions within teams, as distinct from the work tasks themselves and the quality or effectiveness of the tasks	Teamwork
Henrique et al	Professionals involved are constantly trained in Lean concepts, from the basic tools to the philosophy of lean thinking as	Training

	part of a continuous learning process	
Andersen et al	Training: Accessible, substantial, practical and relevant training for immediate use	Training
Hallam and Contreras	Training on new processes	Training
Trakulsunti et al	Staff knowledge and understanding of LSS methodology are important factors to drive LSS sustainability.	Training
Andersen et al	Competence: Tools, assumptions and methods ensure capability	Training
Flynn et al	The degree of Lean training received by clinical leaders and front-line healthcare providers.	Training
Flynn et al	The degree of Lean training that front-line staff receive and are given the opportunity to drive or lead Lean efforts at the unit level.	Training
Flynn et al	The degree and nature of Lean leadership training for organizational leaders.	Training
Trakulsunti et al	To retain and update staff's LSS knowledge, an LSS refresher workshop is needed periodically	Training
Hallam and Contreras	along with clear training plans as staff turnover required continuous re-education.	Training

Appendix 8

Ethics clearance certificate

Private Bag X1290, Potchefstroom
South Africa 2520

Tel: 086 016 9698
Web: http://www.nwu.ac.za/

North-West University Health Research Ethics Committee (NWU-HREC)

Tel: 018 299-1206
Email: Ethics-HRECApply@nwu.ac.za (for human studies)

23 April 2023

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the North-West University Health Research Ethics Committee (NWU-HREC) on 23/04/2023, the NWU-HREC hereby approves your study as indicated below. This implies that the NWU-HREC grants its permission that, provided the general conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Sustainability of Lean healthcare in South Africa: A practitioner's perspective
Principal Investigator/Study Supervisor/Researcher: Prof TS Hattingh
Student: RS Wagner - 38042959

Ethics number:

N	W	U	-	0	0	1	5	1	-	2	2	-	A	1
Institution				Study Number						Year			Status	

Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Application Type: Single study
Commencement date: 23/04/2023
Expiry date: 30/04/2024

Risk: Minimal

Approval of the study is provided for a year, after which continuation of the study is dependent on receipt and review of an annual monitoring report and the concomitant issuing of a letter of continuation. A monitoring report is due at the end of April annually until completion of the study.

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- *The principal investigator/study supervisor/researcher must report in the prescribed format to the NWU-HREC:*
  - *Annually on the monitoring of the study, whereby a letter of continuation will be provided annually, and upon completion of the study; and*
  - *without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.*
- *The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the principal investigator/study supervisor/researcher must apply for approval of these amendments at the NWU-HREC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.*
- *Annually a number of studies may be randomly selected for active monitoring.*
- *The date of approval indicates the first date that the study may be started.*
- *In the interest of ethical responsibility, the NWU-HREC reserves the right to:*
  - *request access to any information or data at any time during the course or after completion of the study;*

- *to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;*
- *withdraw or postpone approval if:*
  - *any unethical principles or practices of the study are revealed or suspected;*
  - *it becomes apparent that any relevant information was withheld from the NWU-HREC or that information has been false or misrepresented;*
  - *submission of the annual monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and/or*
  - *new institutional rules, national legislation or international conventions deem it necessary.*
- *NWU-HREC can be contacted for further information via Ethics-HRECApply@nwu.ac.za or 018 299 1206*

The NWU-HREC would like to remain at your service and wishes you well with your study. Please do not hesitate to contact the NWU-HREC for any further enquiries or requests for assistance.

Yours sincerely,

Digitally signed by
Prof Petra Bester
Date: 2023.04.24
16:28:59 +02'00'

Chairperson NWU-HREC

Current details:(29239522) G:\My Drive\9. Research and Postgraduate Education\9.1.5.4 Templates\9.1.5.4.2_NWU-HREC_EAL.docm
20 August 2019
File Reference: 9.1.5.4.2