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**FACULTY OF ECONOMICS AND ADMINISTRATION**

**APPLICATION OF LEAN MANAGEMENT IN PUBLIC SECTOR ORGANIZATIONS**

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# ZADÁNÍ DIPLOMOVÉ PRÁCE

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## Zásady pro vypracování

The goal of the thesis is to demonstrate the widespread but still limited application of Lean management within the public sector. The aim of the thesis is to define benefits of using Lean management tools and its critical success factors in public sector.

### **Structure:**

- Definition of the Lean management and concepts.
- Analysis of application of Lean methods and principles in the Public Sector Organizations.
- Evaluation of the application of Lean Methods in a selected Public Sector Organizations.
- Assessment of the challenges and benefits for the application of Lean in a selected Public Sector Organizations.
- Formulation of conclusion.

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## **AUTHOR'S DECLARATION**

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## **ANOTACE**

Přestože koncept štíhlé výroby vzešel z výrobního průmyslu, jeho aplikace byla využívána v několika průmyslových odvětvích. V průběhu let však sektor zdravotnictví zaznamenal mimořádný nárůst v používání štíhlých nástrojů, protože je vnímán jako reakce na eskalaci nákladů na zdravotní péči a nedostatečná opatření v oblasti bezpečnosti pacientů. Jeho implementace a aplikace ve zdravotnictví v Evropě však nebyly v literatuře plně zdokumentovány, takže tato studie podtrhuje aplikaci štíhlého managementu ve zdravotnictví v evropských zemích. Studie je založena na obsahové analýze a popisném hodnocení článků publikovaných o aplikaci a implementaci štíhlé výroby ve zdravotnictví v celé Evropě v letech 2010 až 2022. Zjištění ukazují, že aplikace štíhlé výroby ve zdravotnictví má několik výhod (snížení přeplněnosti nemocnic, zkrácení čekací doby, snížení nákladů a neustálé zlepšování využívání zdrojů v nemocnicích a snižování plýtvání) a některé významné nedostatky (zaměstnanci v nemocnicích nebyli obeznámeni s nástroji štíhlé výroby a stresujícím zaváděním). Holistický přístup k procesu a neustálé zlepšování a angažovanost managementu by však mohly výrazně zvýšit jeho efektivitu a efektivitu. Tato studie tedy kromě nastínění budoucích oblastí výzkumu v oblasti štíhlé zdravotní péče poskytuje souhrn zjištění, která jsou relevantní pro zainteresované strany ve zdravotnictví, které mají zájem o zavedení štíhlé péče.

## **KLÍČOVÁ SLOVA**

Lean, štíhlý management, výrobní systém Toyota, veřejný sektor, zdravotnictví

## **TITLE**

Application of lean management in public sector organizations: The case of selected healthcare facilities in Europe.

## **ANNOTATION**

Although the lean concept emerged from the manufacturing industry, its application has been utilized in several industries. However, over the years, the healthcare sector has seen an exceeding increase in lean tools application because it is seen as a response to escalating healthcare costs and underwhelming patient safety measures. Nonetheless, its implementation and application in the health sector in Europe have not been fully documented in the literature, thus, this study underscores the application of lean management in the health sector among European countries. The study is based on content analysis and descriptive assessment of articles published concerning the application and implementation of lean in health care sectors across Europe from 2010 to 2022. The findings reveal that the application of lean in the healthcare sector has several benefits (reducing overcrowding in hospitals, reducing waiting time, reduction of cost and constant improvement of resources use in hospitals and reduction of waste) and some notable shortfalls (staff at hospitals were not familiar with lean tools and stressful implementation). However, a holistic approach to process and constant improvement and management engagement could go a long way to increase its effectiveness and efficiency. Thus, in addition to outlining future areas of research in lean healthcare, this study gives a summary of findings that are pertinent to healthcare stakeholders interested in lean implementation.

**Keywords:** Lean, lean management, toyota production system, public sector, healthcare system



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## **LIST OF ABBREVIATIONS**

EU – European Union

TPS – Toyota Production System

USA –United States of America

LM - Lean management

LSS – Lean six sigma.

DMAIC –Define, measure, analyze, improve, and control.

KCI - Kaizen Continuous improvement

VSM - Value-stream Mapping

VM - Visual Management

LT – Lean thinking

TQM – Total quality management

JIT – Just in time

## **INTRODUCTION**

Globally, public sector agencies have not been exempted from the insurgency that has swept through the service sector over the past couple of decades (Almeida *et al.*, 2017). After the industrial revolution companies relied on high-quality products and services to compete in the market and to achieve customer happiness with consideration of value for money. However, the public sector's efforts proved ineffective in motivating employees for continuous improvement (Khan *et al.*, 2019). According to Sreedharan *et al.*, (2018) the government's productivity assignments to augment the public sector have failed, leading to changes in the management process.

Many manufacturing and service organizations have embraced the popular and dominant process excellence methodology known as lean management to increase process efficiency and effectiveness. This has the effect of improving customer satisfaction, product and service quality, business profitability, and sustainable competitive advantage (Lawal *et al.*, 2014). The notion of Lean originated in the automobile sector, according to Le and Nguyen (2021), but research on its implementation and sustainability in the healthcare profession is still restricted.

Against this backdrop, this study aims to ascertain the significance of employing lean management tools in the public health care sector. To realize the aim of the study, the first chapter introduces the theoretical definition of lean management and concepts in the Public Sector; it reviews the works of literature on the historical background of lean production. Secondly, the study reviews existing literature on the application of lean methods and tools used in the Public Sector. Chapter three highlights the methodology developed for the study. In Chapter four, the content of articles on lean management in the public sector is examined to evaluate the difficulties and advantages of implementing lean management in particular public sector firms. Finally, chapter five contains the Authors' recommendations and conclusion.

## **1.0 THEORETICAL BACKGROUND**

This section presents the theoretical background of the study. Specifically, the history of lean, how lean started, and the historical background of lean in the manufacturing and health sectors are outlined in this chapter.

### **1.1 Lean's historical background**

To define Lean, we must first look at its history and identify the numerous views that are frequently used to characterize it. Table 1 summarizes key stages that have shaped our present knowledge of Lean. Lean is a direct descendent of Toyota Production System (TPS), which is based on Taiichi Ohno's more than 30 years of experience and efforts at Toyota Motor Corporation. It typically serves as a stand-in (proxy) for the Toyota Production System (Shah & Ward, 2007). Formal adoption in the United States occurred when NUMMI was established as a joint venture between Toyota and General Motors in 1984, although informal adoption took more time and developed over time in the country (Shingo & Dillon, 1989). Due to gradual regional dispersion separated by substantial delays, the United States' grasp of the new system develops more slowly and with longer lags. The underlying basis of the manufacturing process is difficult for US executives to grasp because of the diversity and complexity of TPS (Romero et al., 2019). While U.S. executives were aware of the various elements that drive TPS and Lean manufacturing, these ideas were not completely incorporated into academic and business journals' jargon (Lyu et al., 2020; Nicholas, 2014). As a result, even when the fundamental differences are unclear, semantic ambiguities arise (Shah & Ward, 2007).

The chronology for lean manufacturing, as shown in Table 1 below, concentrates on the key advancements made by American and Japanese automakers Ford, GM, and Toyota in their pursuit of consistency, quality, and efficiency.

With this timeframe, the narrative is not over. In academia and production, lean manufacturing is still a hot topic. Lean tools are updated, enhanced, and added to the collection annually. The future appears leaner every day as more companies use these strategies.

**Table 1: Timeline showing important phases of Lean development.**

1927 and before	<ul style="list-style-type: none"> <li>Henry Ford outlines his production philosophy and the basic principles underlying the revolutionary Ford Production System (FPS) in "Today and tomorrow" in 1927.</li> </ul>
1945-78 Progress In Japan	<ul style="list-style-type: none"> <li>1937 - Toyoda (later Toyota) Motor Company is established in Koromo, Japan.               <ul style="list-style-type: none"> <li>Toyoda cousins Kiichiro and Eiji, with Taiichi Ohno study FPS and perfect the principle concepts and tools constituting Toyota Production System (TPS). Just in time (JIT) production method is a key component of TPS.</li> </ul> </li> <li>1978 - Ohno publishes "Toyota Production System" in Japanese. He credits FPS and the American supermarket behind his just in time thinking.               <ul style="list-style-type: none"> <li>According to Ohno, the primary goal of TPS is cost reduction (waste elimination); it can be achieved through quantity control, quality assurance, and respect for humanity. He recommends producing only the kind of units needed, at the time needed and in the quantities needed.</li> </ul> </li> </ul>
1973-88 TPS arrives in North America	<ul style="list-style-type: none"> <li>1973 - Oil crisis hits North America and generates immense interest in the (new) Japanese manufacturing and management practices followed by publication of numerous academic and practitioner books and articles.</li> <li>1977 - First academic article is published by Sugimori et al.; Narrowly focused articles on topics such as Kanban and just in time production (Monden, 1981b), production smoothing and level loading (Monden, 1981c) appear.</li> <li>1984 - NUMMI, a joint venture between Toyota Motor Company and General Motors opens in California.</li> <li>Mid 1980s - Noteworthy books including Monden's Toyota Production System (1983); Ohno's Toyota Production System: Beyond large-scale production (1988) are published in English.</li> <li>There is only a piecemeal understanding of TPS and its constituent elements; equivalence between JIT production, kanban and TPS is suggested (see Table 2).</li> </ul>
1988-2000 Academic progress	<ul style="list-style-type: none"> <li>1988 - Krafcik coins the term "lean" to describe the manufacturing system used by Toyota.</li> <li>1990 - The machine that changed the world by Womack, Jones and Roos is published.               <ul style="list-style-type: none"> <li>The machine establishes "lean production" to characterize Toyota's production system including its underlying components in the popular lexicon.</li> <li>The book describes a lean system in detail; but does not offer a specific definition.</li> </ul> </li> <li>Mid 1990s - Articles related to measuring just in time (Sakakibara et al., 1993; Flynn et al., 1995; McLachlin, 1997), total quality management (Ross, 1993; Dean and Bowen, 1994; Sitkin et al., 1994; Flynn et al., 1995), their interrelationships (Flynn et al., 1995; Sakakibara et al., 1997) and the impact of other organizational variables on their implementation are published in the academic journals.</li> <li>1994 - Lean Thinking by Womack and Jones is published. The book extends the philosophy and the guiding principles underlying lean to an enterprise level.</li> </ul>
2000- present	<ul style="list-style-type: none"> <li>Numerous books and articles written by practitioners and consultants, and a few academic conceptual (Hopp and Spearman, 2004; de Treville and Antonakis, 2006) and empirical articles (Shah and Ward, 2003) highlighting the overarching nature of lean production are published; yet no clear and specific definition is available.</li> <li>2006 - Toyota Motor Company is projected to become #1 automobile manufacturer in North America.</li> </ul>

Source :( Shah and Ward, 2007)

## **1.2 The concept of Lean Management**

In this section, the concept and meaning of lean management are explained. Also, the different philosophies and principles of lean are explained in the context of health care.

### **1.2.1 Definition of Lean Management**

The lean approach to production typically established several techniques in management which is new. It was specifically established for the automotive industry in Japan which aimed at using little resources to produce optimum results (Martínez and Moyano, 2014). However, the discussion and application of lean have evolved from the (Womack et al., 1990) and it's not only practiced in the manufacturing industry but also practiced in health and other essential services industries. According to Martínez-Jurado and Moyano-Fuentes (2014), several firms in several industries have relied on lean management to improve how they compete and improve their overall results. As such lean, firms who want to increase production and management efficiency opted for new methods which could help, it turns out that lean management was found to be a potent strategy that can help firms augment efficiencies in their workplace (Abdi et al., 2006). Besides Abdi et al., (2006) revealed that lean management does not only help to eliminate waste in the workplace but has the need of consumers as its focal point. Nonetheless, there seems to be some form of disagreement among a couple of authors when it comes to the definition of lean (Pettersen, 2009; Arlbjørn and Freytag 2013). 'Lean working', 'leanness' or 'lean' are terms that can be used to describe 'doing more with less' i.e., improved utilization of the organization's resources. This definition goes beyond the original definition of lean production popularised by Womack et al. (1990). Schonberger (1982) says Toyota's production system (lean approach) "... may be the most important productivity-enhancing management innovation since Taylor's scientific management at the turn of the [20th] century." (Wood and Nigel, 2004). However, there is some form of agreement when it comes to the Aspect of the elimination or reduction of what will be considered as 'waste' within the operations of an organisation. Chauhan and Singh (2012) give a perfect definition of what might be termed waste in an organization's operation. Waste in this regard is considered as anything or activity that in one way or the other consumes resources but does not give any form of value to the organisation or the business process. These activities can be identified not only when it comes to production but also when it comes to aspects relating to customer relations, the supply network, design management of the business process, and



sometimes the design of the product or service them. Shah and Ward (2007) explain Lean management as a management style that seeks to find and remove waste across a product's value stream, this style of waste avoidance is not found just in the organization but rather cuts across the entire value chain network. This definition does not only look at the company or the organisation but looks at it from the whole value chain network that's the operations of the company pranks and this regard to ensure that the management approach is implemented perfectly one needs to have an overall overview of the business operations not pertaining only to the company but sometimes outside it change sure that efficiency and effectiveness are achieved.

Since this study deals with the application of lean in the healthcare sector a definition of lean concerning healthcare is therefore adopted. Thus, following the study of Lawal et al., (2014), Lean management is defined as a “collection of philosophies whose central focus aims at minimizing waste and waiting time at health centres and offering value for patients. Also, it places a strong emphasis on staff involvement, and ongoing improvement, and considers the needs of consumers”.

Lean management is a dynamic process that uses knowledge and is focused on the customer. This is a process by which companies are continuously working to eliminate losses and value creation”. The definition takes into consideration the aspect of services which is of significance to this study. It also notes how lean management is not just an activity but a continuous process that is part and parcel of the operations of an institution.

The Lean system is their definition of Lean production. It includes an incorporated environment of internal (company-related) and external (supplier and customer-related) components, and process and human resources components. This recognition recognizes Lean manufacturing's capacity to condense the notion of the journey to correspond with varied applications (Dinis-Carvalho, 2021), but it minimizes what it means to expand or extend the concept beyond rational issues. The term "Lean" refers to a system that reduces not just variation but also variance in units of analysis. It is necessary to handle the activation of supplier-customer interactions that may differ from one another (Hallam et al., 2018; Singh et al., 2020).

Lean production's central idea is to facilitate the flow of work steps that add value while removing non-value steps, such as waste, by concentrating on short cycle times. In addition, lean management helps to reduce Cycle time decrease as waste is eliminated from the manufacturing process until

physical constraints are reached. However, value-adding operations are first made better by internal continuous improvement and adjusting the machinery that is already in place. Major investments in new technology are only taken into consideration once these enhancement potentials have been realized (Marhani et al., 2012). In essence, lean approaches have been applied in a wide range of industries, spanning from manufacturing, automotive and health industries. Likewise, Arnheiter (2005) shows that when applied lean management was found to have improved efficient and drastically reduced time of production by 17 hours. This meant that firms could create value through lean management and increase profit as well.

According to Dekier (2012), Lean Management is a corporate management technique that entails organizational and functional adjustments to respond to changing market conditions. Additionally, professional development, influencing staff attitudes, and upholding positive public relations are also priorities in lean management (Dekier, 2012). Similarly, Dekier (2012) argues that lean management is very concerned with aspects related to the management of human resources in companies. He also mentioned that providing a healthy work environment, defining long-term and short-term goals, correct communication, and proper motivation, avoiding squandering human potential, employee development, and effective leadership are all parts of lean management.

Shah and Wards (2007) operational and conceptual definitions were employed in this investigation. According to Wacker (2004), indicators of clarity, communication, coherence, brevity, difference, inclusion, and exclusivity should be included in the conceptual definition of Lean Management. Companies that follow this philosophy must understand these characteristics and the reasons for them to maintain control over supply, turnaround times, and demand fluctuations. Supply shifts when providers are unable to produce the required quantity or quality at the appropriate time or location (Womack & Jones, 1994). By creating a basis of long-term relationships with a select number of important suppliers, this gap may be bridged. Other techniques used to limit supplier variability include giving frequent feedback on the quality and delivery performance as well as offering training and development for future improvement.

Equally, there are several approaches and instruments for reducing processing time variability (Bevilacqua et al., 2015). Limiting operations to a few minutes, for example, maintains the line balanced and boosts throughput. A rigorous quality assurance program reduces rework and reduces process time variability. Cross-trained employees can fill absent coworker positions without

compromising workflow, quality, or quantity (Bevilacqua et al., 2015). To reduce process time variability, Lean Management integrates these strategies and tools (Bhamu & Sangwan, 2014). Finally, demand changes can disturb day-to-day management procedures and planning by cascading through management processes. Lean Management focuses on production smoothing techniques such as "heijunka" and takt time, which quantifies how much care/production is necessary to fulfil customer demand, to combat the impacts of unpredictable demand. Demand management can also be used to smooth out fluctuations in demand over time. Accordingly, complementing practices/tools that decrease waste in very particular ways might meet the philosophical demand for waste reduction (Shah & Ward, 2007).

**1.3 Principles of Lean**

**1.3.1 Womack and Jones’ 5 Lean Principles**

According to Womack and Jones, (2003), there are five main principles in lean management which give a clear description of how to operationalize lean management. The five principles identified are presented in figure 1. Firstly, principal number one deals with the value creation in a company. As such, it requires that firms investigate and identify the target customers as well as their respective needs. This is essential because it leads to the proposal of Womack and Jones (2003) which indicates that the value of a product is defined by the customers who purchase it, ultimately this is evident. After all, the value is based on the amount the customers will be willing to pay for a given product or service.

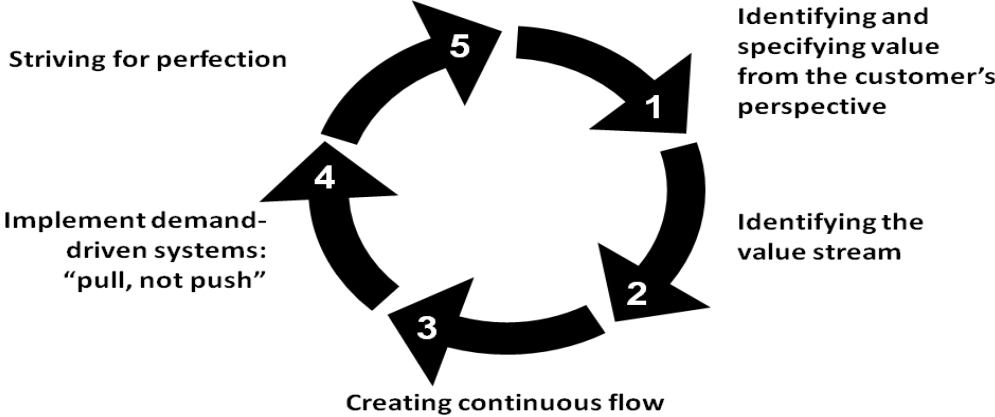


Figure 1: Five Lean principles (adapted from Womack and Jones 2003)

Source: Womack and Jones (2003)

Consequently, there is the need for firms to underscore all the activities required to bring a product or service to being along the value stream, and this can be done via an appropriate approach, which is known as Value Stream Mapping (VSM). This approach shows the various procedures and ways through which services and products can be made. An activity that deals with the process is divided into three sub-sections. This is 1. Activities that improve a good or service, 2. Activities that don't improve a good or service but are still required, 3. Activities that don't improve a good or service and are not required (Womack & Jones, 2003). Figure 2 shows an example of a value stream map. On the top of Figure 2, the flow of information is shown, for instance, the individual process stages may be controlled by the production department, which also emanates from the production plan when orders are made by clients. The actual manufacturing processes are shown in the centre portion, which is called the material flow and includes individual process stages with specific process data and work-in-process (WIP) inventories. For instance, cycle duration, machine uptime, and the number of operators for a certain process are a few examples of such process data. The value-added (VA) and non-value added (NVA) periods of processes, such as, for example, process time and inventory or waiting time, are visualized in the bottom part.

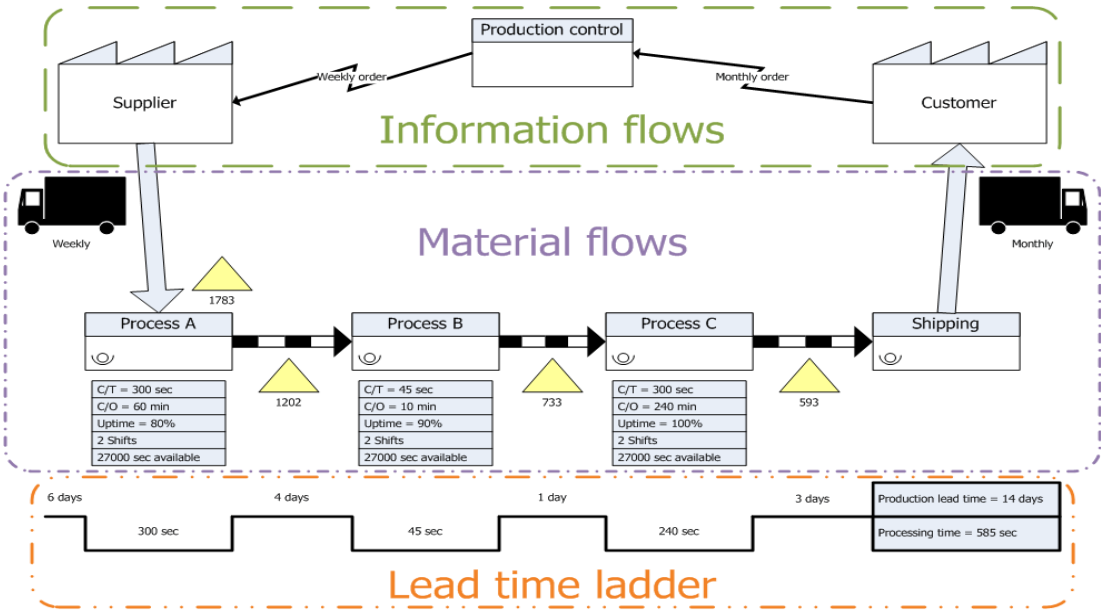


Figure 2: A diagram illustration of value stream map

Source: Womack and Jones (2003)

The remaining value-added and currently required non-value-added process steps need to be set up so they flow, allowing the least amount of work in process (WIP) and consequently the shortest lead time possible (O'Brien, 2018). This must be done after the value stream has been mapped and waste has been identified and eliminated (a never-ending process that needs to be repeated continuously). To understand the VA and NVA moments that happen throughout the whole process, this principle demands diverse ways of thinking. Thus, the point of view of creating appropriate goods and services must be adopted by people (Womack and Jones, 2003). An advanced and diverse way of thinking therefore is necessary to improve traditional functions effectively and efficiently (Womack and Jones 2003). Nonetheless, a loss of batch-processing and process overview might occur due to such groupings. Thus, waiting time for people might be a result of efficient batch processing, which also brings about the interruption of products and information flow (Womack and Jones 2003). Hence, Womack and Jones (2003) suggest that, with the minimum WIP, flow ensures an accurate and efficient process of services and goods. After the value stream has been formed using flow, the lead time between client orders and delivery is significantly shortened.

Nonetheless, some products are still produced with orders from customers, and with this, the waste occurrence is still inevitable. In the absence of demand, commodities and services are advanced through the system, resulting in the creation of finished goods (Womack and Jones 2003). These vain, finished products which are not sold end up creating significant cost losses, which leads to waste creation. As a result, the fourth lean principle, which allows the creation of goods and services as and when demanded, is implemented through a push system. Ideally, this ensures an adequately short production time and ensures that products and services are produced when there is demand. In this regard, the existence of finished goods and products without demand is eliminated (Womack and Jones 2003). Finally, principle number five is the relentless pursuit of excellence that starts the process of continually bettering the present situation, which is one of the key drivers in the Lean concept (Womack and Jones 2003).

### **1.3.2 Liker's 14 Principles**

The work of Liker, another author who uses principles to communicate the TPS's ideas, was published in a book named "The 14 Principles of the Toyota Way." Although he acknowledges the five concepts Womack and Jones first proposed, in his opinion, the Toyota Way is comprised of 14

principles that also serve to characterize the culture that underlies the Toyota Production System (Liker, 2004). Therefore, as structured by him, the principals can be sub divided into 4 categories, as shown in table 1.

**Table 2: Liker’s 14 principles of the Toyota Way**

**Category 1:** Long-Term Philosophy

**Principle 1:** Base your management decision on a long-term philosophy, even at the expense of short-term financial goals.

**Category 2:** The Right Process Will Produce the Right Results

**Principle 2:** Create continuous process flow to bring problems to the surface.

**Principle 3:** Use “pull” systems to avoid overproduction.

**Principle 4:** Level out the workload (heijunka). (Work like the tortoise, not the hare).

**Principle 5:** Build a culture of stopping to fix problems, to get quality right the first time.

**Principle 6:** Standardized tasks are the foundation for continuous improvement and employee empowerment.

**Principle 7:** Use visual control so no problems are hidden.

**Principle 8:** Use only reliable, thoroughly tested technology that serves your people and processes.

**Category 3:** Add Value to the Organization by Developing Your People and Partners

**Principle 9:** Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others.

**Principle 10:** Develop exceptional people and teams who follow your company’s philosophy.

**Principle 11:** Respect your extended network of partners and suppliers by challenging them and helping them improve.

**Category 4:** Continuously Solving Root Problems Drives Organizational Learning

**Principle 12:** Go and see for yourself to thoroughly understand the situation (genchi genbutsu).

**Principle 13:** Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly.

**Principle 14:** Become a learning organization through relentless reflection (hansei) and continuous improvement

Source: Adapted from Liker (2004)

Liker's (2004) four categories are 1) "Long-term philosophy," 2) "The right process will produce the right results," 3) "Adding value to the organization by developing people and partners," and 4) "Continuous problem solving will create a continuous learning organization."

The first category in Liker's (2004) list is "Long-term philosophy," 2) "The proper procedure will result in the proper outcomes," A continuous learning organization will be created 3) "Adding value to the company through growing people and partners," and 4) "Continuous issue resolution. The second principle, which is the “process category” is the most used principle by institutions (Womack & Jones, 1994; Liker, 2004; Ohno&Bodek, 2019). Moreover, most lean principles are intertwined in the second category (the right process will produce the right result) which was also formulated by Womack and Jones (2003). Consequently, when firms implemented the right lean principles and processes (category 2), it helps them achieve flow and this helps them evade inappropriate

production. Likewise, the workload at the firm goes through standardization which sets up continues improvement. Also, the use of adequate technology and visualization aids to restrict problems in the production line. This means the production line has been programmed to stop, whenever there is a technical hitch with disrupts production (Ohno 1988, Liker 2004). The notion behind Liker's first category is underpinned by a future-inclined philosophy, even if this necessitates sacrificing short-term financial objectives. As such, as proposed by Liker (2004), firms need to realize that they have a bigger purpose to make unique products of purpose than just thinking about making a huge profit. Therefore, firms should align their long-term philosophies with all their firm functions; this will be established towards future goals and common philosophies. For this reason, it can lead to value creation for the customers and the entire economy (Liker & Meier, 2006). The third category sheds light on the relevance of employees and their partner firms, which can also be known as people and partners. The Toyota Motor Company views its people as its most valuable resource. As a result, funding employee development also funds the company's future. Hence, it is imperative to note that if companies employ Liker's principal 10, which seeks to develop excellent people and teams in organizations so that they can adhere to the company's long-standing philosophies. Subsequently, he underlines the need to have a single objective that all human progress should be directed. A business must also have leaders who can pass on its ideology to others and who understand it themselves. The ninth principle in Liker's (2004) framework, which reads "Grow leaders who understand the task, practice the philosophy, and teach it to others," captures this. The extended network of partners and suppliers is given additional weight in Principle 11, which reads, "Respect your extended network of partners and suppliers by challenging them and helping them improve." This principle essentially emphasizes that both internal and external people should be treated with respect. Partnering with suppliers and customers is an extension of one's business, according to principle 11. (Liker, 2004; Ohno and Bodek, 2019).

The establishment of a learning organization through ongoing root-cause issue resolution is covered in Liker's (2004) fourth category, which is titled "Continuous problem solving will build a Continuous Learning Organization." An essential rule is, among other things, to look at the issue directly and personally rather than speculating based on what other people, or a computer screen, says to you. The term "genchigenbutsu" is frequently used to describe this idea. A choice must be made on the best course of action after the problem's core cause has been located. According to principle 13, Liker (2004) advises always attempting to reach a consensus with all parties. This method, known as

"nemawashi," may take some time, but it aids in implementing the answer rapidly after an agreement has been reached because everyone agreed on it before the implementation started. Finally, Liker's (2004) fourteenth and final concept, "Become a learning organization via persistent reflection (hansei) and continual development," aspires to become a learning organization. Deploying continuous improvement tools and a continuous improvement process necessitates reliable and consistent processes (kaizen). To support the objective of being a continuous learning organization, regular reflection meetings to identify lessons learned are held (Liker 2004). The explanation of the TPS and Lean by Liker (2004) and Womack and Jones (2003) both emphasize the significance of continuous improvement as the guiding principle for all that the company accomplishes. Today, a lot of people utilize the seven categories of waste to help them in their quest for continuous improvement.

#### **1.4. Seven Types of Waste**

Lean management's primary goal is to eliminate waste, which is characterized as non-value-added and unnecessary processes and inventories (Liker 2004, Ohno 2019, Womack and Jones 2003). Therefore, there are specifically seven non-value-adding activities or processes. These are 1. Over production (which simply means producing goods when no formal order has been placed, it can also be referred to as an item that has not been produced promptly). 2. Inventory that is in excess is usually found in raw materials, finished goods or work-in-progress goods. Additionally, inventory needs to be kept and transported, both of which are expensive and risk damaging the goods. 3. Goods are transported over a long distance which turns into storage and out of storage (Liker 2004). 4. When employees constantly walk around the workplace to search for equipment, it's considered a waste of time, which reduced the number of hours put into work (Liker 2004). 5. When products are processed incorrectly it is a result of inefficient processes during product creation. This can be attributed to adequate tools usage and products bad product design (Liker 2004, p.29). Additionally, waste happens when a good or service is better than necessary. 6. When employees do not utilize their time properly to watch automated machines and wait to repair all malfunctions in machines (Liker 2004). Lastly, when defects on products are reworked and repaired, it needs additional time and effort, and this brings about handling delays (Liker 2004). The seven types of waste which have been explained in literature are not only limited to the ones above. However other studies also contribute to the discourse in diverse ways. For instance, Czabke et al. (2008) opined that when firms do not learn



from their previous mistakes and make mistakes continuously it brings about the occurrence of waste. Above and beyond, in the lean management discourse, it has been proven that when waste is properly identified and curtailed via lean management principles it aids in the continuous improvement of business performance.

## **1.5 Summary**

Lean Management has supplanted TPS and Lean Manufacturing. It is today regarded as one of the world's most utilized management systems. Several famous scientists and practitioners have consistently proved and verified its usefulness (Womack and Jones 2008). If adopted and performed appropriately, these concepts and ideas may be extremely effective. All sectors may benefit from Lean's ideas and philosophy. Essentially, Lean may assist any industry by decreasing waste and streamlining operations to improve competitiveness. However, in comparison to other industrial and economic sectors in the EU, the lean industry does not appear to have adopted lean quickly or readily, even though lean may alleviate many of the difficulties in the lean sector.

## **2.0 LEAN IN THE PUBLIC SECTOR**

### **2.1 Public Sector Context of lean**

According to Collins Dictionary (2017), the public sector is "the portion of a nation's economy that is managed or financially supported by the government. lean public sector comprises organizations with shared funding that offer essential social services. Thus, it is indicative that the definition of the public sector might vary across different countries. Also, organizations like the police, hospitals, and schools are frequently included. In terms of traditional orientation, three main important dimensions make public sectors distinct from private sectors (Boyne, 2002). Public sectors play immense roles in the economies of countries in every part of the world. However, irrespective of the nature of their operation, functions and activities, public sectors are usually confronted with several similar constraints (Rodgers and Antony, 2019). The public sector is known to have a unique character since it is not intended to maximize profit but ensure the public good (Drotz, 2016). The operations of the public sector, however, must be sustained, which calls for strategies aimed at cutting down or eliminating losses. This motivated the earlier adopters of the lean methodology (Drotz, 2016). Generally, the public sector provides public services to citizens; thus, the services they provide must be both quality and affordable (Poister and Streib, 2018). Flynn (2007) posits that public services are mostly rendered to the vulnerable in society and irrespective of the customer's ability or inability to pay, the service must be provided to ensure their satisfaction. As a result, it is prudent that, to serve the public well, public sectors should devise strategies that will make their services cost-effective and time efficient. Hence, several authors (Radnor and Osborne, 2013; Procter and Radnor, 2016; Antony et al., 2016; Carter et al., 2016) propose that the adoption of lean management in the public sector is key in ensuring efficient and effective service delivery among public sectors.

Likewise, Waring and Bishop (2010) indicated that in terms of research on the application of lean among public sectors, the healthcare sector remains the sector with the highest lean research focus. Although most studies conducted in lean health show how lean functions in various healthcare sectors, practical application in the same context is scant in the literature (Liberatore, 2013). Moreover, Liberatore (2013) further argued that, despite a colossal agreement on the importance of lean to the healthcare sector, the focus is highly directed to individual projects, and case studies but does not focus on organizational methodologies. Besides, the evidence is clear in the literature

concerning the adoption of lean management, nonetheless, evidence on the appropriate lean methodologies selected is minute (Proudlove et al., 2008; Chiarini and Bracci, 2013). As such, a deeper understanding of the application of lean methodologies is required. Therefore, this study aims to delve deeper into the literature to examine the application of lean in the healthcare sector to add to the literature in the lean and health care discourse.

## **2.2 Application of Lean Management in Selected Public Sector Institutions**

There has been some form of discourse, research, and deliberations when it comes to whether the lean methodology approach is applicable in the service sector since it started from a predominantly manufacturing or production-based operation. Evidence as noted by Bateman, et al, (2014), over the years suggests that there have been quite tremendous improvements with the introduction of the lean methods of principles within the service sector. When one specifically thinks of the public sector there is replete research, although these normally would give diverse results depending on the sector it was applied, so for instance concerning health care, a couple of research have been conducted (Spear, 2005; Esain et al., 2005; Radnor, 2010), Some have also been conducted when it comes to the armed forces or the military ( Agripino et al., 2002; Costa, et al, 2020) and others too when it comes to higher education within the public sector (Comm and Mathaisel, 2005; Emiliani, 2004).

In the EU, the public sector continues to be a significant employer, particularly in sectors such as health and education (Afonso et al., 2010; Giordano et al., 2011). Despite sustained economic issues over the next decade, the public sector has been on an increasing trend since 2007 and will remain in the EU at a tremendous cost to taxpayers (Antony and colleagues, 2017). In the current state of nosebleeds, public services are places where the public and its users have certain needs that must be provided as effectively and efficiently as possible. According to Siraj et al. (2010), there is greater proof for the application of lean in the European public sector. The transfer of Lean from manufacturing to the government sector is demonstrated in a case study from the European Union (Radnor, 2010). Spanish municipal governments adopt Lean Kaizen activities to enhance operational and managerial systems, according to Barraza et al. (2009). Before 2001, and maybe until 1995, the NHS in the United Kingdom followed the Lean philosophy (De Souza, 2009). Because of mounting proof of its long-term performance, including case studies demonstrating Lean's success in areas such as hospital material logistics, Lean is frequently adopted by the healthcare industry. Wait times and travelling throughout the institution, as well as Healthcare's strategic and cultural goals, are all

addressed in the patient flow case study. In addition, Kollberg et al. (2007) suggested a set of performance measures to assess ideological change in healthcare.

Higher education institutions have had their hurdles, impediments, and success factors evaluated (Anthony et al., 2012). Concerning higher education, they utilize lean to improve classroom methods and techniques (Cudney et al., 2014; Kanigolla et al., 2014). Therefore, the use of lean management in the European healthcare sector is the main topic of this study.

### **3.0 LEAN IN HEALTH CARE SECTOR**

Recently, both the academic and healthcare communities have gained interested in the application of lean methodologies to healthcare operations. Research reveals that the first article on lean management in healthcare was published in the year 2001, by the National Health Service (NHS) Modernisation Agency of the United Kingdom (Brandao de Souza, 2009). Subsequently, numerous healthcare organizations across the world have started lean efforts. These include the Flinders Medical Centre (Bedford Park, Australia) in 2003, Theda Care (Appleton, USA) in 2001, the Royal Bolton Hospital (Bolton, UK) in 2005, the St. Boniface Hospital (Winnipeg, Canada) in 2008, and the Virginia Mason Medical Center (Seattle, USA) in 2001. As such, in a bid to constantly equip and improve daily practice in the healthcare sector, health institutions press on to eliminate several components in all aspects of healthcare whiles recurring patient response time and providing quality services. Therefore, since these pertinent solutions are of high significance to healthcare sectors across both affluent and non-affluent countries, they continue to search for these solutions to improve defined areas and targets. If healthcare sectors want to improve, their most reliable source of information should be sourced from management techniques and strategies, which have been tried, tested, and worked in multinational corporations and competent institutions worldwide. In scientific literature the term "lean" as a concept for the management of production and business systems is generally accepted and used. This is even though those strategies go by many different names (Lean production/philosophy, Toyota Production System, Lean/Six Sigma, World Class Manufacturing, Kaizen, etc.). Lean in healthcare is the application of a "lean" methodology to healthcare organizations to reduce waste and enhance patient care. According to Aminu (2018), healthcare organizations may make their choices and processes more patient-centred by using Lean concepts and practices. Additionally, all staff members—clinicians, nurses, doctors, and administrative personnel—participate in locating and reducing instances of waste and inefficiency.

The use of Lean in the public sector has been a source of dispute for nearly three decades, beginning with the concept of employing Lean in a healthcare setting. From the outset, the prose has been speculative rather than factual. Healthcare procedures and approaches, according to the researchers, can be utilized without any empirical evidence to support (or contradict) their assertions (Souza, 2009), or they can be based on common sense and experience (e.g., Jacobs and Belfry, 1995; Speer, 2005; Whitson, 1997).

These studies, on the other hand, frequently lack a critical viewpoint and do not sufficiently scrutinize the findings. Academic research on the use of Lean concepts in medicine falls into three groups, according to Brandao (2009): To begin, there is theoretical literature speculating on the advantages of Lean in a Lean environment. For example, (Allway & Corbett, 2002) illustrates how Lean may be utilized to accomplish performance goals by utilizing the power of the institution.

Second, there's a methodology which refers to the development of new techniques or Lean healthcare solutions. As an example (Womack et al., 2005) Examine the parallels between manufacturing and healthcare, and consider the benefits and drawbacks of Lean Healthcare (Jones & Mitchell, 2006). It also contains a review of implementation challenges (Spear, 2005), which considers some of the reasons for Lean Healthcare's slow acceptance. Finally, a case study demonstrating how the Healthcare approach is applied is included. The following are the different types of case studies: closer to industrialization (e.g., pathologic case studies by Condel et al., 2004). Administrative support (e.g., Flinders Medical Centre and (King et al., 2006) Bolton Hospitals NHS Trusts Brandao, (2009) in Australia), organizational processes, and patient processes (e.g., (Massey & Williams, 2005) NHS Trust Education and Development Unit's single tool implementation assessment report). It was said that in this subject, there is more speculative literature than systematic and case-based investigations. More particular work in Lean healthcare is also needed, according to him, and the literature analysis found no critical work on the usage of Lean in healthcare. However, in recent years, a growing number of critical studies have examined how teenage thinking is used in complex social institutions like healthcare.

### **3.1 Scope of Lean in Healthcare Application**

Generally, in the healthcare environment, several areas are known to increase waste. The identified areas are processing of waste, inventory, longer patient waiting time, waste defects and transportation. Usually, waste occurs when patience is not quickly attended to. For instance, when meetings are paused because a staff member did not come early, there is more standby patience. For this reason, lean techniques give hospitals a better understanding that idleness in the hospital leads to waste. Employees who are mostly idle become less innovative and less creative and they are not able to use their full ability to positively affect good patient healthcare. As a result, the waste that employees generate while idle could be used to advance continuous improvement in patient healthcare at the hospital, as well as to build an exception network with patience.

Lean in the healthcare sector curtails defects; it improves quality health care etc. For example, defects in the hospital can be inaccurate diagnoses, failures among process systems, and medical errors. In addition, conditions such as allergic reactions which are preventable, deficient medical records and avoidable infections can lead to waste. In all lean health care improves efficiency and effectiveness in the hospital and helps to avoid waste. Likewise, it reduces costs at the hospital and saves the time of both employees and patients. The health care sector, despite its critical importance, can benefit from lean principles.

### **3.2 Lean Tools for the Healthcare sector**

Over the years, the lean concept which originated in the automotive industry has been applied successfully in the health care sector. The introduction of lean management in the healthcare sector has been done to reduce waste and improve procedures in the healthcare sector (Kovacevic et al., 2016). As documented in the literature, several lean tools have been used in the health care sector. Although these lean tools and methods have many names such as (Lean production/philosophy, Toyota Production System, Lean/Six Sigma, World Class Manufacturing, Kaizen, etc.), "lean" is a concept for managing production and business systems that are widely accepted and utilized in scientific literature. According to Fagerlind et al. (2015), the use of lean tools is considered to increase people's capacity for action and participation, which facilitates the innovation of work processes. Visual follow-up boards, standardized work, 5S (housekeeping), and value stream mapping (VSM) are examples of tools that are frequently used (Pettersen, 2009). Subsequently, lean tools used in literature have been discussed below.

### **3.3 Value-stream Mapping (VSM)**

This lean tool was developed to utilize graphics in its analysis; hence it enables a straightforward representation of flow for a chosen process step from the beginning (material acquisition from the supplier) to the end (the finished product) (learning to see). During the analysis process, VSM displays the duration of each process step, the resources employed, the amount of waiting time between steps, the volume of inventories, the flow of information and materials, the efficiency of the workforce as measured by the cycle time per product (activity), and the turnaround time when switching between products (activities). During its analysis, it also gives essential information such as

bottlenecks, excessive inventories, missing resources, misbalance in process steps, and the definition of corrective actions for process redesign and reorganization for achieving necessary improvements and better process effectiveness (Kovacevic et al., 2016). As indicated by Almutairi et al., (2018) VSM has proven to be highly beneficial. This is evidenced by the fact that wait times in hospital emergency rooms have decreased, prices have decreased, and deliveries have improved in both quality and timeliness.

### **3.2Kaizen - Continuous Improvement**

The name Kaizen is a Japanese word meaning "better improvement," which is ideally a philosophical approach that is concerned with offering concrete solutions in an orderly, continuous, and progressive manner. In the context of a work environment, the name is used to depict how workers work in synergy to improve work operations and activities continuously to eliminate waste. Like many other lean tools, this tool was also developed for the manufacturing industry and has since seen its application in several sectors, most importantly the healthcare sector. Every Kaizen event must be organized and carried out using the PDCA cycle, which is recommended by Deming (Plan - Do - Check - Act). This assumes that the problem identification, analysis, and definition of an improvement solution happen in the first step (Plan), the testing happens in a small, controlled model zone in the second step (Do), the results are evaluated in the third step (Check), and the adoption or modification of improvement activities happens in the fourth and final step (Act). Kaizen events should be planned, executed, and evaluated regularly using coordinated cooperative activities. In healthcare businesses, kaizen helps improve work organization, utility use, patient care procedures, as well as waste reduction in several specializations and departments (Jacobson et al., 2009; Iannettoni et al., 2011; Smith et al., 2012). Kaizen implementation in healthcare is ensured by several factors, including ease of training and introduction, staff motivation, a focus on low-cost, low-risk improvements, employee involvement in the improvement proposal and implementation process, transfer of improvement implementation analysis and testing to the originators of the idea, and respect for all ideas, regardless of their scope and significance (Graban, 2012). Continuous altering/improvement methods may not always be enough in the early phases of Lean adoption when changing the frequently used kaizen technique. Ultimately Kaizen seeks to find and eliminate waste. A Rapid Improvement Event is completed in a short amount of time (1 to 5) and involves significant process stakeholders that focus on resolving a specified opportunity for process improvement.



### **3.3 Visual management**

Primarily human beings are visual beings, and we assimilate information better with visuals methods, for this reason, the visual management (VM) lean tool has been tailor-made to Utilize visual management techniques and tools as a means of establishing a fully visual workplace has been given great significance by the lean approach (Galsworthy, 2017). Correspondingly Galsworthy (2005) shows that VM seeks to ultimately establish a workplace that is self-explanatory, self-ordering, self-regulating, and self-improving, where what is intended to occur does so on schedule and without fail thanks to visual solutions. Most importantly, visual tools such as color, info boards, marking, signs, lights, etc. have been incorporated into visual management (VM). These relevant visual tools can be employed in hospital property to manage space, monitor activity, and track the use of appliances and equipment. Because of the self-restraint function, visual management promotes the safety of both patients and employees. (Kovacevic, M., Jovicic, 2016)'

### **3.4The 5S method in Lean Health Care**

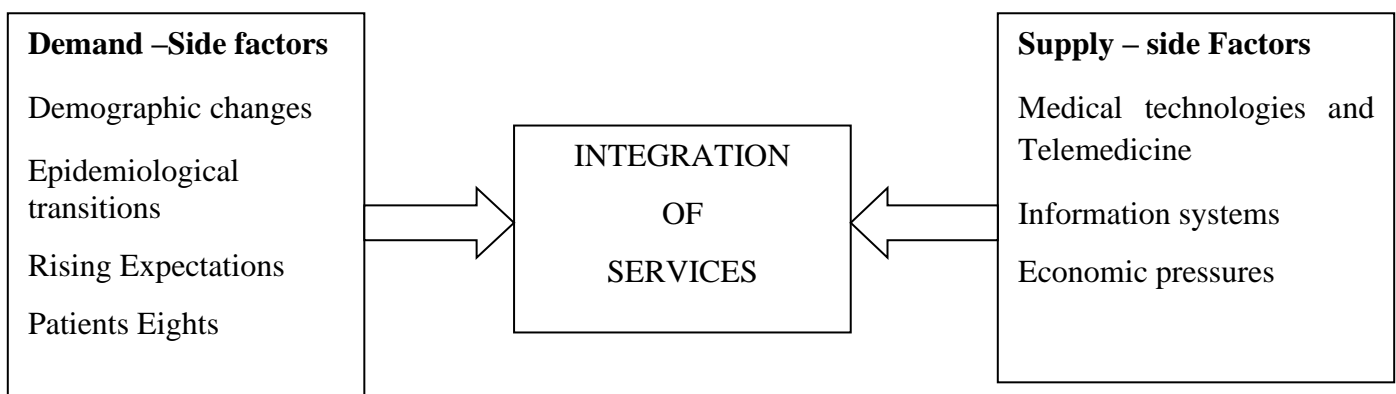
The implementation of the lean concept is also dependent on one of the most important methods known as the 5S method, which is a method for working institutions such as health care. The method is usually implemented with high standards and good assurance of internal organisation rules that are put in place to ensure the achievement and maintenance of high-end results. The name 5S stands for an acronym for 5 words of activities that should be taken in chronological order. The activities delve deep into how organisation operations entail activities such as detailed cleaning of the workplace, equipment and items, and sorting of items to ensure effectiveness and efficiency at the workplace. If safety (for both patients and staff) should be one of the top objectives in healthcare, implementing 6S (5S plus 1) in healthcare organizations can further reinforce this advantage by improving safety procedures in a meaningful and sustainable way (Ikumaa and Nahmens, 2014). Consequently, the method has been employed in several health care departments such as the finance department, administration, offices, and laboratories (Esain et al., 2008). Moreover, the implementation across these health care departments has yielded considerable results, nonetheless more needs to be done. Specifically, the results emanating from implementation indicates that some methods have aided in enhanced safety among workplaces, it has led to a rapid reduction in inventory and supply cost, increase production efficiencies and effectiveness and finally helped reduce overhead costs (Young, 2014; Amasaka, 2015).

### 3.5 Microeconomic Indicators in Healthcare

Most nations recognize health care access as a fundamental human right. As such, governments must take proactive steps to improve citizens' access to healthcare while safeguarding consumers from upfront medical expenses (Zhou *et al.*, 2020). According to Barik and Arokiasamy (2016) types of economic indicators that influence health care here are two, which are micro economic indicators and micro-economic indicators. Tajudeen (2018) established that increase in macroeconomic indicators, especially income is crucial for the individual consumer to access quality health care. In comparison with developed countries, less developed countries, which have the quickest rates of economic growth, do not draw more workers from around the world than they do for huge amounts of production. As a result, it is essential to provide high-quality healthcare, which will necessitate significant financial resources (Zhou *et al.*, 2020). Micro economic analysis of health care indicators is vital for health care systems across the world. Hence micro economic indicators among health facilities are human resources cost, public and energy cost, and private consumable cost (Rezapour *et al.*, 2012). Another important micro-economic indicator is Information and communication technologies that have the potential to improve clinical care on a micro level by facilitating the provision of feedback to individual health professionals on the outcomes of the care they deliver, empowering citizens, allowing better-informed patients and caregivers, and allowing better-informed citizens (Detmer, 2000).

### 3.6. Demographic Issues in Healthcare Delivery in Europe

**Figure 3: Demand and supply indicators of healthcare issues.**



**Source:** Adopted from United Nations. "World population prospects 1950-2050." (1996).

There are several demographic issues in the health care delivery system in Europe and these problems range from dwindling population growth, high rate of old age population and other health concerns. For instance, in countries like Bulgaria, Estonia, Hungary, and Latvia, the population growth is very minimal. The population in most countries is dwindling at a rapid rate and it might lead to a loss of population among some countries. Population ageing will make these trends worse (United Nations, "World population prospects, 2006). Additionally, according to United Nations population projections, by 2025, there will be an additional 1 billion people living on the planet, making a total of 9.6 billion (United Nations population projection, 2019). Although demographic projections suggest that Africa will have a younger population than Europe, it is anticipated that Africa will account for a significant portion of this population expansion. The UN "World Population Prospects: 2015 Revision" study emphasizes that 34% of the European population will be over 60 by 2050, whereas the European Commission estimates that a quarter of Europeans will be over 60 by 2020 (United Nations "World population prospects, 2020). This poses a huge demographic problem as elderly people tend to have a lot of health-related problems that require health care funding. Moreover, there is also the issue of a falling or relatively flat birth rate in Europe.

Europe is faced with some challenging healthcare and economic decisions due to an ageing population, a declining birth rate, and a declining work-age population. As a result, fewer young people will contribute to the coffers, whether through insurance- or tax-based systems (Krugman, 2022). Additionally, as the older population grows, chronic diseases like diabetes, cancer, and heart disease are more common. Over a fifth of persons, 85 years and older live with dementia and the risk of heart disease more than doubles between the ages of 45 and 65. This suggests that there should be some concern about the long-term viability of European health systems (Krugman, 2022). It is obvious that to address these issues, healthcare management needs to be rethought. The secret to a healthy future for Europe, according to many, lies in meeting the increasing demand by concentrating resources on the issues that truly matter. Although the old age dependence ratio is a useful demographic concept, it does not fully capture the extent of economic dependency since it ignores the fact that a sizeable section of the denominator population, particularly young people, is unemployed in some European countries (England and Azzopardi-Muscat, 2017). According to a study by Pammolli *et al.* (2012), the negative consequences of the economic crises have led to a high

unemployment rate, which has been notably high in Greece, Spain, Croatia, and Cyprus since 2016. As a result, the welfare system may be put under stress by shifting populations. This needs to be addressed through a variety of strategies, such as family-related benefits that assist couples who want to have children and facilitate (Colombo et al., 2011). Additionally, research in the developed world has demonstrated a correlation between rising gender equity levels and increased fertility rates (Cleland and Wilson, 2010). The impacts of demographic ageing on healthcare spending have frequently been overstated, as seen, for instance, in the field of pharmaceutical spending, where innovation appears to be a more significant driver (Bongaarts and Sobotka, 2012). Nevertheless, age alone cannot predict a person's health needs. Aspects to consider include the idea of healthy ageing and the development of frailty (Cesari et al., 2016).

Therefore, if healthy ageing is to continue to be a top of the public health discourse among the European public health in the years to come, there is no room for complacency from a public health perspective. The implications of population transition on public health will be far more widespread; the ideas presented above are only a very narrow view. For instance, the necessity to stop concentrating on young people alone and start meeting the unmet needs of older people has been recognized in planning for strategies like sexual health (Lindau et al., 2007). Another clear topic that needs more research attention in the coming years is the effect of ageing on public mental health. Demographics will impact public health strategy and practice in other areas as well, such as communicable diseases. It has been demonstrated that the estimated disease burden of HBV and influenza in the Netherlands is affected by an ageing population in distinct but evident ways. Planning communicable disease management measures for the future requires taking a dynamic demographic perspective (McDonald et al., 2012).

Likewise, migration and changing ethnic composition is also very important factor which may have an impact on population growth and structure in Europe. Migration from Africa to Eastern and Southern European countries has become rampant. Hence migrant health has been a significant topic worth discussing. Nevertheless, these demographic changes will have a distinct effect on various regions of the world. Flexible and adaptive models will be needed for global change to be successful and sustainable and to match the new health economics (PWC Global, 2017). The changing demographics demand that health care expenses are increased across Europe due to the increasing age of residents, also the influx of immigrants and the high rate of deadly diseases. Subsequently, lean

management in the healthcare system provides a good solution. For instance, Salam and Khan (2016) indicated that the adoption of a lean process in the hospital gave patients health care that was safer, more efficient, and more timely. Thus, the application of lean management in healthcare will ensure the delivery of safe and efficient healthcare among the aged and immigrants who seek health. Moreover, the application of lean management in health care will improve the utilization of resources in the hospital. This will ensure the reduction of waste, lower inventory levels, fewer hospital machines and equipment breakdown. These will prompt the efficient utilization of healthcare funds Kadarova and Demecko (2016). With the application of lean management, healthcare funding will increase, and every patient can have access to adequate healthcare. Above and beyond the evidence, it provides accurate information on why lean is the pertinent solution to the changing demographics in European healthcare.

### **3.7 Funding Sources in Europe's Healthcare System**

In most of the industrialized economies around the globe, healthcare is one of the largest economic sectors. Health care accounts for 11.7% of the total GDP in all OECD (Organisation for Economic Cooperation and Development) countries (OECD, 2019). To main maintain constant funding and operation, the health care sector needs sustainable funding sources. From literature, three main models can be used to fund health care, these are the taxing-oriented model called the (Beveridge model), the social insurance premium financed system, which is made up of a combination of private and public providers called (Bismarck's mixed' model). Lastly, the private insurance model also exists and can be mostly found in the USA (Lameire et al., 1999). As well Kulesher and Forrestal (2014) reveal that the nature of every health care system shows the financing models that are used to finance it. There are three types of insurance: social insurance, private insurance, and national health insurance, which is funded by a pool of money provided by governments. Ultimately, these forms of health care models are financed by taxes paid by individuals to the government, other private types of funding, and specific funding types across Europe. Considering the above, Kulesher and Forrestal (2014) further argued that a country's health system may vary from one funding source to another, hence one funding model cannot be used to explain a nation's funding sources. According to Gruber (2022), funding for health care comes from taxes, social insurance payments, private insurance premiums, personal savings, loans and other out-of-pocket expenses, grants, and donations.

### **3. METHODOLOGY**

In this section of the thesis, the research methodologies are presented. The type of study that was utilized to carry out the investigation, and the process used to choose the study cases are explained in this section. The method used to acquire the data as well as its analysis is both detailed. The ethical principles that formed the basis for this investigation were also sufficiently explained in this chapter.

#### **3.1 Study Design**

This study utilized a cross-sectional descriptive systematic literature review on lean healthcare. Due to the expected detail of work, this study approach requires a robust approach to design a competent methodological framework, and this is done via content analysis. Therefore, content analysis is a good method for doing a systematic analysis of a sample of research publications (Seuring and Gold, 2012). These four phases will be used to conduct content analysis following Seuring and Gold's (2012) approach. Specifically, these are;

- I. Collecting material,
- II. Descriptive analysis,
- III. Category selection,
- IV. Material assessment.

#### **3.2 Criteria for considering existing publications for this review.**

The first stage involved searching for papers containing the term "Lean Healthcare" on the web of science database which resulted in 840 articles. Next, the search was narrowed down to publications on lean health care in Europe "Lean healthcare in Europe" was entered into the web of science database and it also resulted in 320 publications. In addition, the titles, year of publication, and abstracts of the papers were checked, and the search was narrowed down to 90 articles that were published from 2010–2022.

Subsequently, the title of the articles was checked to ensure it fits the requirements of the study. Also, since the study used articles published from 2010 -2022 the years were checked to verify if the article was published within the year range which was required. Besides the abstracts of the articles, the aims, objectives, and results were checked to see if they were suitable to be used. This is because the abstract gives accurate and precise information about articles, especially the country or origin of the

paper and other relevant information that will show if the paper is suitable to be used. There were additional checks of abstracts and titles to download. 23 papers that fit the topic under study were downloaded from the Web of Science database. The chosen papers contained information relating to lean management and applications of lean in healthcare.

The second stage is reading the texts, where it may be possible to determine the articles' core thesis and the writers' primary findings. Based on the data gathered, analyses were carried out, including grouping the articles by publication year, author, lean tools used, and key findings.

The documents will be categorized at the third stage using the given criteria. In a conceptual model, the criteria will be organized into two main parts, each of which will be further subdivided into subcategories. General article information includes the authors of the articles, the name of the journal, the country in which the research was conducted, and year of publication. Also, conceptual, and practical papers were grouped. Conceptual papers are those that evaluate the literature on lean healthcare. Most of them are reviews of literature. Papers that include case studies and applications are regarded as practical papers. This is when lean tools are used in hospitals.

### **3.3 Study Units and Sampling**

The research was conducted concerning healthcare sectors or institutions in European countries. Moreover, 23 papers in the web of science database were used for content analysis. Subsequently, 5 papers were selected and further securitized via content analysis and discussions were made concerning the benefits and barriers of the application and implementation of lean. Specifically, this is based on papers and articles on hospitals and other healthcare institutions in Europe that use Lean principles and practices for healthcare delivery.

### **3.4 Content Analysis**

The research involved conducting a content analysis of all the information that the research instrument yielded. The variables were compared in some way to highlight the key similarities and differences in how the Lean management technique is applied within the context of the selected healthcare institutions.

To make the presentation of the result precise and understandable, the study illustrates and explains the findings using a range of tables and charts. The results would be structured in accordance with

benefits and challenges of implementation and application of lean. The conclusions would then be followed by recommendations drawn from the writings of other authors whose works were considered for the investigation.

### **3.5 Ethical Consideration**

Since the entire project is based on a desktop research approach, all writers who were chosen for the study earned the proper credit through references and in-text citations. This will aid in preventing academic fraud or plagiarism.



#### **4.0 RESULTS AND DISCUSSION**

Although the lean concept emerged from the manufacturing industry, its application has been utilized in several industries. However, over the years, the healthcare sector has seen a drastic increase in lean tools applications because it is seen as a response to escalating healthcare costs and underwhelming patient safety measures, and there has been considerable interest in the same. Nonetheless, its implementation and application in the health sector in Europe have not been fully documented in the literature, thus this study underscores the application of lean management in the health sector among European countries from 2010 to 2022 via content analysis.

**Table 3: Results and discussion of content analysis**

<b>Authors</b>	<b>Year</b>	<b>Objectives of the study</b>	<b>Methodology used.</b>	<b>Lean tools used</b>	<b>Key Findings</b>
McIntosh et al. (2014)	2014	The study aim to examine lean management in health care sectors	Secondary research	Implementation of general lean tools across the literature	The paper found that although lean management possesses good prospects in its application in the health care sector its actual performance is incoherent across the literature
Hydes et al.,(2012)	2012	The study was focused on scrutinizing the effects of lean thinking on unsedated patients	Survey data and qualitative research	Value stream mapping (VSM)	The unsedated UGI endoscopic pathway has been transformed using lean thinking, resulting in shorter wait times, less staffing needs, and increased patient flow. This pathway template may be successfully applied to other endoscopy environments with excellent patient satisfaction rates.

Grove et al., (2010)	2010	The purpose of the study was to observe the effectiveness of lean management in 13 months in a primary care health visiting service	Quantitative data	Value stream mapping (VSM)	Analysis revealed that about 65% of procedures were unnecessary and could be eliminated in the revised process map. According to the baseline time-and-motion statistics, the administrative support personnel generated 46% of the waste, compared to 15% for clinical staff.
Wang et al., (2015)	2015	The study aimed to apply lean management tools in the hospital and evaluate their benefits.	Descriptive analysis	Value stream mapping	1.The application of value stream mapping (VSM) reduced patient waiting time from 1 hour 18 minutes to only 38 minutes at the Emergency department 2. In addition (VSM) increased service delivery from 54% to 89 % at the Emergency department
Niemeijer et al., (2012)	2012	The paper illustrates the importance of lean six sigma at the University	Descriptive analysis	Lean sigma six	The study found that lean sigma six helped reduce costs and improve quality at the University medical centre. In addition, it helped in cost reduction and problem-solving.

		Hospital in Groningen			
Eriksson (2017).	2017	The knowledge and perception of nurses on lean and sigma six were evaluated in this study.	Descriptive analysis	Lean and lean sigma six	It was found that nurses interviewed for the study had the perception that lean is better than sigma six because nurses were more familiar with the qualities of lean work and also because of its bottom-up approach.
Mazzocato et al.(2012)	2012	The main goals of the study were to ascertain why and how applications of lean management fail or succeed.	Case study	Four lean principals (Visualization, standardization, first-time quality, and continuous improvement	Lean helped address changes in employee roles and reduce both waiting and lead times significantly.
Davies et al. (2019).	2019	The study aimed to assess the effect of lean six sigma on the efficiency of a	Post and pre-evaluation methods via (interventional study)	Lean sigma six	The study revealed that lean sigma six implementation improved service performance and increased the satisfaction of both patients and staff at the hospital. Also, lean six sigma

		daycare unit in a private hospital. Further, the study ascertained the impact of lean sigma six on patient care and nursing time.			improved nurse to patient ratio and increased nursing care time.
D'Andreamatteo et al. (2015)	2015	To find out theoretical and empirical works released until September 2013	Literature review		LEAN is best understood to increase productivity. Theoretical works have mainly focused on barriers, challenges, and success factors.
Tapani_Jorma et al. (2016)	2016	This study aims to assess how LEAN thinking is applied as a management and development tool in the Finnish public healthcare system and what	A mixed method approach included the Webropol poll.	Total Quality Management (TQM), Six Sigma (SS), LEAN Six Sigma (LSS) and LEAN	The study found that the application of lean tools in Finish health care is relatively new, and knowledge of the application is also low among finish healthcare professionals. Although it has not yet been fully deployed, it is mostly utilized as a development tool to look for financial savings and to increase the effectiveness of patient processes.

		results have been attained or anticipated because of its application.			Nevertheless, LEAN programs have had good results, and the technique is already well-known. Hence, if well-articulated in the finish health care, it will improve efficiency and effectiveness.
Barelet al., (2015)	2015	The study aimed to assess lean processes in hospitals	Case study approach (discrete-event simulation model)	5S methodology Kaizen - Continuous Improvement Value-stream Mapping (VSM) Visual Management	The study indicated that the application of lean tools in hospitals had tremendous benefits to hospitals.

Drotz and Poksinska (2014)	2014	To contribute a deeper understanding of new roles, responsibilities, and job characteristics of employees in LEAN healthcare organisations	case study	5S methodology Kaizen - Continuous Improvement Value-stream Mapping (VSM) Visual Management	The implementation of LEAN had a great influence on the roles, responsibilities, and job characteristics of all employees. The focus shifted from healthcare professionals, where clinical autonomy and professional skills have been the guarding principles of patient care, to process improvement and teamwork
Improtaet al., (2018)	2018	The purpose of the study was to introduce lean thinking to a hospital in Italy to augment patient flow and improves the continuous flow of patience in various stages of treatment in the	Qualitative analysis and case study approach	Value stream mapping	After the application of the lean thinking methodology in the hospital, it was observed that the performance in the emergence department drastically improved. Specifically, the time in patient care was improved and waiting times for patients improved greatly.

		hospitals.			
Laureani et al., (2013)	2013	The study aimed to examine the implementation of lean six sigma approaches in a hospital	Case study approach	Process mapping, seven wastes, 5S and logic tree/root cause were each used in two of the five projects.	The study found that even when executed by relatively inexperienced users, Lean Six Sigma projects may produce significant organizational benefits. The initiatives' advantages included a decrease in hospital falls, more thorough medical records, and shorter lead times for prescriptions.
Andersen et al. (2014)	2014	To analyse the factors that support LEAN intervention goals and comprehend when and how each facilitator contributes	Literature review	5S methodology Kaizen - Continuous Improvement Value-stream Mapping (VSM)	The study identified 23 factors that enable a successful LEAN intervention in hospitals.



				Visual Management	
Chiarini and Bracci (2013)	2013	The study aimed at understanding how and under what circumstances the Lean Six Sigma model could be applied to the healthcare industry, with an emphasis on challenges relating to people and process	Literature review	Lean Six Sigma	The study found that there are several challenges in applying the lean Six Sigma model to the healthcare industry. Thus, Institutional, cultural, and technical challenges were highlighted as the three key problems.

Houchens et al., (2014)	2014	To access, how lean principles can be applied in healthcare and to determine the customers in the healthcare system and their values specific to each.	Literature review	5S methodology Kaizen - Continuous Improvement Value-stream Mapping (VSM) Visual Management	Modern healthcare organizations comprise complex processes and are in significant need of improvement in the domains of safe, efficient, timely, and appropriate delivery of care to patients. From decreased patient wait times to improved patient throughput in emergency departments to more efficient bedside rounding practices, lean has improved the quality of healthcare delivery in institutions that teach its ideals and goals. By going and observing where the work is performed, asking why to determine the root cause of problems, and respecting and supporting involved parties, organizations may have a positive transformative effect on the way healthcare is delivered.
Jens Karstoft and Lene Tarp	2011	The study aimed to employ Lean management in a non-profit	Case study	5S method, VSM and Kaizen continuous	The implementations lead to an increase in productivity in the hospital. Specifically, lean implementation leads to a reduction in patient wait times and

		hospital because of the spike in demand		improvement	also increases training times in the hospital.
Rubin (2014)	2018	Review literature on Lean, an improvement philosophy made famous by the Toyota Motor Company, regards to the healthcare sector	Literature review	5S methodology Kaizen - Continuous Improvement Value-stream Mapping (VSM) Visual Management DMAIC	The study indicated that lean management improves the delivery of patient care, governments and healthcare institutions that adopted quality improvement methods that had been developed decades earlier in manufacturing industries.
Kovacevic et al., (2016)	2016	A review of some of the most effective applications of lean tools and principles in	Literature review	5S methodology Kaizen - Continuous Improvement Value-stream	As a primary outcome, the use of the lean concept enabled healthcare organizations to concentrate on their primary core tasks and give patients more time and attention without raising expenses for the patients or the healthcare system. Lean

		healthcare businesses is presented in this paper		Mapping (VSM) Visual Management	implementation in the healthcare industry, however, may be considerably more challenging than it is in a typical industrial setting. There are numerous examples of lean in healthcare initiatives that have failed to provide any quantifiable outcomes or long-lasting advantages.
Robinson et al., (2012)	2012	The potential complementary functions of DES and lean in healthcare are investigated in this research from both a theoretical and an empirical standpoint.	Case study	SimLean model	SimLean evaluation makes it possible to mix simulation and lean over a longer time frame, maintaining their impacts and perhaps improving lean's sustainability. DES and lean are generally fed back into each other through SimLean. Because DES users are more engaged, Lean has a bigger effect.
Improta et al., (2015)	2015	The study's goal was to demonstrate how lean sigma six	Case study	Lean sigma six	According to the study's findings, lean sigma six implementations decreased costs related to prosthetic hip replacement surgery and decreased

		cuts' expenses associated with prosthetic hip replacement surgery.			patient stay time from 18.9 days to 10.6 days.
Ulhassan et al.(2013)	2013	The purpose of the study was to investigate why and how a hospital adopts lean in a Cardiology department	Content analysis	Lean model	Lean adoption differed depending on how much the staff felt that change was necessary. Teamwork and task redesign were shown to be beneficial in enhancing patient care, whereas problem resolution was found to be beneficial in maintaining staff engagement and maintaining the results over time.

**Source:** Authors own, 2022

#### 4.1 Results of descriptive analysis

The results of the descriptive statistics of content analysis are presented in the figures below. Specifically, the results which are presented are the number of lean tools used, the year distribution of papers published on the application of lean in healthcare sectors in Europe, the number of articles that were found in respective years and the methods used in various articles used.

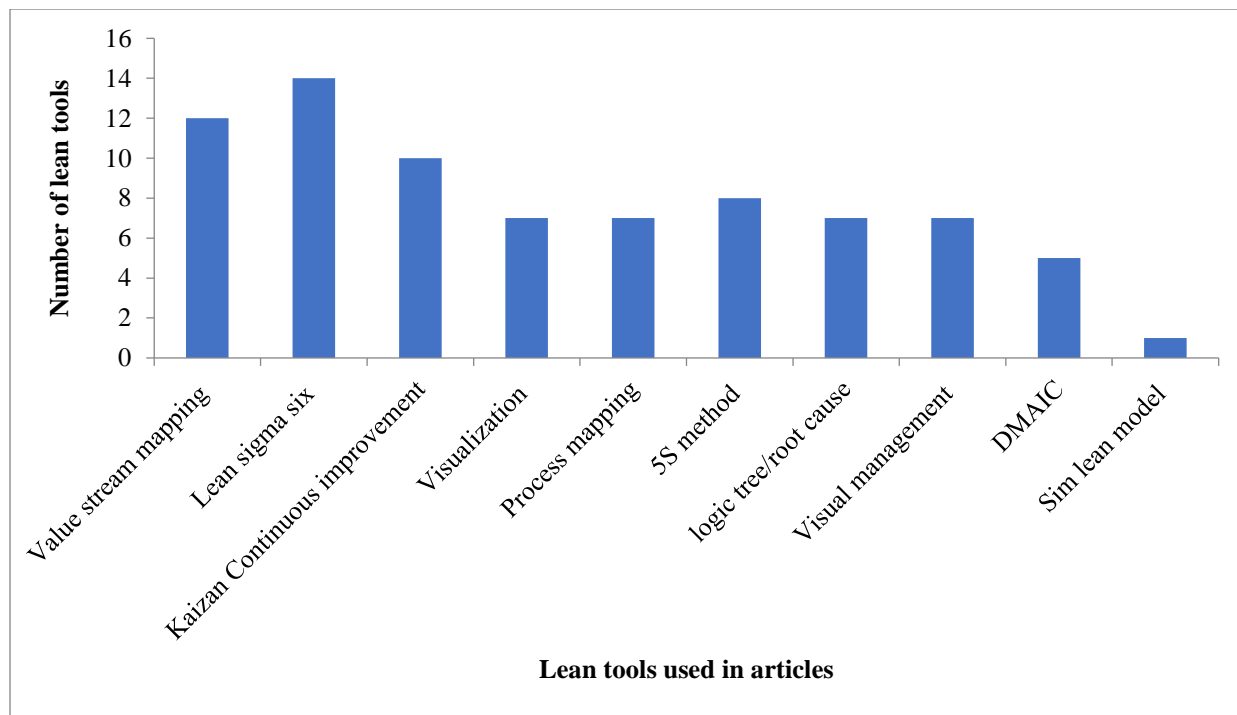


Figure 4: Lean tools used in articles.

Source: Authors own, 2022

The used papers were published from 2010 to 2022 in the Web of Science database. The results from figure 4 show the numerous lean tools used in articles used for content analysis. It was found that lean six sigma was the most used lean tool in healthcare sectors followed by value stream mapping, whereas the sim lean model was the least used lean model among healthcare sectors.

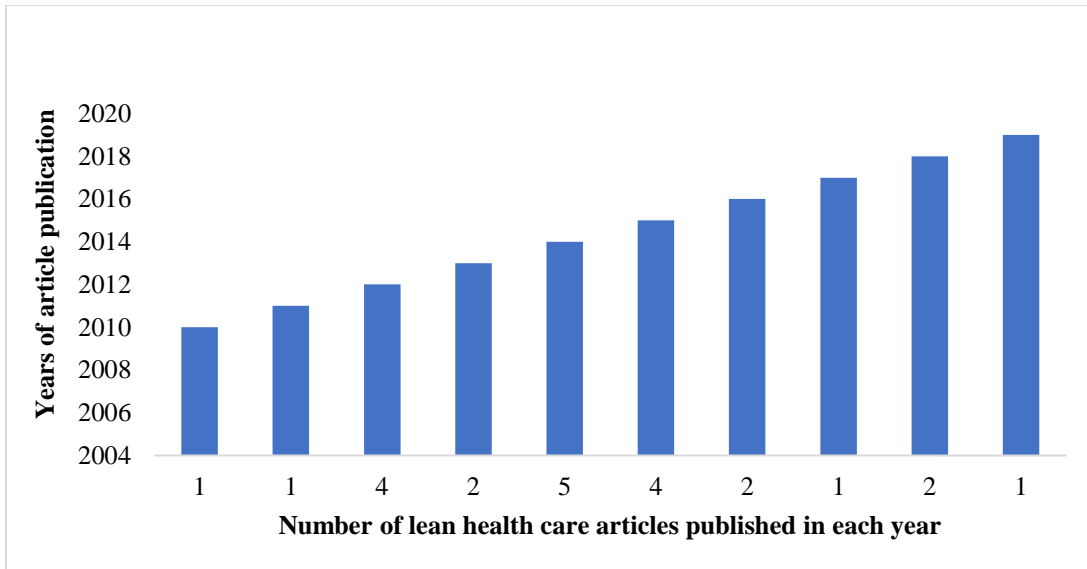


Figure 5: Yearly distribution of articles published on lean in healthcare sectors in Europe.

Source: Authors own, 2022.

The figure shows that most of the papers were found in 2014, while 1 article was found in 2010, 2011, and 2019, respectively.

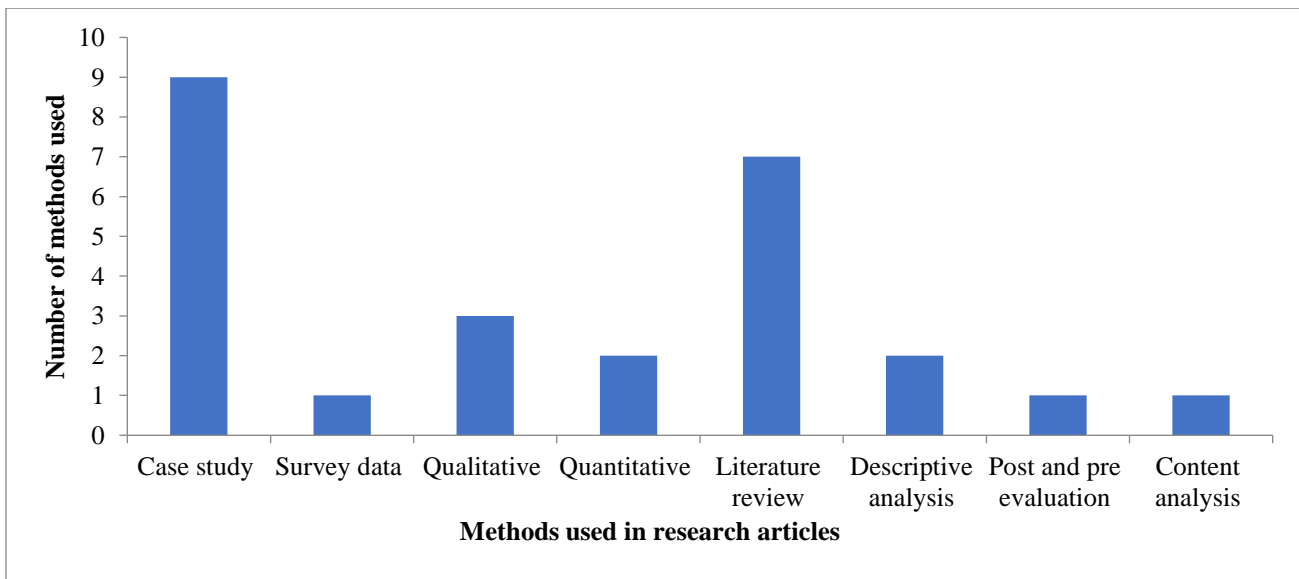


Figure 6: Methods used in research articles.

Source: Authors own, 2022

Figure 6 shows the methods used in various articles. The information in Figure 6 indicates that case studies were mainly used among the articles documented in this study, followed by a literature review.

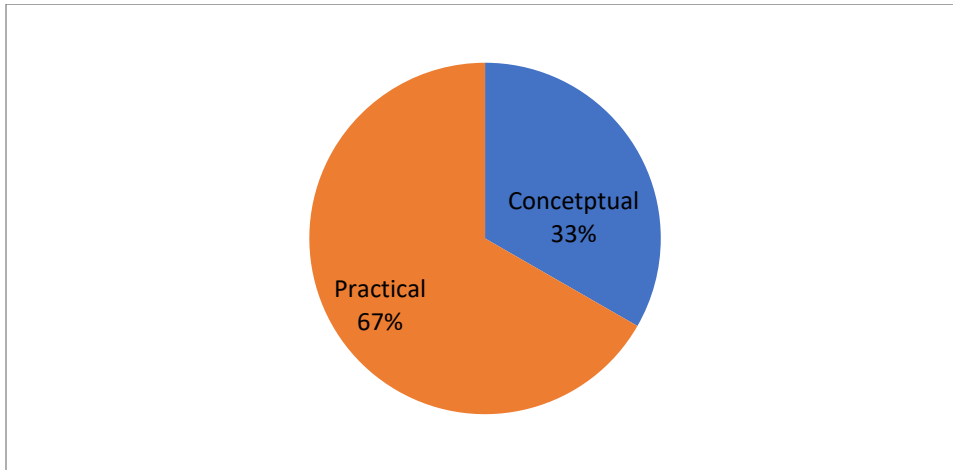


Figure 7: Type of articles used.

Source: Authors own, 2022



## **4.2 Practical application of lean tools in European hospitals**

The discussions were held concerning the benefits and challenges of the application and implementation of lean. Specifically, this is based on papers and articles on hospitals and other healthcare institutions in Europe that use lean principles and practices for healthcare delivery. These papers were chosen for further scrutiny because they fit the purpose of the study perfectly. Also, these 10 articles were selected because the articles adopted the practice use of lean tools in hospital departments which showed practical results and challenges.

**Table 4: Benefit of lean application in European hospitals**

<b>Authors</b>	<b>Lean Tool</b>	<b>Hospital department</b>	<b>Benefit</b>
Davies et al. (2019).	Lean six sigma	Day care unit	<ol style="list-style-type: none"> <li>1. In the daycare centre lean sigma six reduced time wastage and reduced nursing time.</li> <li>2. Also About 200 hours were saved per nurse, per annum and every nurse in the department can have about 4 extra hours which they can devote to patient care.</li> <li>3. Lean sigma six Improved patient satisfaction in the daycare centre</li> </ol>
Improtat et al. (2018)	Value stream mapping and 5S method	Emergency unit	<ol style="list-style-type: none"> <li>1. The results found that value stream mapping helped reduce overall time spent by patients.</li> <li>2. Also value stream mapping decreased patient waiting time</li> <li>3. 5S method improved the overall performance of the Emergency Unit</li> </ol>
Laureani et al. (2013)	5S method	Several departments	<ol style="list-style-type: none"> <li>1. 5S method improved inventory management at the hospital.</li> <li>2. Also 5s method helped to improve storeroom cleanliness.</li> </ol>
	Define, measure, analyse, improve,		1. DMAIC was applied at the hospital, and it enhanced the delivery of medical records (28 out of 90 faults were noted in medical records) this was

	control (DMAIC)		improved to (5 out of 220 defects)
	Mistake-proofing (poka-yoke) and Control Chart Root cause analysis		2. Mistake-proofing (poka-yoke) and Control Chart Root cause analysis improved hospital data quality and availability
	Process mapping	Psychiatric unit	1. Process mapping reduced cost and resources at the Psychiatric unit, and the lead time for the written communication process was cut from 15 days to 3 days.
Robinson et al. (2012)	Discrete-event simulation (DES) and Process mapping		Discrete-event simulation (DES) and Process mapping helped to minimize resource wastage and helped to identify unexpected effects of change.
Jens Karstoft and Lene Tarp (2011)	5S method, VSM and Kaizen continuous improvement	Radiology department	1. The implementation 5S method leads to an increase in productivity in the Radiology department  2. Lean implementation lead (VSM and Kaizen continuous improvement) helped to reduce patient wait times and increase training times at the Radiology department
Wang et al.(2015)	Value stream mapping	Emergency department	1.The application of value stream mapping (VSM) reduced patience waiting time from 1 hour 18 minutes to only 38 minutes at the Emergency department 2. In addition (VSM) increased service delivery from 54% to 89 % at the Emergency department
Mazzocato	Four lean principals	Pediatric	The four lean principles which were applied reduced lead time. Specifically,

et al. (2012)	(Visualization, standardization, first-time quality, and continuous improvement	Accident and Emergency department.	lead time at Pediatric Accident and Emergency department improved from 19-24 percent.  Also, the four lean principles which were applied helped address changes in employee roles, improved coordination and communication at the Emergency Department and Pediatric Accident unit
Eriksson (2017).	Lean and lean six sigma	Hospital	It was found from nurses interviewed for the study that lean sigma six reduced time wastage and reduced costs at the hospital.
Niemeijeret al. (2012)	lean six sigma	University medical centre	Lean sigma six improved quality reduced cost and enhanced problem-solving at the University medical centre.
Drotz and Poksinska (2014)	Kaizen's continuous improvement	Hospital	The implementation of Kaizen's continuous improvement improved efficiency and effectiveness, specifically roles, responsibilities and job characteristics of employees were well defined and executed through continuous improvement.

**Source:** Authors own, 2022

### **4.3 Results of Benefits of the practical application of lean in healthcare sectors (hospitals)**

Table 4 shows 10 articles which were selected and discussed below. These papers were chosen for further scrutiny because they fit the purpose of the study perfectly. Also, these 10 articles were selected because the articles adopted the practice use of lean tools in hospital departments which showed practical results and challenges. Particularly, these articles were used because they adopted the case study approach and they also had relevant information which was current. The discussions were made concerning the benefits and barriers of the application and implementation of lean. Specifically, this is based on papers and articles on hospitals and other healthcare institutions in Europe that use Lean principles and practices for healthcare delivery.

Since the introduction of lean management by Toyota it has evolved it has been applied in diverse fields and has yielded appreciable results in each of the sectors in which it has been applied. In this study, we examine its application in the healthcare sector in European countries. From the 10 documented papers it is realized that there are several practical benefits to the application of lean management and several lean tools in health care. This phase of the study provides an overview of the benefits achieved. Specifically, the use of lean six sigma in a daycare unit in Ireland by Davies et al., (2019) in Post and pre-evaluation methods via (interventional study) yielded significant results. Davies et al., (2019) examined the effect of sigma lean six on the efficiency of a daycare unit in a private hospital. Further, the study ascertained the impact of lean sigma six on patient care and nursing time. Firstly, the results show that the application of lean management reduced time wastage in nursing time. With this, about 200 hours can be saved per nurse, per annum and gives every nurse in the department about 4 extra hours which they can devote to patient care.

Nursing time was significantly reduced because of the elimination of time wastage. Savings per nurse are thought to be around 200 hours annually. This gives each nurse an additional four hours each week to devote to patient care (a value-added activity). The findings are in line with the study of Tagge et al. (2017) which used lean six sigma application to reduce turnaround time from arrival to departure was reduced from 41 minutes to 32 minutes at the children's hospital. Also, after post-intervention evaluation analysis, it was revealed that there was high satisfaction among both patients and staff nurses. Interestingly about 90% of the patients alluded that their experience and satisfaction

at the daycare unit were excellent. Also, the emergency unit is one of the key areas in hospitals which need expedited processes and quick services due to overcrowding and higher waiting times. For instance, the application of lean thinking in an Italian hospital by Improta et al. (2018) had a positive effect in the emergency department. The study reported that, in all five phases namely (triage, examination, diagnostic test, advice, and dismissal) of the emergency department, there was a reduction in overall time spent by patients. Interestingly this was achieved through the application of the most important healthcare management lean tools (VSM and 5s method). Moreover, corrective actions which were tailored towards (staff collaboration and IT systems improvement) were also taken after the intervention of the lean tools. Similarly, Tortorella et al. (2017) found that VSM reduced waiting time and production lead time after the application of VSM in hospital sterilisation unit in Brazil.

Likewise, Laureano et al. (2013) examined several (Process mapping, seven wastes, 5S and logic tree/root cause). The study examined the use of lean tools in 5 different projects in hospitals and examined its success. Specifically, the 5S method was used to manage inventory, which improved storeroom cleanliness and ensured the optimum number of stocks in the storeroom. Secondly, the study applied DMAIC to enhance the delivery of medical records. The study showed definite process improvements that directly benefited the surgical and medical records departments. Before implementation, 28 out of 90 faults were noted, meaning that 28 medical records were not available when surgery was scheduled. Five out of 220 defects were found after implementation, meaning that only five medical records were missing when they were needed during surgery. Moreover, after the lean applying Mistake-proofing (poka-yoke), Control chart Root because analysis made data highly available for top-level managers in the hospital. At the psychiatric unit, the application of lean process mapping 7 wastes. The results indicated that there was no increase in cost or use of resources, and the lead time for the written communication process was cut from 15 days to three days. The result is comparable to the study of Bhat and Jnanesh (2014) who also applied DMAIC principal in rural hospital in India. The study found that average waiting time was reduced by 97% and the length of time patients spent in the queue was also significantly reduced by 91%. This enhances efficient record keeping and delivery of medical services in the hospital.

Several lean tools have been used in the healthcare sector to improve efficiency and effectiveness (Chiarini, 2014; Improta et al., 2014; 2015). However, the application of simulation lean approaches

such as Discrete-event simulation (DES) is not often used and documented in literature. As such, Robinson et al. (2012) employed the Discrete-event simulation (DES) via a theoretical and an empirical perspective to scrutinize the effect of both approaches on health systems and analyse their complementary roles. It was found that respondents supported the complementary use of DES alongside lean methodologies. Also, it was found that when used complementary. Due to its ability to illustrate and comprehend the dynamics of healthcare processes, DES can aid in the teaching of important lean principles. Besides, a dynamic version map that may be utilized to engage participants and further promote problem-solving concepts and dynamics in the healthcare industry can be made using the DES model in addition to during process mapping. By enabling choices to be tried and explored before making expensive investments, DES thus offers a way to improve healthcare operations. As a result, it assists in minimizing resource wastage and identifying unexpected effects of change. The results correlate with the findings of Atalan (2022). Atalan (2022) used the DES method to reduce daily cost of operations in the emergency department.

It is evident that the application of lean approaches in healthcare is beneficial and if articulated well enough in the healthcare sector, the benefits will increase time after time. These benefits range from minimizing resource wastage and identifying unexpected effects of change, which can then be addressed. Also, lean management tools such as sigma six can greatly improve the time nurses spend on patients and reduce time wastage in nursing time, which improves the satisfaction of both health workers and patients. Likewise, tools such as VSM and 5s method has been proven to reduce wait time in the emergency unit, which is essential in reducing emergency unit mortality. Furthermore, lean tools such as Mistake-proofing (poka-yoke), and Control chart Root were proven essential to reduce costs at the psychiatric unit. Overall lean tools such as VSM, the 5S method, sigma six, and process mapping, were highly employed in healthcare sectors across Europe, due to their suitability in healthcare sectors. Owing to the spike in demand for the services of nonprofit hospitals, lean management principles such as the 5S method, VSM and Kaizen continuous improvement, DMAIC were implemented and assessed if they can work in the radiology department in Denmark hospital. After the implementation, it was found that the implementation of lean leads to an increase in productivity in the hospital. Specifically, lean implementation leads to a reduction in patient wait times and increases training times in the hospital. Despite its industrial beginning, lean concepts have shown a high positive impact and success rate when applied at health sectors (Jens Karstoft and Lene Tarp, 2011).

#### **4.4 Challenges of lean application in health care sectors in Europe**

Despite several benefits associated with the application of lean management in the healthcare sector, it has its drawbacks and bottlenecks. Hence it is prudent to highlight the challenges lean application faces. Consequently, Davies et al., (2019) noticed that, despite its immense benefits, the application of lean in the hospital laboratory did not reap immediate benefits; however, benefits were slowly gained. This was attributed to the slow involvement of laboratory scientists. Also, it was found that the inability to state a clear objective for why lean management is being introduced also hampered the benefits of lean management, which occurred due to low engagement by laboratory staff. Flidner (2008) made the same assertion that the initiation for lean tools application might take a while for it takes off, however if applying lean tools, sustainability should be of major concern. It is important to note that not all lean tools applied in healthcare institutions are liked and preferred by hospital staff. For instance, Robinson et al. (2012) reported that some medical practitioners were not impressed by the visual aspect of the DES model; also, some other staff disliked the process maps drawn on brown paper. Ultimately, this could hamper the application and implementation process and could derail its success. There results defer from the findings of Aaby et al (2006) that indicates that by other staff were impressed with the DES model because it enables personnel at all levels to experiment with process modifications in a computer-simulated environment, DES offers a way to achieve this that is both "cheaper" and "safer" than making actual physical changes.

Similarly, Silvester et al. (2004) insisted on the idea that designing healthcare systems operating with low or no waiting times for patients requires the application of various tools and approaches (e.g. lean thinking, process mapping and capacity management), as opposed to adding capacity arbitrarily without having a good understanding of the situation (e.g. bottleneck identification).

In addition, Jens Karstoft and Lene Tarp (2011) reveal that at the initial stages of the implementation some staff at the radiology department were skeptical about the application, which lead to high resistance to its application by some staff members. Likewise, the results are in tandem with of Proudlove et al. (2008), which state that, lean tools and principals are still needs a lot of growth in the healthcare sector, there staff members need a better understanding before its implementation otherwise it might not be fully engaged in it. Furthermore, despite the increasing application of lean management in hospitals, it is worth noting that several other hospitals in Europe are new to lean concepts and their application. Subsequently, Laureani et al. (2013) noted that while some staff have



extensive clinical backgrounds, many were relatively new to lean concepts and their application. As a result, it could make implementation and application a little difficult among staff that is now the lean concepts. This corroborates with the findings of De Souza, (2009) which also indicated that, application of lean in health is in its early stages when compared with the automobile industry. Nonetheless, Brandão de Souza & Pidd (2008) assert that the health care sector can take advantage and learn from the mistake of the automobile industry to improve the application of lean tools. Accordingly, if the management of the hospital is in support of lean implementation, they help staff members adapt to changes, however, if organizational leaders are not in support of the lean management process it makes implementation nonexistent and difficult. The results indicate if the implementation of the lean tools and methods can be successful, firstly, there is a need to get the support of organizational leaders and top management in health care. Secondly, the appropriate lean tool should be implemented for the right objectives and problems it intends to solve. Thirdly, staff should be highly engaged, and they should be trained to become familiar with these lean tools. This can prevent and control any shortcomings and challenges. Moreover, there is a need for constant process improvement using lean concepts in the health sector.

#### **Table 5: Challenges of lean application in European hospitals**

The challenges of applying and implementing lean in the healthcare sectors are presented in table 5. The specific lean tool had several benefits attached to it and the general application of lean in the healthcare sector had several benefits. This is not the case for challenges, as challenges found in the literature are more generic and deal with general staff reception of lean conception and lean management application, support by top management and other notable challenges. Moreover, with respect to challenges, 9 articles were adopted, this is because not all the articles document benefits as well as challenges. Some articles only talked about benefits and ignored challenges, there the number of articles that was used for the challenges were limited to only 9. Subsequently these 9 articles were chosen for further scrutiny because it fit the purpose of the study perfectly. Also, these 9 articles were selected because the articles adopted the practice use of lean tools in hospital departments which showed practical results on challenges. These articles were used particularly because they adopted the case study approach and they also had relevant information which was current.

## Challenges of lean application in European hospitals

Authors	Challenges
Davies et al. (2019)	<p>Despite its immense benefits, the application of lean in the hospital laboratory did not reap immediate benefits; however, benefits were slowly gained.</p> <p>This was attributed to the slow involvement of laboratory scientists.</p>
Robinson et al. (2012)	<p>Some medical practitioners were not impressed by the visual aspect of the DES model, also some other staff disliked the process maps drawn on brown paper, and information on signs and boards were sometimes not clear and cannot be seen well by patients and staff.</p>
Jens Karstoft and Lene Tarp (2011)	<p>The staff of the hospitals were skeptical about the application of lean management which was a challenge in implementing lean management.</p> <p>Some Staff members are resistant to change. Lean management involves significant changes to traditional work processes and organizational culture, which can be met with resistance from hospital staff.</p>
Laureani et al. (2013)	<p>Staff are new to lean concepts and their application</p>
Eriksson (2017)	<p>Limited resources: Hospitals often have limited resources, including time, budget, and staff, which can make it challenging to implement and sustain lean initiatives.</p>
Fillingham (2010)	<p>Implementing lean in the healthcare industry is a stressful and challenging process, which serves as a major implementation challenge.</p>
Pesic et al., (2022)	<p>The complexity of healthcare: The healthcare industry is complex, with many different stakeholders and a wide range of services. This can make it difficult to apply lean principles consistently and effectively.</p>

D'Andreamatteo et al. (2015) and Pesicet al. (2022)	Lack of standardization: Healthcare practices and protocols vary widely across hospitals and countries, which can make it difficult to standardize processes and apply lean principles consistently.
D'Andreamatteo et al. (2015)	Unavailability of data: Lean principles rely on data-driven decision-making, but hospitals may not have access to the data needed to effectively implement and track lean initiatives.

**Source:** Authors own, 2022

## 4.5 Discussion

Over the years, lean management and its principles have been immense in improving the efficiency and effectiveness of work in place of several public sectors. Notable amongst them is health care, especially hospitals. Also, most of the literature concerning the implementation of lean tools in healthcare sectors is replete among developed countries with countries such as the United Kingdom and the United States leading the way. Nonetheless, a complete account of the application of lean tools in the European context is scant. For this reason, this study aimed at examining the application of lean management in healthcare facilities across Europe, spanning from 2010 to 2022. Accordingly, the study aims to examine specific lean tools employed in European hospitals, what are used for and the benefits, and barriers of using such tools. Also, the study documented the most frequently used lean tools among hospitals in Europe. It is appreciated to apprehend that; lean management can be applied in different sections and departments in the hospital and can achieve significant positive results. Throughout the study, evidence gathered showed that lean management can be applied in sectors such as the daycare unit, emergency department, medical records departments, psychiatric unit and radiology department (Chiarini and Bracci, 2013; Improta et al., 2018; Davies et al., 2019). As a result, other studies applied lean management in other departments such as the pharmacy department and the pediatric units (Abdelhadi and Shakoor, 2014). However, a higher number of studies mostly applied lean management in the emergency department (Stanton et al., 2014; Hussain and Malik, 2016). No matter the unit or department of application, its application has yielded good results and benefits among healthcare sectors. This includes reducing overcrowding in hospitals, reducing waiting time, reduction of costs and constant improvement of resources use in hospitals and reduction of waste. Comparatively these results are consistent with studies of (Radnor et al., 2009; Laureani et al., 2013; Abdelhadi and Shakoor, 2014; Isfahani et al., 2018) which also found similar results with lean implementation in healthcare. Despite all the positives lean management applications in health also had some barriers. Medical staff in some hospitals were not impressed with an aspect of lean tools such as visual management. Also, since some health centres were new to lean approaches, their staff was a little skeptical at the initial stages of implementation. Nonetheless, one important thing to note is that if lean management can survive in healthcare, it should have the support of top management and organizational leaders in various healthcare sectors. Equally,

challenges in the implementation of lean management have been documented in the literature. For example, according to Fillingham (2010), implementing lean in the healthcare industry is a stressful and challenging process. Also, Waring and Bishop (2010) argue that lean may represent a new trend in the restructuring of healthcare labor, and thus it may not be the simple solution to boosting healthcare productivity and effectiveness. Other studies are also of the view that due to its roots in the automobile and manufacturing industries, lean management requires constant improvements, restructuring and modification to fully fit into the healthcare sector (Brandao de Souza and Pidd, 2011). Above and beyond the application of lean management in the healthcare sector has been a feasible and successful journey, as long bottlenecks are recognized and addressed during the implementation process, it can only get better. As a result, if the application of lean management can forge on into the future and deliver concrete results, there needs to be a holistic approach and lessons should be learnt from the various failures and successes achieved over the years. Questions on why some health institutions can apply lean management successfully and why other health sectors are not able to apply it successfully should be asked and answered. Also, to ensure the successful implementation of lean management tools in hospitals, success from different hospitals should be emulated and different departments should adhere to specific lean tools that work at specific departments in the health care sectors, especially hospitals. In a nutshell, the application of lean management in the healthcare sector has shown tremendous results and huge potential to do more when constant improvements are made. Thus, research attention should be channeled to the corridors of lean healthcare applications to improve and shape the healthcare sector.

In summary, this is an interesting field with a huge need for research into the application of lean approaches to effectively improve patient outcomes within the healthcare field.

## 5.0 Recommendation

This section entails recommendations of the study. The recommendations have been given specifically with the lean tools used in literature and how they benefited hospitals. It also entails the recommendations on challenges that confront application of lean tools in hospitals.

The specific recommendations of the study are as follows.

It is evident from studies reviewed in the literature that the application of lean management in the healthcare sector has shown tremendous results and huge potential to do more when constant improvements are made. As such the study recommends that hospitals which use different lean tools should constantly evaluate the processes and tools to identify problems and make constant improvements. This will increase efficiency and effectiveness in healthcare sectors.

In addition, the study recommends that health sectors across Europe and other continents should use lean sigma six because it reduced time to waste at the daycare department and reduce cost. As such health sectors that will use lean sigma six can save money simultaneously. Also, lean sigma six is recommended since it improves the quality of services and helps hospitals to easily identify problems and solve them.

Moreover, the study recommends that healthcare sectors that want to manage their inventory efficiently and effectively should use the 5S method due to its ability to improve inventory management at the hospital.

Medical records are essential to any hospital since they promote proper healthcare and make it possible for doctors to comprehend patients' conditions and medical histories. Therefore, the Define, Measure, Analyse, Improve, and Control (DMAIC) process should be used by the health sectors to improve the delivery of patient medical data with few mistakes.

Data management is relevant in several organisations; as such the study recommends that health sectors use Mistake-proofing (poka-yoke) and Control Chart Root cause analysis since it improves hospital data quality and availability.

The healthcare sector always takes care of many people in a short period. Emergency departments of hospitals are mostly crowded with patients in critical condition, which need quick medical care. For this reason, value stream mapping (VSM) is recommended for emergency departments because it

can help to reduce waiting time for patients and significantly increase service delivery by 90% when implemented.

The study recommends that health sectors should be extra vigilant when implementing process mapping because sometimes information on signs and boards is not clear and cannot be seen well by patients and staff. If process mapping would be used, it is recommended that signs are checked properly.

## CONCLUSION

Lean management tools have been widely applied in the healthcare sector in developed countries and Europe is at the forefront. Twenty-one (23) papers from the Web of Science published from 2010-2022 were used for the content analysis. In addition, 10 articles were chosen for in-depth discussions. The aim of the study was to describe the benefits and challenges of the application of lean management tools in hospitals.

The results revealed that Lean six sigma was the most used lean tool in healthcare sectors followed by value stream mapping, this is because it delivers excellent results. Specifically, lean six sigma reduces time wastage in hospitals and reduces cost while promoting effectiveness and efficiency at work. Comparatively while other lean tools such as value stream mapping may help to identify challenges and sources of waste, its ability in reducing waste may be minimal which makes lean six sigma the widely used lean tool because its more efficient and effective in reducing waste and cost.

However, in terms of implementation lean six sigma is more complex and requires more training for staff to implement, while value stream mapping is a more straightforward visualization tool that can be used to improve communication within hospitals.

In addition, system improvement method (SIM) lean was the least used lean method in European hospitals. This is attributed to the fact that the health care sector and its departments involve several processes which may not be well suited for SIM lean. Moreover, while SIM model can be applied in hospitals, it may not be fit due to complex and dynamic nature of healthcare processes, and the importance of patient centricity, clinical outcomes, and patient safety. Furthermore, the use of SIM lean is relatively low due to limited data availability in the healthcare sector. The healthcare sector is heavily regulated, and there may be limitations on the availability of data required by SIM lean to fully map out and analyze processes.

Additionally, lean tools can be utilized in a variety of healthcare and hospital departments, and based on the objectives specified by the hospital, a number of lean tools can be integrated and employed in the healthcare sector. For instance, value stream mapping helps the hospital to better understand the current process and identifies opportunities for improvement in the hospital easier through a visual map, 5S method can be used to sort and remove unnecessary items from the hospital and help standardize procedures and workflows at the hospitals, so that the staff will know what to do and



when to do it and can also be applied to establish standard operating procedures for various processes such as infection control and patient care. Kaizan continuous improvement can be used to analyse and improve processes related to medication administration, laboratory testing and other areas in the hospitals where errors are likely to occur to reduce risk of medical errors at the hospital. Thus, hospitals which seek to achieve all these several objectives tend to combine several lean tools and vice versa. As such the goal of the hospital will determine the need to combine one or two lean tools or use only one lean tool.

### **Future studies**

Future studies should develop other lean frameworks and tools that can be employed at the hospital for better efficiency and effectiveness. Also, future studies should evaluate the knowledge and perception of healthcare staff and management on different lean tools and applications in the healthcare sector.

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