ISCTE Business School
Instituto Universitário de Lisboa

Lean Management in Healthcare Sector

LI XUEYING

Dissertation submitted as partial requirement for the conferral of

Master in Management

Supervisor:
Professor Doutor Álvaro Augusto da Rosa, Assistant Professor, ISCTE Business School,
Department of Marketing, Operation and Management

September, 2019

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Abstract

Purpose – The purpose of this study is to describe an understanding of Lean in healthcare try to identify barriers in successful implementation of lean in healthcare, as it has achieved in mass manufacturing.

Methodology – Systematic literature review approach is adopted for this paper and literatures are classified into categories, based on the quality aims of healthcare proposed by IOM in 2001.

Findings – A total of 52 literatures in lean healthcare are reviewed, classified and analyzed. Several barriers are found in literatures including lost in translation of lean lingos, difficulty to define customers in healthcare settings, narrow application of Lean instead of broad pictures, the lack of pursuit in continuous perfection of lean and readiness of Lean before implementation.

Value – The finding of this study indicates what should be paid attention to for a successful implementation of lean in healthcare .

Keywords – Lean management; Quality; Healthcare; Continuous improvement

Resumo

Objetivo - O objetivo deste estudo é descrever uma compreensão do Lean na área de saúde, tentando identificar barreiras na implementação bem-sucedida do Lean na área da saúde, como foi alcançado na fabricação em massa.
Metodologia - Adota-se a abordagem de revisão sistemática da literatura para este trabalho e as literaturas são classificadas em categorias, com base nos objetivos de qualidade da saúde propostos pela OIM em 2001.
Resultados - Um total de 52 literaturas em saúde lean são revisados, classificados e analisados. Várias barreiras são encontradas nas literaturas, incluindo a perda na tradução de jargões enxutos, a dificuldade de definir clientes em ambientes de saúde, a aplicação restrita do Lean ao invés de imagens amplas, a falta de busca na perfeição contínua do lean e prontidão do Lean antes da implementação.
Valor - A constatação deste estudo indica o que deve ser prestado atenção para uma implementação bem sucedida de Lean na área da saúde.
Palavras-chave -- Manejo enxuto; Qualidade; Cuidados de saúde; Melhoria continua

Acknowledgement

It takes about one year and a half to finish this master dissertation. It is a challenge working and writing the dissertation in the same time yet the outcome will be fruitful and meaningful. Striking a balance between working and studying is just like what the word challenge in Chinese means: crisis and opportunity. It is not easy, but it is worthwhile. And the topic of this study is also about challenge—Lean in healthcare, which is a method seeking opportunity for a leap in healthcare quality confronting the problems existing in the industry. Thus reading successful cases of Lean in healthcare also inspire me a lot.

My special thanks go to my beloved supervisor—Professor Álvaro Rosa, who is always kind and helpful, offering me guidance in studying the topic as well as reminding me not to loose up. In the beginning there was lots of confusion on how to do a research and write a dissertation. With the help of Professor Álvaro, the topic becomes clearer and clearer, and the structure of this study was gradually formed and refined little by little. As a Chinese saying goes, “One day as someone’s teacher, forever as someone’s father”. Education is profound, conveying not only knowledge, but also care and love which needs a lot of patience and energy. Professor Álvaro as my beloved supervisor always has my full respect.

I am also very grateful to my dear colleague when I was doing my bachelor in China, Chen Xiuyan, who is generous to offer me help in acquiring articles in Chinese through database such as CNKI. She is an excellent student which means she is also very busy, but still willing to give away her precious time to help. I will cherish our friendship forever.

Last but not least, a lot of gratitude goes to my colleagues in ISCTE. They are good friends and companions who are always willing to listen and comfort. They inspire me a lot on writing the thesis and trying to keep a balance between work and study. Friendship is one of the greatest wealth above all.

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Chapter 1: Introduction

1.1 Introduction

During 1990s, there was a rising discussion of quality problems in hospitals in America since a growing number of medical accidents and deaths were taking place out of issues related to medical service quality such as avoidable error, underutilization/overutilization of services and variation in services (Griffith, 1998). Medical incidents and quality problems in healthcare services became a major cause appealing health care professionals and policy makers to redesign and improve the healthcare delivery system. (Institute of Medicine & Committee on Quality of Health Care in America, 2001; Joosten, Bongers, & Janssen, 2009) In 2001, the American Institute of Medicine (IOM) released the report "Crossing the Quality Chasm: A New Health System for the 21st Century". In this report, it proposes six quality aims for the 21st century healthcare system: safe, effective, patient-centered, timely, efficient and equitable (Institute of Medicine & Committee on Quality of Health Care in America, 2001). Responding to this challenge, IOM and the National Academy of Engineering (NAE) released another report entitled "Building a Better Delivery System: A New Engineering/Health Care Partnership". (Fanjiang, Grossman, Compton, & Reid, 2005) In this report, it promoted the implementation of tools and techniques applied successfully in mass manufacturing production as well as highlighted the importance of adapting the Toyota Production System into healthcare to improve the quality of healthcare services delivery in the 21st century (Abouzahra et al, 2014). In 2005, the Institute for Healthcare Improvement in the U.S.A promoted to utilize the lean approach to improve healthcare service in order to pursue safe, effective, efficient, patient-centered, timely and equitable healthcare delivery as proposed by IOM (James P Womack, 2005).

Proving its success in various walks such as automotive manufacturing, metalworking and finance, lean has considerable potential in realizing the goal of healthcare service proposed by IOM (Abouzahra et al, 2014). Lean contributes by defining who are the customers and what do customers want, eliminating waste, removing non-value adding steps, enabling flow to go smoothly and continuously in pursuit of perfection. (Bonome, Costa, & Filho, 2016) According

to Johnson, Bullard, and Whitley (2018), Lean makes it possible to reach the highest level of value achievable within a certain setting. It has tremendous potential to refine workflow in clinical processes and enhance drastically profitability in healthcare areas such as OR (operating room), Department of Radiology and Pharmacy. (Collar et al., 2012; Yueyu, 2014; Stig, Ellen, & Sørensen, 2016; Linlin, Zhichao, Wanli, & Xuehui, 2017) Lean prevents serious adverse events from happening, for example, complications after a surgery and in-hospital infection (Joosten et al., 2009). According to Abouzahra et al (2014), to achieve any one of the healthcare quality aims, there are several Lean principles can be applied, as shown in Figure 1-1.

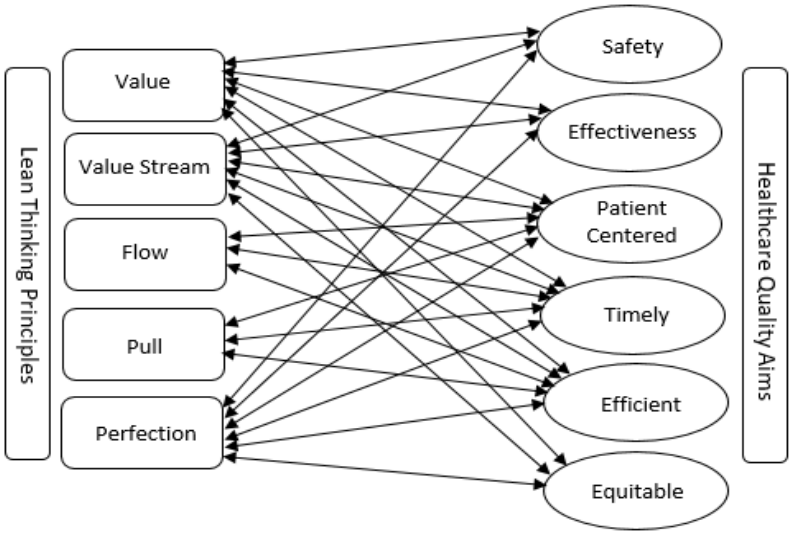


Figure 1-1 Lean Principles and Aims of Healthcare Quality
Source: From (Abouzahra et al, 2014, *"Lean thinking for healthcare"*)

There is a tremendous number of studies on the topic of Lean in healthcare. (Cheng, Bamford, Papalexi, & Dehe, 2015; Roemeling, Land, & Ahaus, 2017) Nowadays Lean in healthcare are being carried out in many nations and regions such as the U.S, the U.K., the Netherlands, Brazil, Sweden, Australia, mainland China, Hong Kong and so forth. However, during the implementation of lean in healthcare, arguments are that unlike spare parts in assembling lines, every patient is unique and requires special treatment. Disappointment towards lean exists among medical specialists due to its poor fit in healthcare (Schonberger, 2018). Although lean thinking has achieved great success in some hospitals in the U.S, it is still facing a lot of criticisms from perspectives of philosophy and practice (Grove, Meredith, MacIntyre, Angelis, & Neailey, 2010; Powell, Rushmer, Davies, & Powell, 2009). Despite all the doubts and confusions towards lean, it is a fact that as a complex organization, “healthcare system consists several different processes

just like other industries, and it is these processes that are targets for improvement using lean techniques" (Abouzahra et al, 2014). The purpose of this comprehensive literature review is to describe an understanding of lean thinking in health care and try to identify barriers or challenges in successful Lean implementation in healthcare like it has achieved in mass manufacturing.

1.2 Structure of this study

This study consists of 7 chapters and can be divided into two parts – first part is introduction and theories of Lean and healthcare (Chapter 1-3); second part is research work (Chapter 4-7). Chapter 2 focus on presentation upon theories of quality management and Lean, while Chapter 3 introduces the concept of healthcare management. Chapter 4 is methodology of this study. Reporting of literature review on the topic of Lean in healthcare is presented in Chapter 5. And Chapter 6 and 7 is discussion and conclusion.

Chapter 2 Lean Management

2.1 History of Quality

2.1.1 Definition of Quality

In terms of ISO standard, quality is to what extend a set of inherent characteristics fulfill requirements. In broad definition, quality is of various meanings, but there are two of great significance: 1. “Quality” stands for features of products that meet customer demand and therefore achieve customer satisfaction; 2. “Quality” means minimum amount of deficiencies which require rework that increases cost (Khoja, Prajapati, Khoja, R.Panjwani, & Ray, 2017).

2.1.2 Revolution of Quality

While some authors define the evolution of quality management as four phases (Dahlgaard-park, 2011; Fisher & Nair, 2009) and others into five (Raho & Mears, 1997; Živaljević, Trifunović, & Pejović, 2016), management of quality can be traced back to the beginning of the 19th century when the first Industrial Revolution took place (Hyun, Seon, Hyun, & Lee, 2017). To have a more detailed picture of the history of quality, this dissertation introduces the five phases of quality revolution:

The first phase: quality inspection and test. After the second Industrial Revolution, inspection was used in mass production to make sure that products are of reasonable quality with an emphasis on increasing quantities in the meanwhile. The guru of quality management in this phase is Frederick Winslow Taylor, who introduced normative and inspection into mass production to maximize productivity and eliminate products of poor quality. Departments of tests and inspection are set up or professional inspectors are assigned to monitor the quality of products (Fisher & Nair, 2009; Yingfeng, 2018; Živaljević et al., 2016).

The second phase: statistical quality control. The awareness of the need of quality management raised after World War II (Raho & Mears, 1997). Instead of simply picking out the defective products, data and statistical methods are used in this phase to reduce nonconformities. W.A. Shewhart from Bell Laboratories, who developed the control chart to prevent defect, is a representative figure in adopting such technique. This stage focus on production process.

The third phase: quality assurance. After the Second World War, Japan started to rebuild their industry. Quality assurance, from merely technical tools, changed to more of a managerial philosophy, concerning quality costs, quality control and zero defects. W. Edwards Deming contributes a lot to this transformation by introducing PDCA cycle in this phase and Joseph M Juran introduced the theory of quality costs (Khoja et al., 2017; Raho & Mears, 1997). This phase focus on the entire production chain (Raho & Mears, 1997).

The fourth phase: strategic quality management. Strategic Quality Management shows a new era in the quality movement starting from 1990 to 2000 (Dahlgaard-park, 2011). In this phase, market and customer needs were emphasized and the business system was considered as a whole. The aim of quality in this phase is to satisfy customers' needs with services and products as a result of optimal process conduction in organization (Živaljević et al., 2016).

The fifth phase: total quality management. Witnessing the success of Japan's reconstruction and more and more market shares gained by Japanese companies, the U.S. business leaders realized that continuous quality improvement is vital to possess global competitiveness (Raho & Mears, 1997). In this phase, the management entity is all organizations in supply chain and the aim is to satisfy stakeholders' needs (Živaljević et al., 2016). Total Quality Control (TQC) involves every single employee and division within an organization and concerns every aspect throughout the value chain (Ishikawa, 1985). Table 2-1 shows the revolution of quality since early 19th century.

Table 2-1 Evolution of Quality Theories

Phase and Period	1800-1930 Quality Inspection and Test	1930-1950 Statistical Quality Control	1950-1980 Quality Assurance	1980-1990 Strategic Quality Management	1990-2000 Total Quality Management
Entity	Product	Production processes	Production and supportive processes	Business system	All organizations in supply chain
Understanding of Quality	Realized product features of design	Realized product features of design with optimal costs of production	Realized product features of design with optimal costs of important processes	Satisfying customers´ needs with good quality products by optimal process conduction	Satisfying stakeholders´ needs by optimal process conduction in supply chain
Aim of Quality	Remove defective products in the market	Decrease defective products and costs of production	Prevent nonconformities	Satisfying customers´ needs	Satisfying stakeholders´ needs
Represen-tative quality pioneers, standards and theories	Taylor F. introduced normality and inspection to maximize production and eliminate poor quality products	Walter Shewhart at Bell Laboratories applied statistical methods to detect defects and developed the control chart	Walter Shewhart with Deming introduced PDCA cycle; Joseph M Juran introduced the theory of quality costs.developed .	W. Edwards Deming introduced 14 points of Management in 1982; Joseph M Juran introduced The Quality Trilogy; Feigenbaum A. developed a concept of `Total Quality Control`; Ishikawa K. developed cause and effect diagram in 1970;Six Sigmawas developed by Motorola in 1986	W. Edwards Deming introduced Theory of Profound Knowledge in1993; ISO 9000:94 put into implementation; Joseph M Juran introduced process triple role in 1988; Ishikawa K. stressed the importance of internal customer and implementation of quality circles in 1980; Shingo developed Zero Defect concept in 1961, SMED in 1970 and JIT in 1990

Source: From (Živaljević et al., 2016, *"Two Quality Revolutions: Industry VS. Health Ca*re")

2.2 Total Quality Management

According to the research of Živaljević and his colleagues, the term of “Total Quality Management” was first introduced by Feigenbaum in 1968 (Živaljević et al., 2016). But the earliest work available on Total Quality Management can be dated back to 1956 which was published on Harvard Business Review by Feigenbaum (Feigenbaum, 1956). As (Deming, 2000)

indicated, “Total Quality Management (TQM) is a philosophy”. It is not only one single idea, but a number of related ideas summed up together, creating a consolidated approach in business management (Goetsch & Davis, 2000). To be short, “TQM is a continuous quality improvement approach” (Nawar, 2008). It is a series of activities striving for continuous improvement, which involves everyone in the organization in every point throughout the value chain. The purpose is to realize the best of the organization’s competitiveness by improving continuously the quality of its products, services, personnel, environments and processes (Goetsch & Davis, 2000). It can be also described as a total organizational excellence (Okland, 2001). TQM can be regarded as having a soft aspect and a hard aspect, namely, tools of TQM (Abouzahra et al, 2014). Figure 2-1 summarizes the hard elements of TQM while Figure 2-2 indicates the soft aspects. According to one expert’s count, there are approximately 400 TQM techniques (Pyzdek, 2000). Thus the table below shows only a part of them just to have some understanding of the many TQM techniques.

Figure 2-1 Hard aspects of TQM
Resource: From (Abouzahra et al, 2014, "Lean thinking for healthcare")

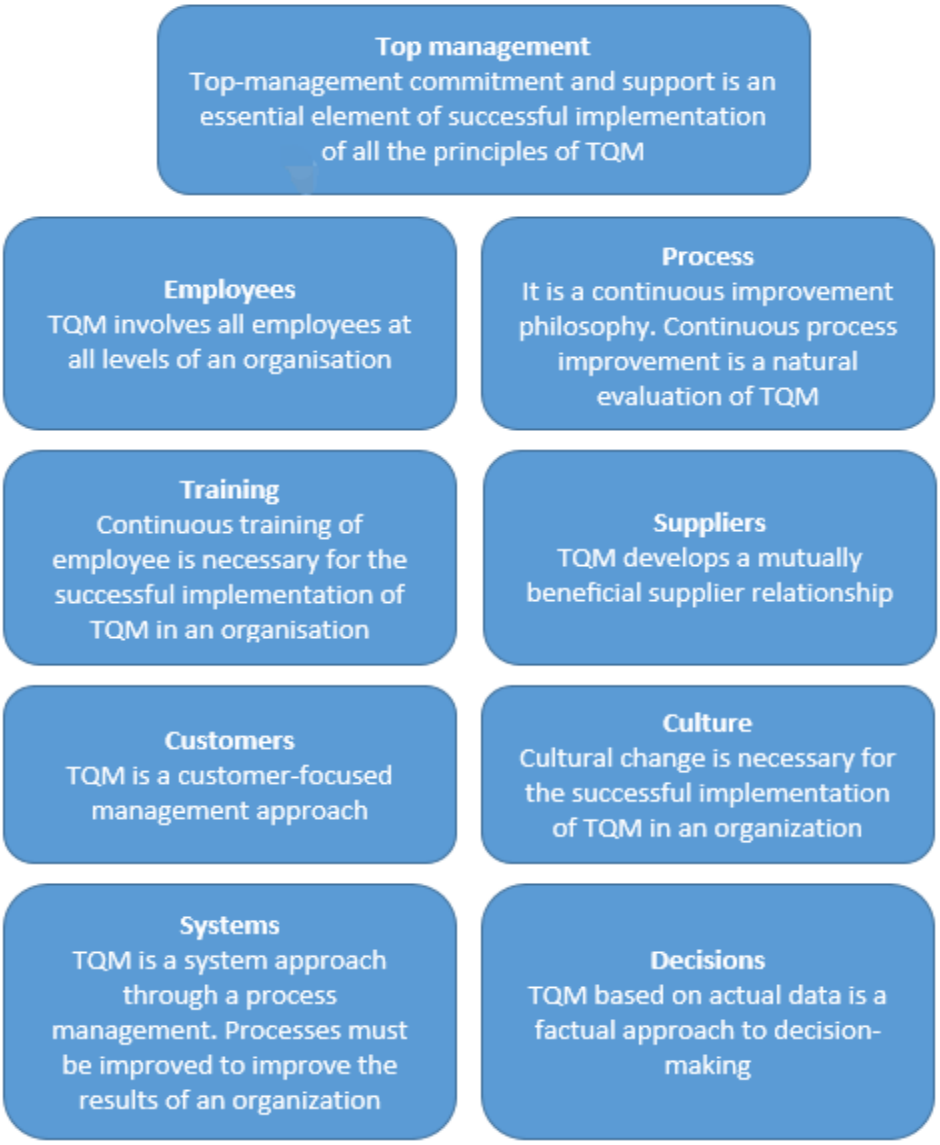


Figure 2-2 Soft aspects of TQM
Resource: From (Abouzahra et al, 2014, *"Lean thinking for healthcare")*

2.3 Kaizen

2.3.1 What is Kaizen?

During the period between the first and second world wars, products of Japanese were generally labeled as “bad quality” (Nelson José dos Santos António, 1995). After World War II, in order to build up their own economy, the Japanese started to learn from the U.S. and Europe regarding technology aspects on a large scale aiming towards continuous improvement of quality of their products (Imai, 1986; Nelson José dos Santos António, 1995). In the beginning of the story,

Masaaki Imai was working with the Japan Productivity Centre in Washington D.C. where his job focus mainly on helping groups of Japanese businessman to study “the secret of American industrial productivity” by visiting American companies. After three decades of improvement in Japanese productivity, quality and flexibility, Masaaki Imai embraced the slogan and titled his book “KAIZEN”, which means continuous improvement, to consolidate the KAIZEN strategy- the key to Japanese competitive success (Imai, 1986).

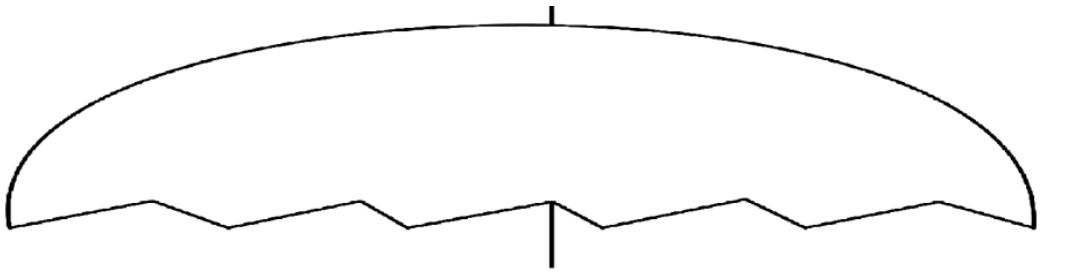
Introduced by Masaaki Imai, KAIZEN is a concept of management, which means continuous improvement. It also means continuous improvement in personal life, home life, social life, and working life (Imai, 1986). The idea is not to let a day pass by without any improvement and the change is incremental (Imai, 1986). Putting in workplace, Kaizen means continuing improvement involving everyone – managers and workers alike (Imai, 1986). To achieve KAIZEN does not require much input (Abouzahra et al, 2014).

2.3.2 Practices and methods of Kaizen

Despite that there´re almost endless paths to achieve Kaizen, Total Quality Management is considered as the “high way” to achieve this goal (Imai, 1986). The Kaizen umbrella (See Figure 2-3) shows some of the worldwide famous practices of Kaizen, including TQC, Zero Defects, Just in Time, Kanban and so forth (Paraschivescu, 2015). There´re 7 crucial elements of Kaizen which are team work, personal discipline, improved morale, quality circles, suggestions for improvement, elimination of wastes and inefficiency and the 5S methodology (Abouzahra et al, 2014). The 5S framework refers to the following, corresponding to the first letter of 5 Japanese words (Jaca, Viles, Paipa-galeano, Santos, & Mateo, 2014):

• Seiri, the willingness to reach a goal.
• Seiton, put things in order.
• Seiso, earn the esteem and respect of both peers and superiors.
• Seiketsu, maintain self-composure.
• Shitsuke, build and maintain self-discipline.

The 5S can also be roughly equivalent to five English words: Sort, Set in order, Shine, Standardise and Sustain (Jaca et al., 2014).



The Key Kaizen Practices	
Mindset & Culture	**Production Process**
• customer orientation	• automation & robotics
• quality control (QC) circles	• autonomation
• suggestion system	• zero defects
• discipline in the workplace	• total productive maintenance (TPM)
• small-group activities	• Kamban
• cooperative labour-management relations	• just-in-time (JIT)
• total quality control (TQC)	• productivity improvement
• quality improvement	• new product development

Figure 2-3 the Kaizen Umbrella

Source: From (Paraschivescu, 2015, *"Quality Continuous Improvement Strategies Kaizen Strategy – Comparative Analysis"*)

2.3.3 Kaizen and Management

KAIZEN is a continuous process involving everyone in the organization from all hierarchy (Imai, 1986). Everybody from workers to top managers is responsible for some aspects of KAIZEN, as shown in Figure 2-4 below.

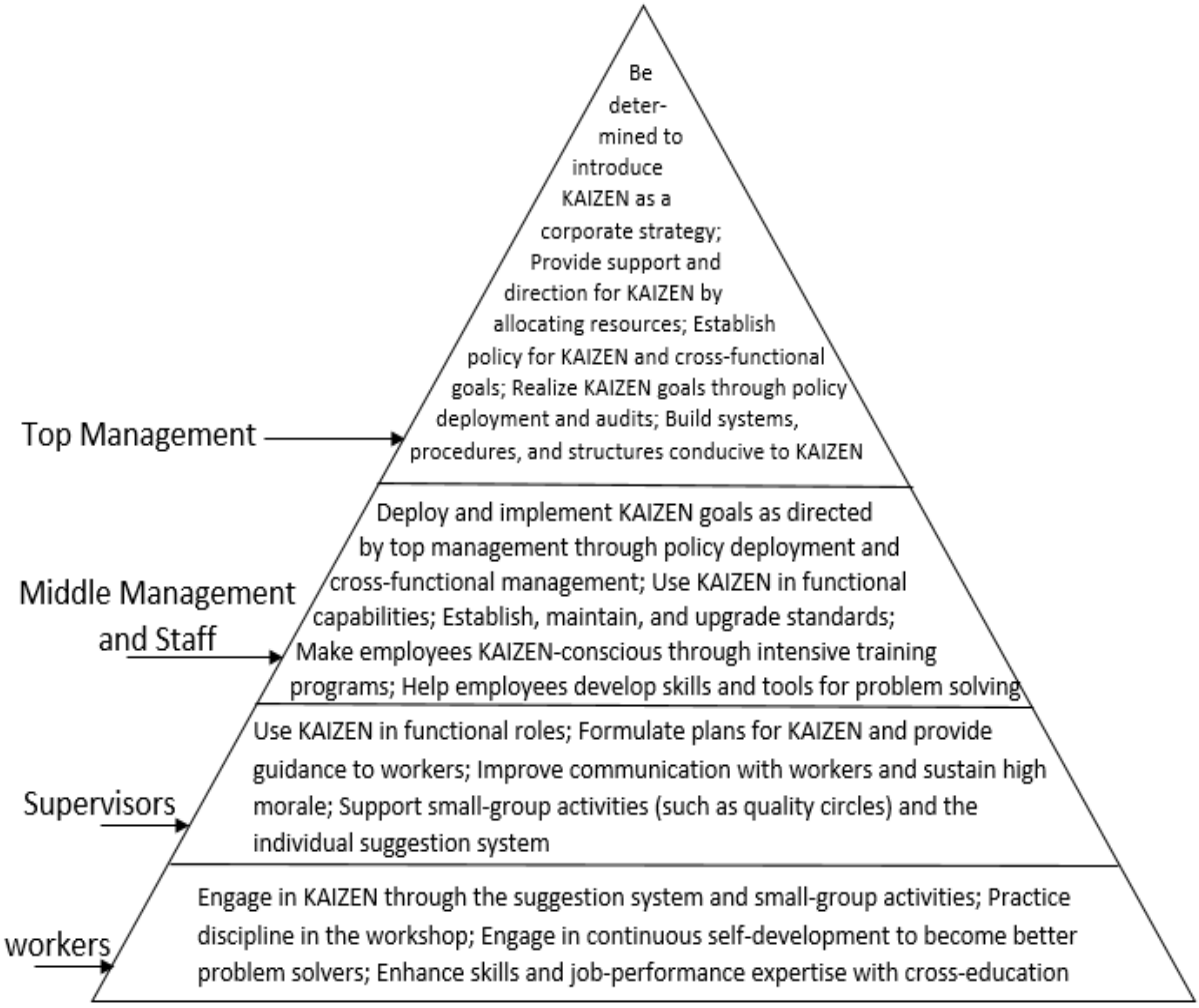


Figure 2-4 Hierarchy of KAIZEN Involvement
Source: Adapted from (Imai, 1986, *"Kaizen: the Key to Japan's Competitive Success"*)

2.4 Lean Thinking

2.4.1 What is Lean?

The term of "lean" was first coined by Prof. Womack and Prof. Jones from Massachusetts Institute of Technology during 1980s, after conducting a 5-year research to study Toyota Production System (TPS) and then published their book entitled "The Machines that Changed the World" (Abouzahra et al, 2014). This management philosophy focus on reducing waste and increasing value for customers by analyzing, finding non-value adding steps and improve the process of manufacturing. Lean was first implemented in car industry and then diffused to other manufacturing industries such as metalworking, and finally comes to service industry (Hines et al., 2004). After being introduced to the world, the concept of Lean has evolved quite a lot

(Joosten et al., 2009). When first introduced it focused on process-oriented aspects. Nowadays, lean extends to include “respect-for-human system” which means it requires to look into the system as a “sociotechnical” system where human factor engineering and technology is in the center of the stage (Joosten et al., 2009; Abouzahra et al, 2014).

2.4.2 The aim of Lean and five lean principles

Lean thinking aims at providing what the customer wants in a quick and effective way, with the minimum of waste (Jones & A., 2006). The most important parts of lean are customer value and waste reduction (Joosten et al., 2009). Customer value refers to what, from the perspective of customers, add value and customers are prepared to pay for (J. P. Womack & Jones, 1996). There are two kinds of wastes. One is those non-value adding but necessary and the other is that add no value and avoidable and recognized totally as waste. Lean aims at eliminating the latter (Abouzahra et al, 2014). It is defined by Taiichi Ohno seven initial wastes and adapted for healthcare context, as shown in Table 2-2 (NHSIII, 2007; Ohno, 1988). Assuming that organizations consist of processes, there are five “Lean principles” defined by Womack and Jones, which is also most widely embraced (J. P. Womack & Jones, 1996). By engaging with the five principles and implement in a wise way one after another, it enables organizations to continuously reduce waste and add value (Radnor, Holweg, & Waring, 2012). However, some scholars such as Pettersen indicates that there are six lean principles which are define value; define value stream; flow; pull; standardization; and perfection (Pettersen, 2009). According to Spear and Bowen, based on their observation of the Toyota system, there are four lean principles: Standardize work; Connect people and machines that are dependent on one another; Create smooth and continuous flow through the process; Empower staff to investigate problems within the process and to develop, test, and implement countermeasures using a “scientific” method (Mazzocato et al., 2012b; Spear & Bowen, 1999). Figure 2-5 shows the seven elements of wastes , respective healthcare examples and Lean principles. Figure 2-6 indicates the five principles of Lean proposed by Professor Womack and Jones (J. P. Womack & Jones, 1996).

Defects: outputs not as intended or do not fit requirements and need correction or repetition
Healthcare examples:
• readmission because of failed discharge
• Repeating tests because correct information was not provided
Lean Principle: Value Stream

Transportation: movement of material and equipment or transportation of patient from one place to another
Healthcare examples:
• staff walking to the other end of a ward to pick up notes
• central equipment stores instead of discrete location for commonly used items
Lean Principle: Flow/value stream

Motion: the movement of medical staff to obtain material or information
Healthcare examples:
• unnecessary staff movement looking for paperwork
• not having basic equipment in every examination room
Lean Principle: Flow/value stream

Waiting: delay in performing an activity or waiting for an action to occur
Healthcare examples:
• Patients, Theatre, staff results, prescriptions and medicines
• doctors to discharge patients
Lean Principle: Pull/value stream

Inventory: excess material stocks in a storage
Healthcare examples:
• excess stock in stockrooms that is not being used
• long waiting lists for surgery
Lean Principle: Value, value stream, perfection

Over-processing: Unnecessary repetition of an action
Healthcare examples:
• duplication of information
• asking for patients details several times
Lean Principle: Value, value stream, perfection

Overproduction: Unnecessary reproduction of the same product/service
Healthcare examples:
• requesting unnecessary tests from pathology
• keeping investigation slots "just in case"
Lean Principle: Value, value stream, perfection

Figure 2-5 The seven elements of wastes, respective healthcare examples and Lean principles
Source: Adapted from (Radnor et al., 2012, *"Lean in healthcare: The unfilled promise?"; J. P. Womack & Jones, 1996, " Beyond Toyota : How to Root Out Waste and Pursue Perfection"*)

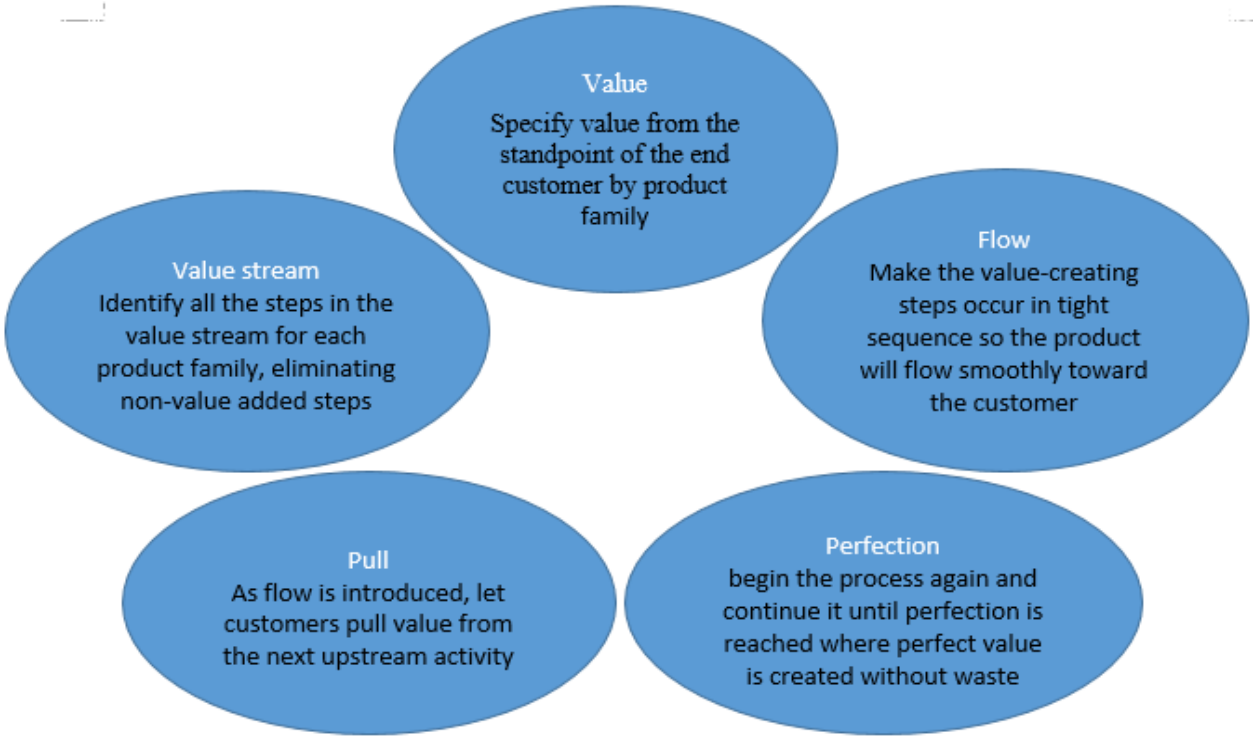


Figure 2-6 F*ive principles of Lean*
Source: Adapted from(J. P. Womack & Jones, 1996, *" Beyond Toyota : How to Root Out Waste and Pursue Perfection"*)

2.4.3 Quality Management tools used to facilitate Lean

2.4.3.1 Six Sigma

Six Sigma is a rigorous management principle and technique applicable in improving products, services and processes which aims for virtually error free business performance and could have considerable economic return. (Pyzdek, 2000) While the variable sigma (Σ, σ) stands for the level of variation, six sigma represents an ideal situation where among 1 million performances, only 3.4 errors occur. Six Sigma deals with sources of variation in the process using a set of rigorous quality tools, which are highly compatible with existing lean approaches. (George, 2002) A performance improvement model used in Six Sigma projects is DMAIC (Define-Measure-Analyze-Improve-Control) as below (Pyzdek, 2000):

- Define the system and customer demand
- Measure critical steps and obtain data
- Analyze obtained valuables
- Improve process using previously collected data
- Control future process and make adjustments when necessary

Specifically in healthcare organizations, a DMAIR approach (design, measure, assess, improve and redesign) is mostly adopted (Giannini, 2015).

Six sigma was developed by a team of Motorola while Lean was developed in Toyota (Bentley & Davis, 2010). With the focus on elimination, Lean is also a methodology for solving business process problems. Comparing to Lean, Six Sigma is more of statistical methods to detect and eliminate variation in processes (Barach & Kleinman, 2018). While Lean, consisting of a number of tools and techniques, is a management philosophy to remove non-value-added wastes and create value to the customers (Abouzahra et al, 2014). Six sigma and Lean, as two methodologies that have their own strengths and weakness, can be a powerful approach when combined together to address various business process problems (Bentley & Davis, 2010).

2.4.3.2 Constraints management

Constraints management is a theory developed by Eliyahu Golddratt (Abouzahra et al, 2014). It is used in operations and supply chain management to examine and address bottlenecks in a process (Abouzahra et al, 2014; Young et al., 2004). It looks at companies as systems consist of a collection of interrelated, interdependent components or processes that function together to achieve the organization's goal (Spector, 2006). The theory of constraints is also helpful in Lean as it assists to focus on capacity constraints, especially where more than two capacity constraints collide in a value stream (Moore & Scheinkopf, 1999).

2.4.3.3 Value stream mapping (VSM)

Value stream mapping is one of the key tools of lean production management (Yüksel & Uzunovïc, 2019). To be brief, it first presents all the production activities taking place within the value stream of a product or several products in a transparent way, clearing stating the value-adding and non-value-adding activities, and then describe a future state value stream which is improved and more continuous with previously detected defaults eliminated (Yüksel & Uzunovïc, 2019). VSM distinguishes itself from other mapping tools like process mapping by observing both flows of materials and information, which is the most important feature of this lean management tool (Yüksel & Uzunovïc, 2019). The ultimate purpose of VSM is to remove non-value-adding activities by identifying them, and eventually be capable of generating a future state with higher efficiency and more continuous flow (Andreadis, Garza-Reyes, & Kumar, 2017).

According to Rother and Shook, to conduct VSM, a special team can be established to lead the project following five steps: a. select a product family; b. draw current state VSM; c. draw future state VSM; d. describe a plan to realize future state VSM; e. achieve future state VSM (Rother & John, 1999; Wenchi, Jun, Peng, Xiangyu, & Heapyih, 2017; Yüksel & Uzunovïc, 2019).

VSM serves but not limited to visualize wastes throughout a process. It also helps to indicate where the wastes come from by detailed description including walking distance, inventory volume, lead time and other steps (Yüksel & Uzunovïc, 2019). Benefits generated from VSM includes better management in inventory, decreased lead time, less defects, more efficient human resources management, increased value-adding time and decreased non-value adding time (Wenchi et al., 2017).

2.4.3.4 Standardized work

As the saying of the father of Toyota Production System, Mr. Taiichi Ohno goes, “Where there is no standard, there is no improvement” (Pereira et al., 2016) Standardization is to set, communicate, comply with and refine standards (Pereira et al., 2016). Standardized work consists of a series of working procedures demonstrating best practice for each worker to follow, aiming at achieving a more stable and continuous working process by eliminating wastes and minimizing undesired variations, such as standard operating procedures (Pereira et al., 2016; Simons et al., 2014).

Chapter 3 Healthcare Management

3.1 Healthcare Management and its Function

Management is defined as the process consists of both social and technical functions in organizations to accomplish predetermined aim making use of humans and other resources (Longest Jr & Darr, 2014). Healthcare system is a complex system because of the variety of stakeholders—healthcare providers such as doctors and nurses, patients, insurance company, government and so on, and the ever-developing environment—medical breakthroughs and technology innovation (Cinaroglu, 2016). Healthcare management is to make use of resources available to coordinate among the various stakeholders and in the meanwhile adapt to the rapidly changing environment in order to provide healthcare services (Cinaroglu, 2016; Peiro & Rodrı, 2012). It is needed for healthcare organizations to maintain daily operation (Buchbinder & Shanks, 2011). According to The Bureau of Labor Statistics in the United States, healthcare management is one of the fastest growing occupation, reaching a growth of 22 percent between 2010 and 2020 (Bureau of Labor Statistics, 2010). The growing need of healthcare providers and facilities may attribute to the aging and longer life expectancy of the population. It will also be more and more necessary for professionals to command the knowledge of running healthcare organizations. Effective healthcare management is vital for delivering high quality healthcare service (Askheim, Heggen, & Engebretsen, 2017).

To understand healthcare management, we need to understand what healthcare managers do, what is the structure of management in a healthcare organization and how to set up strategies in pursuit of better management in healthcare as well as higher quality in healthcare delivery. All the contents above will be introduced in the following sessions and in this chapter it further unfolds the challenges and quality aims of healthcare delivery in the 21st century.

3.2 Healthcare Managers, Structure and Healthcare Strategy

3.2.1 The roles of healthcare managers and healthcare management structure

Managerial competence is an essential determinant of healthcare organization performance and healthcare managers are required to possess proper management qualification and experience in

healthcare (Haefner & Francis, 2010). The hierarchy of management focus can be defined as self, unit/team and organization and roles of managers fall in talent management, ensuring high performance and succession planning (promotion path) (Buchbinder & Shanks, 2011). It is of significance that healthcare managers, who are probably also clinical professionals in previous period, obtain proper managerial trainings and knowledge in order to fulfill their responsibilities. (Haefner & Francis, 2010; Navarro & Cepeda-Carrio´n, 2013; Askheim et al., 2017) Figure 3-1 describes the common functional organizational structure within healthcare organizations.

3.2.2 Healthcare Strategy

The sector of healthcare management is unlike any other sectors due to its complexity and it is also dynamic thus it demands management (Buchbinder & Shanks, 2011; Cinaroglu, 2016). It is indicated by some scholars five aspects that appeal strategic planning in healthcare management: a. Increasingly informed, demanding and non-loyal clients; b. Increasingly professional and skilled competitors; c. limited resources for production; d. Focus is shifted from product or service to the client; e. size and complexity of the healthcare organizations (Peiro & Rodrı, 2012). According to Griffith (1998), there are five common strategic dimensions regarding healthcare in the 21st century: Value, Clinical Improvement, Physician Organization, Diversification and Community Outreach and Strategy. Value indicates the price and quality delivered to the customer. Clinical Improvement involves the core of healthcare-clinical work and can be achieved by three approaches: clinical pathways, profiling and case management for high-risk patients. Physician organization is to coordinate to provide communication, shared goals and resources, and conflict resolution between the caregivers. Diversification is to diversify the focus on different functions of the hospital and community outreach aims to reach out to at-risk populations who need early testing and prevention. And strategy is to integrate all parties of the healthcare system into a coherent whole (Griffith, 1998).

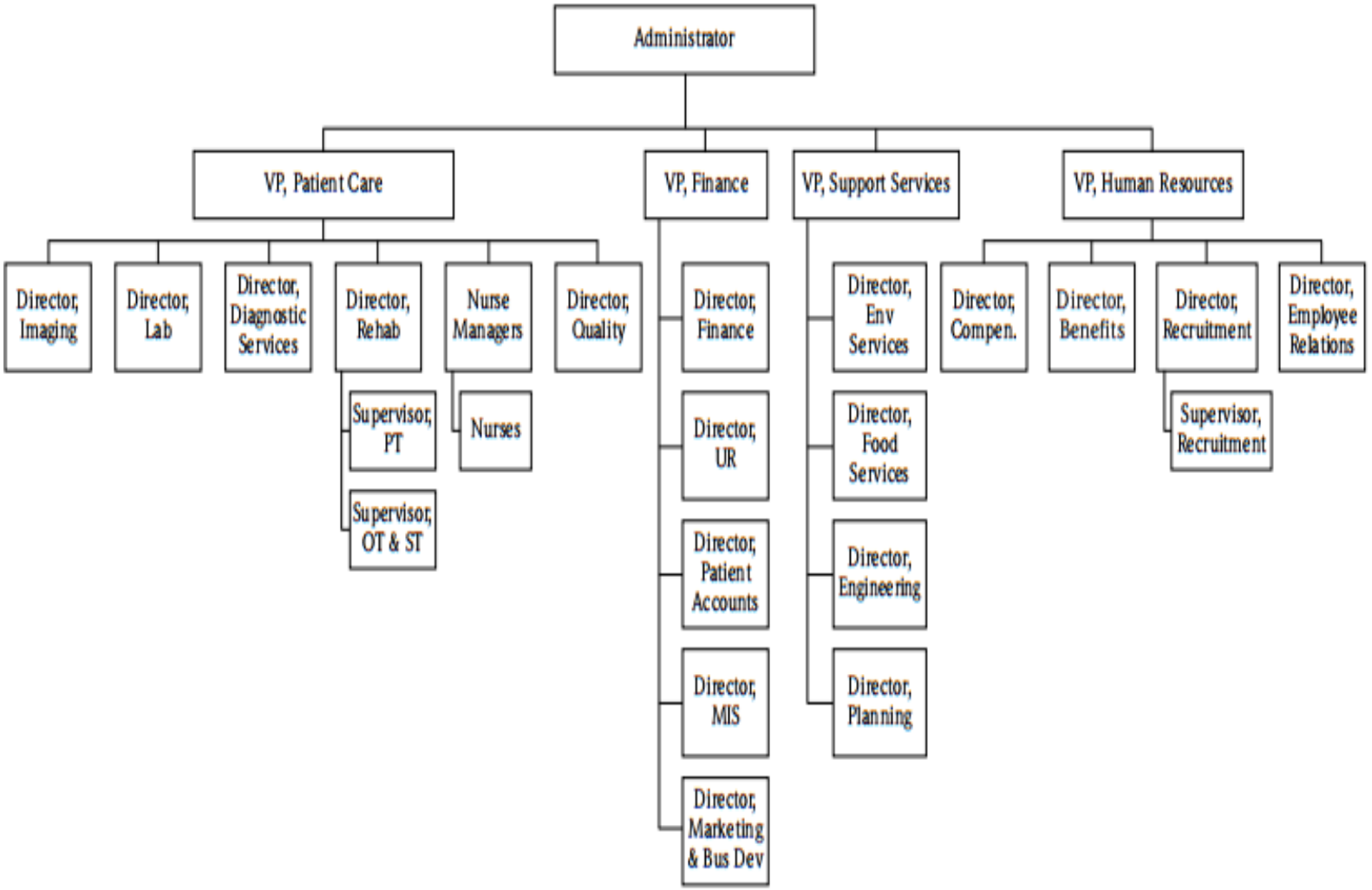


Figure 3-1 Functional Organizational Structure

Source: Adapted from (Buchbinder & Shanks, 2011, *"Introduction to Health Care Management*)

3.3 Improving Healthcare Delivery in the 21st Century

3.3.1 Challenges confronting healthcare delivery

Cost control is a pressing need global wide to reduce waste and improve efficiency in healthcare organizations (Navarro & Cepeda-Carrio´n, 2013; Grigorescu, Condrea, & Bradley, 2015; Roberts, Fisher, Trowbridge, & Bent, 2016). More and more quality problems in hospitals in America occur such as a growing number of medical accidents and deaths, while others involve medical service quality problems such as avoidable error, underutilization/overutilization of services and variation in services (Abouzahra et al, 2014). As market competition becomes intensive, it is also a challenge for healthcare organization to retain loyal customers (Calero & Gallarza, 2018; Peiro & Rodrı, 2012). A commonplace in healthcare organizations is that clinical professionals are appointed as healthcare managers however do not acquire necessary managerial knowledge or training (Haefner & Francis, 2010).

3.3.2 The Aim of Healthcare Delivery in the 21st Century

In 2000, the American Institute of Medicine released its landmark report “To Err is Human: Building a Safer Health System” which focus on the errors within the American healthcare systems (Abouzahra et al, 2014). Following this report, in 2001, IOM release a second report “Crossing the Quality Chasm: A New Health System for the 21st Century” which specify six quality aims for the 21st century healthcare systems: safe, effective, patient-centered, timely, efficient and equitable (Institute of Medicine & Committee on Quality of Health Care in America, 2001). The six quality aims are presented in Figure 3-2 below:

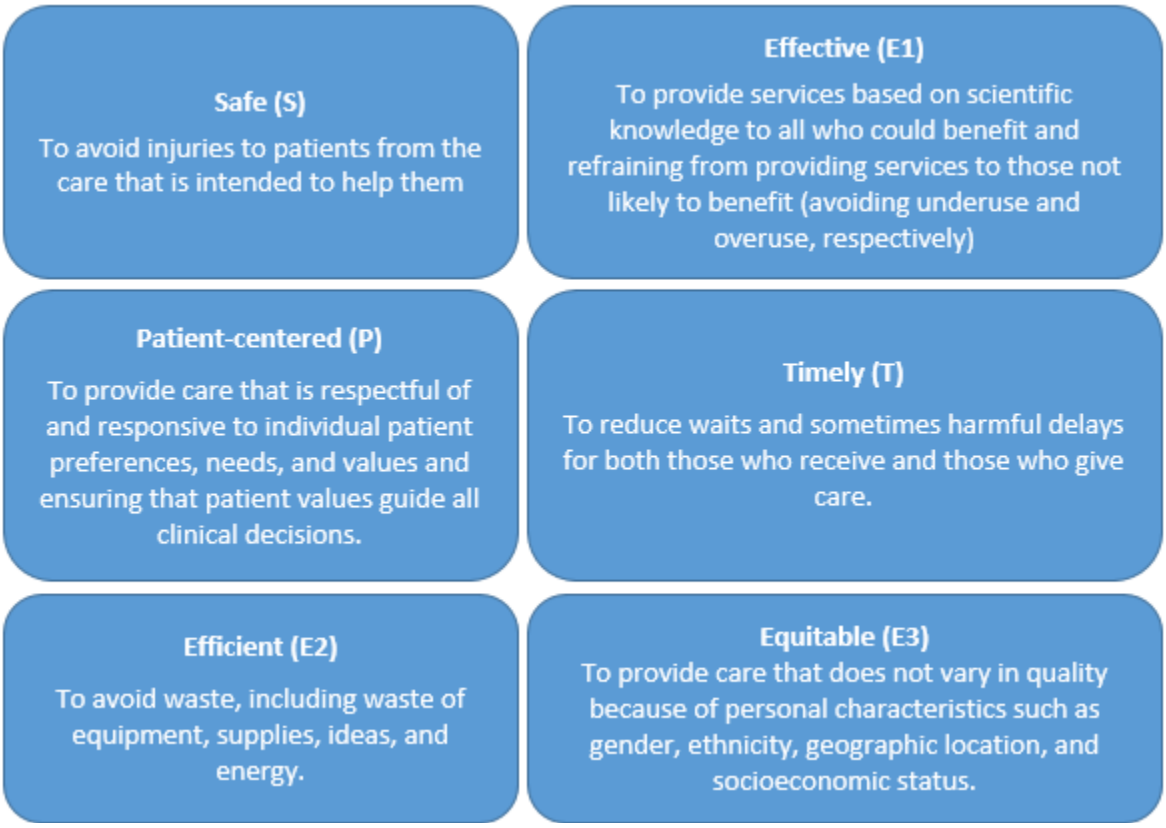


Figure 3-2 Six Quality Aims for the 21st Century Healthcare System
Source: (Institute of Medicine & Committee on Quality of Health Care in America, 2001)

In this report, the IOM/NAE study highlights the significance of adapting Toyota Production System (TPS) concepts to healthcare performance. Under the great pressure of financial budgets on healthcare, many researchers work on healthcare problems to reduce waste and increase efficiency in every step of healthcare processes (Civelek, 2012). Since then, there have been booming research on the concept of lean management implemented in healthcare sector. Thus it is necessary to consolidate, organize, and synthesize the existing knowledge (Kunisch, Menz, Bartunek, Cardinal, & Denyer, 2018).

Chapter 4 Methodology

4.1 Methodology

4.1.1 General approach

This study adopts theoretical-conceptual approach and presents a literature review of 52 articles in total on the topic of Lean in Healthcare, mostly published between 2009-2019. Among them, 51 articles are published after 2009. The article of (Ben-Tovim et al., 2007) is included because it studied a famous lean setting hospital—the Flinders Medical Centre in Australia. The inclusion and exclusion criteria are as follows:

- Inclusion criteria: Journals/ doctoral theses in both English and Chinese related to the application of lean in healthcare sector after 2009;
- Exclusion criteria: conference papers, comments, master theses, editorials, news papers, Chinese literatures without English title and abstract, literature reviews in Lean Healthcare Management before 2009 and articles not relevant to this topic.

This study can be divided into 3 stages: planning, conducting and reporting/discussion. In the stage of planning, it is defined that the purpose of this literature review is to describe an understanding of lean in healthcare and answer the question: how does lean principles contribute to achieving the quality aims of healthcare delivery proposed by IOM in the 21st century? This study reviews articles in Chinese and English related to application of lean in healthcare. Classification methods of literatures is also defined in this stage. This study classified literatures into six dimensions. Besides, they are also categorized according to the six healthcare quality aims proposed by IOM. A literature may appear in more than one category as it involves study striving to achieve more than just one healthcare quality aim. The six dimensions and six categories of classification will be introduced in the following session of 4.1.2.

In the conducting stage, articles were searched using key words and terms including: “lean management in healthcare”, “lean in healthcare” and “lean health” from 2009 until 2019. Some articles were also added applying snowball approach. The referred database for English literatures includes B-on and Google Scholar, and for Chinese literatures, CNKI database is

searched. Other resources of reference include Wikipedia and specialized webpage in lean management. The results of articles searching is shown in Figure 4-1.

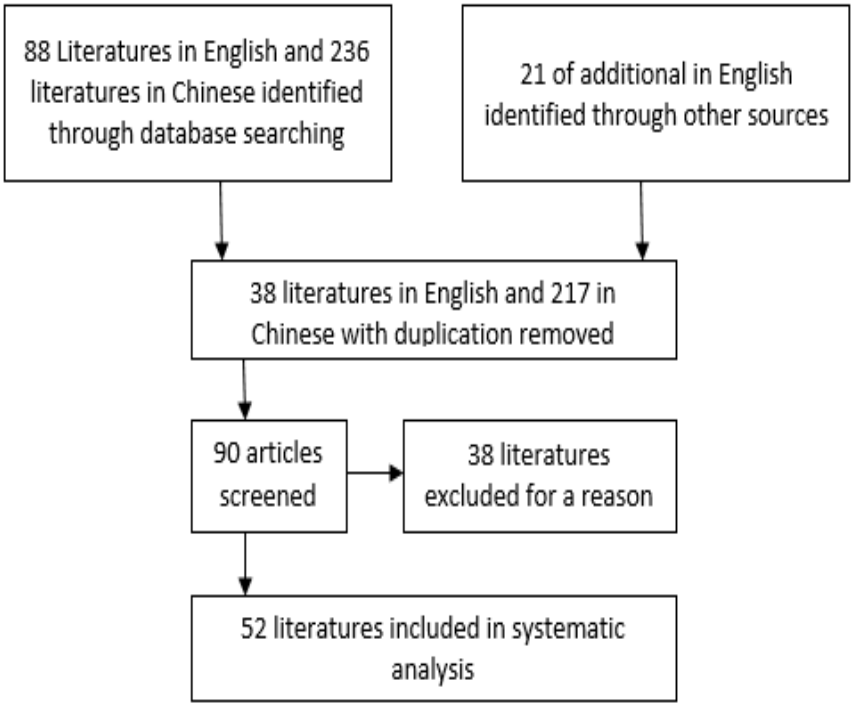


Figure 4-1 Flow chart of literature selection

In the reporting/discussion stage, it is reported a general description of different dimensions the literatures are classified into, using graphics and figures; the challenges confronting lean healthcare; the categories of literatures and other findings in the review. The former two parts will be presented in Chapter 5 and the last two ones will be reported in Chapter 6. In the end, Chapter 7 is conclusion of this study.

4.1.2 Classification of literatures

4.1.2.1 Classification into six dimensions

The study classified literatures into six dimensions, which will be presented in Chapter 5:
1) research method; 2) country the study was conducted in; 3) healthcare area; 4) the quality aims of healthcare it responses to; 5) the related lean principles. The first four dimensions are also used in the work of (Bonome et al., 2016). This paper selected the four of the dimensions in their work, adding two dimensions which are healthcare quality aims and lean principles, to serve the purpose of this study—to describe an understanding of lean in healthcare setting and find out how lean principles contribute to achieving the quality aims of healthcare in the 21st century as

proposed by IOM (Institute of Medicine & Committee on Quality of Health Care in America, 2001). The classification dimensions are defined as below:

Dimension 1— research methodology:

(1) Theoretical-conceptual (TC): according to Berto & Nakano (2000), theoretical-conceptual studies are conducted upon theory with application of scientific methods, which include but not limited to literature reviews and conceptual discussions.
(2) Action research (AR): action research is to use scientific approach to study the resolution of important social and organizational issues together with those who have intimate experience with these issues. Action research is problem-solving oriented and the key idea behind AR is that a scientific approach is applied.(Stig et al., 2016)
(3) Case study (CS): Case study is considered a qualitative method, which refers to the way researchers collect data is in face-to-face situations, interacting with selected persons in a natural setting such as a school, a home, or a community. CS typically focus on the individual, rely on anecdotal information, and have no control groups. (Range, 2018)
(4) Survey (S): Survey is a quantitative approach where a questionnaire is conducted to collect data through a number of ways: In-person interviews, mail surveys, telephone surveys, and Internet surveys. (Wienclaw, 2019)
(5) Ethnography (E): in general, researchers participate during the process for a certain period of time observing what people do, what is happening, what is said, or conduct interviews to obtain field-based experiences and collect any data available through documents. (Carter, 2017);

Dimension 2 — country or region the study was conducted in;

Dimension3 – healthcare area: According to healthcare areas defined by (Bonome et al., 2016), the areas involved are: Inpatient Department, Operating Room, Emergency Department, Laboratory, Diagnostic Imaging Department, Financial Department, Supply Chain Department, Radiology, Hospital, Pediatric Department, HR Department, Oncology, Department of Veterans Affairs (VA), Department of Physical Therapy and Rehabilitation, Sterilization unit, Pre-consultation, Information Department, Department of equipment, Pharmacy, Department of medical insurance, Department of Logistics, Department of injection & transfusion, and "General" if it does not involve a specific area;

Dimension 4 – implementation: if specific methods or tools of Lean is implemented, it is marked as “YES”. If no specific Lean tools or methodology is implemented in real field, it is marked as “NO”;

Dimension 5 – healthcare quality aims: to serve the purpose of this study, it is specified which quality aims a certain study has achieved;

Dimension 6 – lean principles: in the end of the classification it is pointed out which lean principle a certain study has applied. The five lean principles are value (V), value stream (VS), flow (F), pull (P), and perfection (PE) (Mersereau, 2014).

4.1.2.2 Classification into six categories

This paper also classified the 52 literatures obtained into six categories defined by the six healthcare quality aims proposed by IOM in 2001, which are safe (S), effective (E1), patient-centered (P), timely (T), efficient (E2) and equitable (E3). In each category it is specified the number of papers obtained regarding the quality aims, the Lean principles that are applied, the healthcare areas involved and the findings from the literatures. One paper may show in more than one category as it involves improvement in several quality aims. This classification of categories helps to look deeper into the cases of Lean in healthcare and most importantly, reveals how lean principles contribute to achieve the quality aims of healthcare, which is the main purpose of this study. This part of classification and demonstration will be displayed in Chapter 6 of discussion.

Chapter 5 Lean in Healthcare

5.1 Six dimensions of literatures in lean healthcare

The study classified literatures into six different dimensions as shown in Appendix 1.

5.1.1 Dimension 1—research methodology

Figure 5-1 shows that case study is the main research method in Lean healthcare studies, which takes up more than 50% of the total number. Unlike the results of the work by Souza (Souza, 2009), where papers adopting theoretical approach construct the majority of literatures, or results of the work by Luana and Moacir (Bonome et al., 2016), where action research is the main research method, this study indicates that most papers are found utilizing case study approach. After exploring in theories and turning theories back into practice, there is a trend to consolidate those empirical studies for analysis. Furthermore, more action research is found in Chinese literatures than those in English. Since Lean in healthcare started in early 21st century, but this concept was introduced into China much later than most western countries like the U.K, the U.S. and countries from Europe (Mersereau, 2014). Among the case studies, some literatures adopt single-case study to explore in depth (Grove et al., 2010; Mazzocato et al., 2012b; Stanton, Gough, Ballardie, & Bartram, 2014) while some papers favor multiple case study to provide more evidence and be more persuasive or holistic (Hussain & Malik, 2016; Radnor et al., 2012; Tony Kinder, 2013).

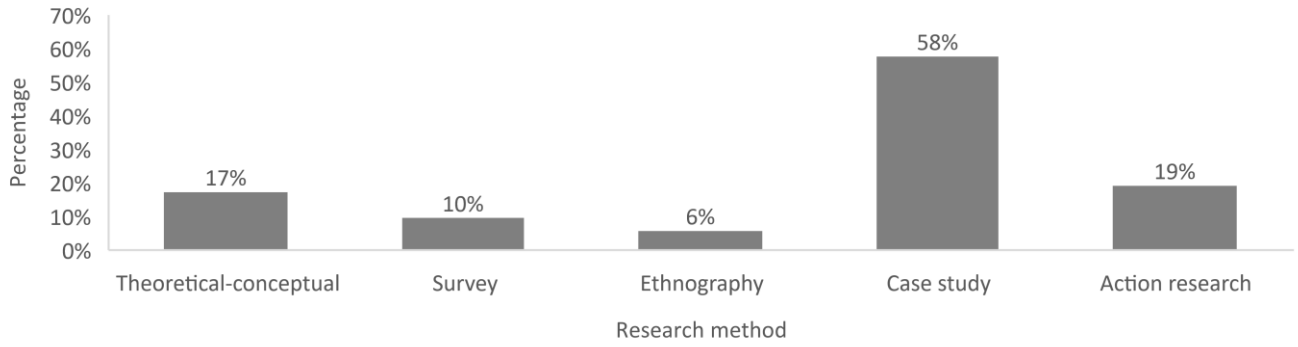


Figure 5-1 Percentage of Papers per Research Method

5.1.2 Dimension 2—country or region the study was conducted in

Figure 5-2 shows the number of papers identified for each country. Among all the 52 literatures reviewed, 15 articles are obtained from CNKI, database in Chinese while others are acquired through B-on, database in English. From the graph we can see that half of the lieratures in English mainly come from the Netherlands, the U.K. and the U.S.A. This feature is consistent with the results of the work done by Luana and Moacir, where the Netherlands distinguishes herself in the number of publications in Lean healthcare (Bonome et al., 2016). There is a broad range of the countries involved in publications of Lean healthcare, however most of them is low in number of publications, which is only one or two papers. In spite of this fact, we can still draw the conclusion that Lean in healthcare has been and is still being widely explored in a global scale with pace moving forward and content diving deeper.

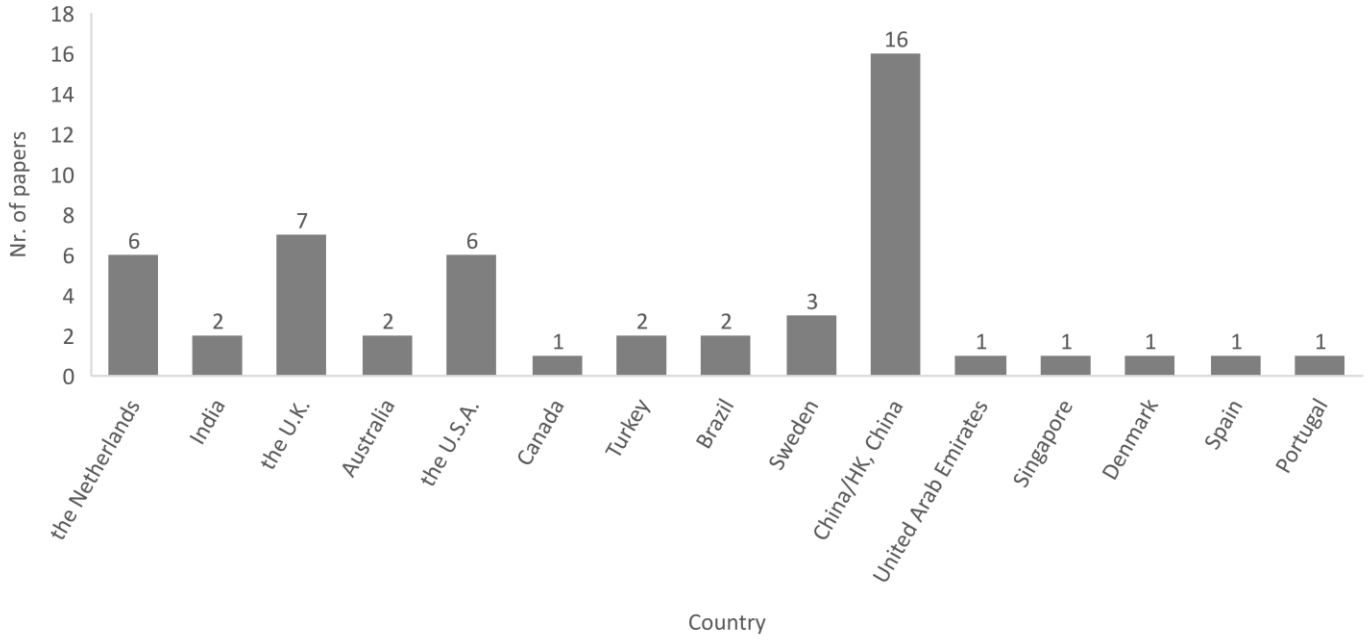


Figure 5-2 Number of Papers per Country

5.1.3 Dimension 3 – healthcare area

A total of 22 healthcare areas are covered in the literature review. Figure 5-3 shows the frequency of healthcare area studied. 29% of the literatures studied hospital-wide issues and 13% of articles did not specify a certain healthcare area. From the perspective of hospital, most studies discussed about the feasibility of Lean in healthcare (Grove et al., 2010; Cheng et al., 2015; Mccann, Hassard, Granter, & Hyde, 2015; Radnor et al., 2012; Tay, 2016).

Over half of the literatures reviewed looked into the application of Lean in a specific healthcare area such as Emergency department (8%), Pharmacy (8%), Operating room (6%), Radiology department (6%) and so on. In the work of (Mccann et al., 2015), a 3-years ethnographic study was carried out to describe how Lean was enthusiastically promoted to finally faded away in a large public hospital in the U.K. During the application of Lean in the hospital, there was hardly real progress in the performance of the organization thus the voice of criticism raised louder and louder and Lean was abandoned eventually. In most papers, the results of Lean implementation in a certain healthcare area turned out to be positive. For example, in the study of (Ben-Tovim et al., 2007; Crema & Verbano, 2015; P. Simons, Benders, Bergs, Marneffe, & Vandijck, 2016; Zhonghua, 2016), the rate of serious adverse events significantly went down and there was less risk of making mistakes during operations; decreased surgical complication and death rates were observed (Barach & Kleinman, 2018); there was more on time operation which brought financial benefits to the hospital (Schonberger, 2018; Yaduvanshi & Sharma, 2017).

There were negative effect though. Decreased productivity in medicine for the elderly and in Radiology Department were observed, mainly attributed to the fact of lacking integratedness of coordination mechanisms (Tony Kinder, 2013). The study of (P. Simons et al., 2016) found both work load and time consuming increased after Lean application.

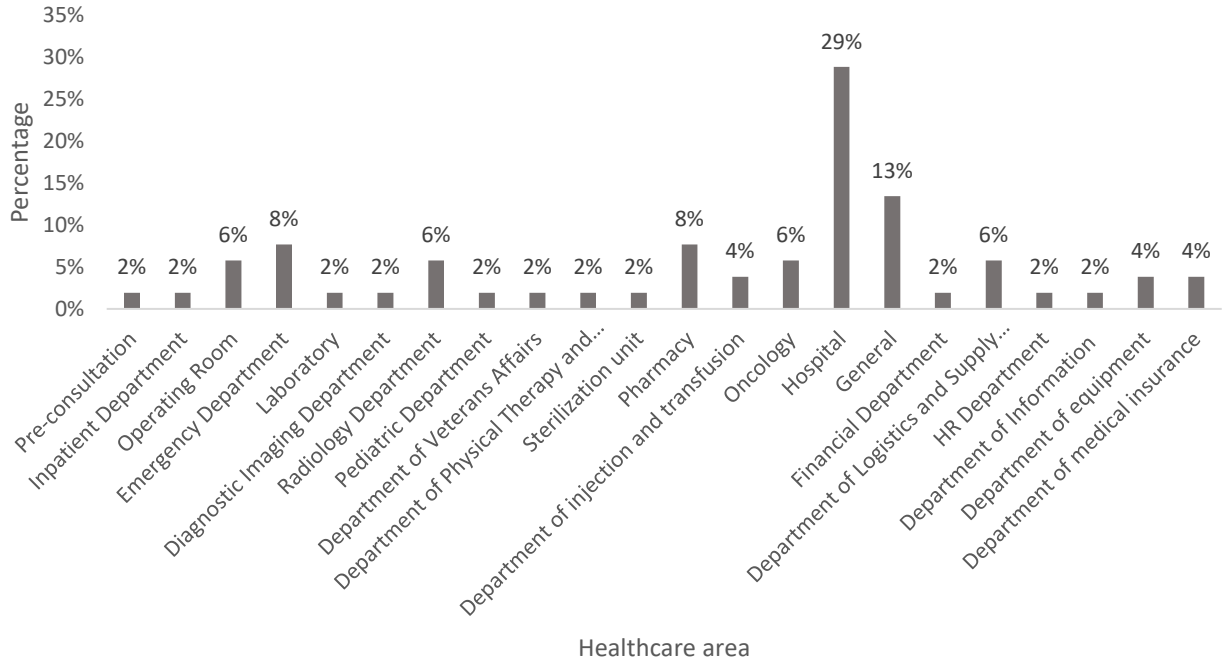


Figure 5-3 Frequency of healthcare area studied

5.1.4 Dimension 4—implementation of Lean in healthcare area

A total of 41 articles implemented Lean in healthcare while 11 studies did not. The percentage of Lean implementation in literatures is 78.8%. Among the literatures implemented Lean, the majority of studies adopt case study and action research as the research method. While for those studies that did not implement Lean in practical terms, they mostly used theoretical-conceptual and case study approach. The number of literatures implemented Lean in practical terms or not and respective research method the studies adopted is shown in Figure 5-4.

It is important to study Lean in real setting of healthcare area. Figure 5-4 indicates that there are much more studies exploring Lean in healthcare settings in practical terms while theory exploration occupies approximately 21.2%, which this study considers as a reasonable percentage.

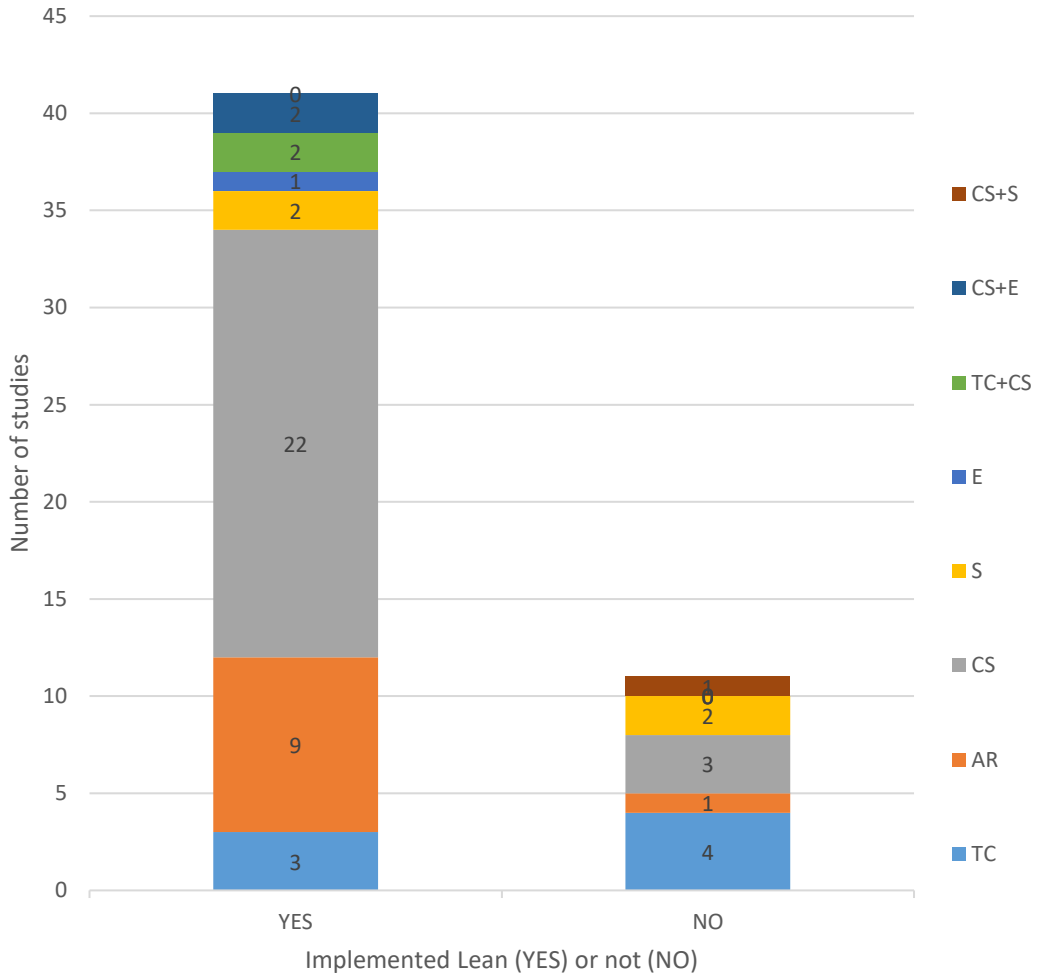


Figure 5-4 Lean implementation and research methods adopted by studies

5.1.5 Dimension 5—healthcare quality aims

Figure 5-5 shows the percentage of studies per healthcare quality aim. The aim of efficient healthcare delivery takes up the most portion as 90%, followed by patient-centered of 88%. The least explored healthcare quality aim is equitable, which is identified in medical insurance deparment as the aim of action research.

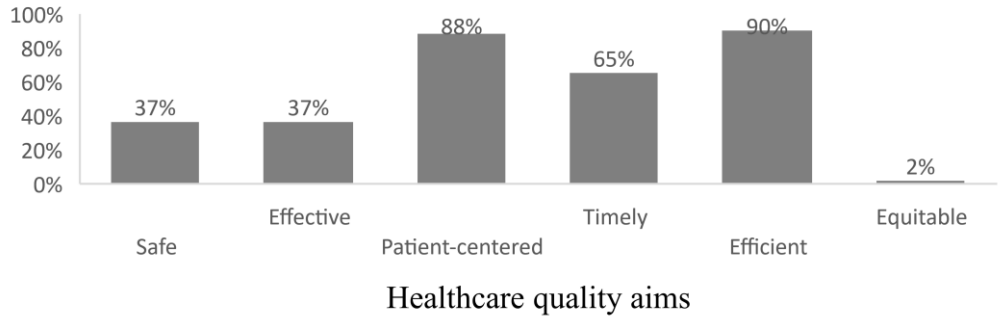


Figure 5-5 Percentage of Studies per Healthcare Quality Aim

5.1.6 Dimension 6—Lean principles

As indicated by Pettersen (2009), in the world of Lean it is of significance to define what do customers value to deliver the desired value to the customers. 96% of literatures make efforts to define what is the value or talk about what conveys value in their studies. 92% of ariticles contribute to realizing a continuous and non-interrupted flow throughout the process. In most papers involving value stream, the method of value stream mapping was adopted (Andreadis et al., 2017; Doğan & Unutulmaz, 2016; Ramaswamy et al., 2017; Rother & John, 1999; Tortorella et al., 2017; Wenchi et al., 2017; Yueyu, 2014; Yüksel & Uzunovïc, 2019). However, some may find it difficult to define which step delivers what kind of value since it is a complicated process (Radnor et al., 2012). Only 38% of studies pursue perfection after lean application which aim at maintaining the effect of lean and realizing continuous improvement, which is not enough. But we may still refer to some of the cases on how to improve continuously instead of making just one-time effort. The methods and cases will be discussed in session 5.3.4 and session 6.4.

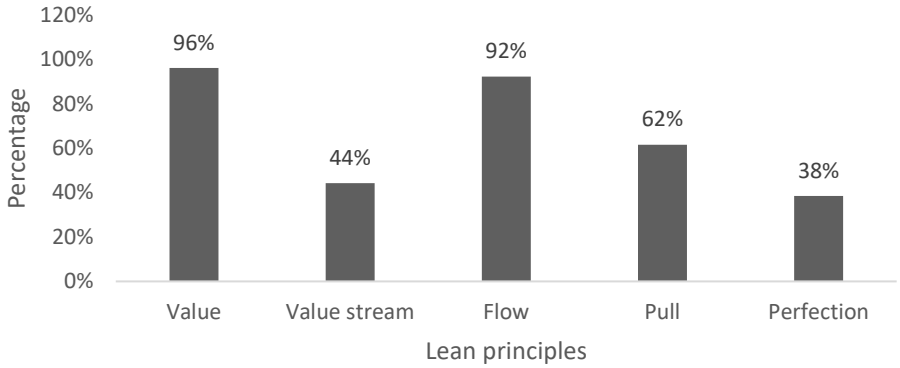


Figure 5-6 Frequency of Lean principles utilized in healthcare

5.3 Challenges confronting Lean Healthcare

Despite of the potential of Lean in achieving higher quality healthcare service delivery and control cost in the meanwhile, the practice is not always successful. The Lean extended enterprise concept is completely understood in manufacturing context, however appears to experience some difficulties when materialized in Healthcare services settings (Guimarães, 2012). Below are some of the obstruction during Lean implementation in healthcare settings.

5.3.1 Lost in translation

It is discovered that Lean has experienced lost in translation while carrying out from manufacturing to healthcare (Andersen & Røvik, 2015). Ricard also pointed out that there is a matter of Lean lingo overload (Schonberger, 2018). Thus it is of significance to correctly interpret Lean terms in a consistent way which is easy for people to perceive.

5.3.2 Difficulty to define customers

Due to high complexity in the environment of healthcare, there is difficulty defining who the customers are and what do the customers value, since there can be several “customers” in healthcare services, and few cases involve the efforts in hospitals to fulfill this step (Radnor et al., 2012; Cheng et al., 2015). However, the importance of identifying customers and accordingly defining values is apparent. As Womack and Jones (1996) are concerned, failures in fulfilling this step will lead to delivery of wrong services or products in a highly efficient way. Furthermore, understanding what creates value can point to strategies for system redesign (Cheng et al., 2015).

Hence, although there are arguments questioning the necessity to accomplish this step, this study insists it is important to ensure realization of a successful Lean implementation in healthcare.

In spite of the difficulty in defining customers and customer values, especially in healthcare settings where there can be multiple "customers", NHS put significant emphasis on regarding patients as the center of care and that values ought to originate from them. A resolution is provided that under the condition where it is not for sure who the customers are, shared values by multiple customers can be seen as the guidance in Lean implementation.

5.3.3 Narrow application of Lean

Implementation of Lean often focuses on disjointed and small scale tasks at department and ward level instead of system-wide and cross-department level. Moreover, as Radnor et al (2012) stated, "Service leaders tended to understand Lean as a collection of stand alone, operational tools, rather than as a broader system-wide improvement philosophy." There is hardly comprehensive Lean Management philosophy applied in health care sectors, and most of the cases, Lean is implemented as an approach to improve process by using various tools and techniques. Few literatures are identified as achieving whole-system improvements by adopting Lean (Stanton et al., 2014). And Lean will be eventually abandoned and faded away if top management is changed and the new head does not promote Lean in respective areas (Tay, 2016). It is discovered in the study of Roemeling and his colleagues that there is narrow application of Lean in healthcare, which means Lean is applied only to reduce direct waste instead of to serve as mental power to generate improvement in a broader picture (Roemeling et al., 2017). To the best of current knowledge, no ethics in Lean healthcare literatures is discussed (Ljungblom & Ljungblom, 2014).

Applying the service design frameworks of Carlborg, Siu Yee Cheng's study indicated that application of Lean principles in healthcare services can be limited (Carlborg, Kingström, & Christian Kowalkowski, 2013; Cheng et al., 2015). It is shown in table 5-3 that some Lean principles in service design could increase efficiency at the expense of customer satisfaction.

Table 5-3 Lean Principles in Services

Lean principle	Pooled service design	Sequential standardized service design	Sequential customized service design	Reciprocal service design
Define value	◙	◙	◙	◙
Define value stream	◙	◙	◙	◙
Flow	◙	○	○	○
Pull	◙	◙	◙	◙
Standardization	◙	◙	○	○
Perfection	◙	◙	◙	◙

Notes: ◙ Increase both efficiency and customer satisfaction; ○ increase efficiency at the expense of customer satisfaction

Source: Adapted from (Carlborg et al, 2013, *"A lean approach for service productivity improvements : synergy or oxymoron ?"*)

5.3.4 The lack of pursuit in perfection

Perfection is one of the Lean principles which means continuous improvement with nonstop pace (Abouzahra et al, 2014). Sustainability is critical for the impact of successful intervention to last and keep influencing the organization (Collar et al., 2012). As one of the clinician participated in Lean project commented when interviewed, "……we do not evaluate enough. When a project reaches an end, we think we are finished. Following up and evaluating the projects' benefits is rarely done" (Simons et al., 2016). To achieve sustainability of lean effect in healthcare, in the case of Johnson et al. (2018), a survey was conducted every time when a hiring process came to an end, to constantly evaluate procedures and provide evidence for refinement.

5.3.5 Readiness of Lean

Necessary preparation before implementing Lean is essential. Understanding the type of variability is of significance to prioritize improvement efforts (Cheng et al., 2015). However, in practical terms, it is identified that there is a lack of knowledge in the roles of buffers and variability, thus no or limited interventions are made to reduce such aspects (Roemeling et al., 2017).

5.3.6 Other constrains in Lean healthcare

Glove addressed the challenges in Lean application in healthcare including high process variability, a lack of understanding towards Lean, poor communication and leadership, target focused and problems defining waste (Grove et al., 2010). From the perspective of information processing, Lean Healthcare is confined due to a lack of adequacy and integration of information (Tony Kinder, 2013). Moreover, it is also identified that how to embed continuous quality improvement as the culture within an organization and ensure availability of resources can be obstacles requiring breakthrough (Stanton et al., 2014).

Chapter 6 Discussion

6.1 Categories of literatures according to the six quality aim of healthcare

It is presented from 6.1.1 to 6.1.6 below six categories of literatures classification. The six categories are defined by the six quality aims healthcare as proposed by IOM (2001)—safe (S), effective (E1), patient-centered (P), timely (T), efficient (E2) and equitable (E3). In each category it is included the number of papers obtained regarding the quality aims, the Lean principles that are applied, the healthcare areas involved and the findings from the literatures. One paper may show in more than one category as it involves improvement in several quality aims.

6.1.1 Category 1: Healthcare quality aim of safe

Among all the 52 literatures reviewed, there are 19 literatures found in efforts to achieve the healthcare quality aim of safe. These studies are conducted in 9 countries: the Netherlands, U.S.A., Turkey, Australia, U.K., United Arab Emirates, Denmark, Spain and China. There are 3 literatures from the Netherlands, 9 from China and one from each of the rest of the countries mentioned above.

According to Simons et al. (2015), Lean tools such as road show and Kaizen events contribute to improve patient safety culture within the organization but it is also important that the top management is stable and coherent, otherwise it may lead to negative outcomes. Other examples where safety is improved include: reduced blood culture contamination (Sinnott, Breckenridge, Helgerson, & Asch, 2015); decreased rates of serious adverse events (Ben-Tovim et al., 2007; Yang et al., 2015); decreased risk of making mistakes (Simons et al., 2016; Wenqin, 2016; Zhuang, 2017)Linlin et al., 2017; ; reduced misplacement of drugs (Zhonghua, 2016); less unclear labels of drugs (Zhonghua, 2016); removing expired drugs in time (Zhonghua, 2016); decreased rate of patient infection (Jinshang, Pingping, & Mei, 2015); and increased rate of qualified drugs (Wenqin, 2016).

6.1.2 Category 2: Healthcare quality aim of effective

A total of 19 articles are identified as using Lean tools to realize the healthcare quality aim of improvement in effective healthcare service delivery. Studies are conducted in 9 countries: three from Netherlands, three from the U.S., eight from China and one from Turkey, the U.K., United

Arab Emirates, Denmark, Spain and India.

Getting down onto the floor, such outcomes include declined observed-to-expected mortality ratio, reduced rate of surgical complication and decreased death rates (Barach & Kleinman, 2018). It was found by researchers from Stanford University that observed-to-expected mortality ratio declined by using a modified WHO Surgical Safety Checklist (Barach & Kleinman, 2018). Among Some literatures categorized as pursuing the quality aim of effective, although not a specific result was indicated, but there is expected outcome to improve effectiveness. In the study of (Cheng et al., 2015), more completed referral information is available, which enables clinicians to transfer patients to the right clinical departments accurately and hence make it more reliable for patients to receive effective medical treatment. In the case of (Sinnott et al., 2015), after employing the method of rapid improvement events, blood culture contamination rate has significantly reduced from year to year. With this reduced rate, diagnosis will be more reliable and thus medical treatments based on this diagnosis dependent on blood culture will be more effective.

According to the chairman of ThedaCare Center, Mr. Toussaint, it is one of the principles of Lean in healthcare that Lean should create value for patients, and value in health care can be interpreted into health outcomes per dollar spent and outcomes per dollar spent over time (Toussaint & Berry, 2013). To improve in this dimension, kaizen/continuous improvement can make significant contributions (Toussaint & Berry, 2013). Other tools such as clinical pathway and fish bone analysis are also utilized to achieve this goal (Wenqin, 2016; Zhongkai, Yuan, Wen, & Aiping, 2016).

6.1.3 Category 3: Healthcare quality aim of patient-centered

Approximately 80% of the literatures reviewed make contribution to the goal as delivering patient-centered healthcare services. Studies are conducted in 14 countries: fifteen from China, six from the Netherlands, five from the U.S.A, three from the U.K., two from Brazil and Sweden as well as Turkey, and one from countries like Australia, United Arab Emirates, Denmark, Spain, India, Singapore and Portugal.

There are eight cases that have experienced improved patient satisfactory (Changhao, Peijun, Hailin, & Xiaoguang, 2015; Linlin et al., 2017; Radnor et al., 2012; Silva, Seraphim, Agostinho, Junior, & Batalha, 2014; Tortorella et al., 2017; Xunliang, Yuhua, & Lei, 2013; Yang et al.,

2015; Zhongkai, Yuan, Qing, & Aiping, 2018). Improved hospital environment enables patients to feel comfortable (Chan, 2012; Jinshang et al., 2015; Langstrand & Drotz, 2016; Radnor et al., 2012; Xiaoxiao, Jianxia, Qiaoying, & Li, 2013; Yang et al., 2015) and clearer understanding of the care pathways by process improvement/redesign helps to reduce confusion of patients when having healthcare visits (Radnor et al., 2012). Other outcomes also include reduced rate of over treatment, realized by using Lean tools such as fish bone analysis and PDCA cycle to control the expense of medical insurance (Zhongkai et al., 2018). And clear list of consumed materials patients pay for helps to eliminate duplications as well as improve patient satisfactory (Changhao et al., 2015).

6.1.4 Category 4: Healthcare quality aim of timely

In this category, thirty-four studies are presented in fourteen countries to improve timely healthcare delivery, where it means less waiting time, more prompt medical aid when needed and medical materials in readiness. Among them, twelve studies are carried out in China, four in the U.S.A., three in the Netherlands, two in Turkey, Brazil, the U.K., Australia and one in India, Canada, Sweden, United Arab Emirates, Singapore, Denmark and Spain.

Decreased patient wait time in various healthcare departments is the outcome mostly found in improvement in timely healthcare delivery (Ben-Tovim et al., 2007; Chan, 2012; Mazzocato et al., 2012a; Radnor et al., 2012; Xiaoxiao et al., 2013; Silva et al., 2014; Chaowu, 2015; Yang et al., 2015; Cheng et al., 2015; Hasle, Nielsen, & Edwards, 2016; Wenqin, 2016; Linlin et al., 2017; Roemeling et al., 2017; Tortorella et al., 2017; Yaduvanshi & Sharma, 2017; Zhuang, 2017). Increased on time OR start times can be achieved by Lean Six Sigma processes (Yaduvanshi & Sharma, 2017). In the case of 1992 at Northwest Hospital, Seattle, it was so much easier and smarter to achieve this outcome—Nurse Debby put a big white board with schedules of surgeries where a check mark will follow if anyone was late. Almost immediately, the rate of punctual surgeries arise out of the shame given rise by being pointed out for bad behavior (Schonberger, 2018). Other outcomes in improvement of this dimension are observed as increased readiness of supplies (Toussaint & Berry, 2013; Hasle et al., 2016; Schonberger, 2018), submitting referrals more quickly (Cheng et al., 2015), reduced time for doctors to write diagnostic reports (Chaowu, 2015; Yueyu, 2014) and reduced time to review subscription in pharmacy (Linlin et al., 2017).

6.1.5 Category 5: Healthcare quality aim of efficient

Efficiency as one of the healthcare quality aims in the 21st century is identified for the most as a desired outcome of Lean implementation in healthcare organizations. A total of forty-seven articles are found, taking up 90% of the reviewed literatures which involve efforts to achieve this goal and cases are presented in all the fifteen countries observed in this study.
Although most of the results to improve efficiency are positive, there are negative feedback identified. It is claimed that there is high failure rate of Lean projects, taking up about 50%, and failures are like decreased productivity in medicine for the elderly and radiology department, which are caused by the lacking of adequate information or the mechanism for inter-unit cooperation and decision making (Tony Kinder, 2013). Similarly, according to Simons et al. (2016), negative outcome was also observed as increased outcome and time consuming in a radiotherapy institution. This happened mainly because process improvement takes time for professionals to communicate and discuss. Furthermore, it is found in their study that ambiguous objectives were perceived during Lean implementation, which is a cause likely to lead to failure of Lean attempt (Simons et al., 2016)

In general, 90% of the outcomes of Lean to improve efficiency in healthcare turned out to be successful and positive. The mostly observed outcome concerning efficiency is improved staff moral. It is indicated that staff morale may be inspired by empowerment to employees which gives them more space in autonomy (Collar et al., 2012). Furthermore, prompt incentives, whether in financial or moral terms, after each successful accomplishment of Lean Project, is an effective way to stimulate employees and to improve staff morale in Lean implementation within hospitals (Zhongkai et al., 2018).

The second mostly identified efficiency outcomes are reduced space and increased or better cooperation among departments. Value stream mapping helps to prioritize design requirements thus reduced space for other more important functions in the healthcare process. This merit has saved thirty million dollars on construction of the healthcare facility (Toussaint & Berry, 2013). In many cases, a multidisciplinary team consisting of members from different departments of the healthcare organization is established to lead Lean implementation. And this team enables colleagues from different departments to work together with shared goals hence improve cross-department coordination (Collar et al., 2012; Silva et al., 2014; Simons et al., 2016).

The third most frequetly found outcome in efficiency is reduced duplication. In the case of (Cheng et al., 2015), duplication refers to unclear referral information for clinicians to signpost the patients accurately towards the clinical department that one should go to. Root cause of inadequete referral was found to be artificial variations and by eliminating this variation patient lead time will decreased. Duplication also refers to unclear patient care pathways. By applying visual management, labels are used to identify medicla departments in a hospital and realized clearer understanding of care pathways, where patients are not confused what will happen in a health consultation and will be more relax as they know what to do next (Radnor et al., 2012). From the perspective of employees, duplication is also reduced where there is clear definition of tasks, job responsibilities and roles that an employee should play (Crema & Verbano, 2015).

6.1.6 Category 6: Healthcare quality aim of equitable

One article is found in achieving the healthcare quality aim of equitable.The study took place in the department of medical insurance in a Chinese hospital. By analyzing where the medical aids go to and how it was used, the medical insurance department managed to control the cost of inpatient service where over clinical treatments were restricted. With the deduction in inpatient expense, the service becomes more affordable for patients of various financial capability and helps to relieve economic burden on patients (Zhongkai et al., 2018). This quality aim is realized by identifying what do the customers value which is coherent to the correlation between healthcare quality aims and Lean principles proposed by carlborg and adapted by Abouzahra and his colleagues (Abouzahra et al, 2014).

6.2 Refined management and Lean management

What is interesting is that, in Chinese hospitals, there is Refined management before a healthcare organization transforms into Lean management. It is a transition period to Lean, which is not found in English literatures. It is also argued by some researchers as well as healthcare practicioners that most Chinese public hospitals can only achieve “part lean management” out of limited resources on finance and personnel. There is similar expression in the work of Schonberger (2018) that in the majority of healthcare organizations, dynamic regulatory and legislative environment together with increasing cost and measurement difficulties divert attention away from Lean in silence. What is more, there is limited motivation within Chinese

public hospitals to restrict “over clinical treatment”, which is one of the wastes that should be eliminated, because this is one of the means to generate profits for hospitals. But we do not necessarily become pessimistic towards Lean in healthcare. Under conditions of limited resources, Ramaswamy and his colleagues have provided an example to improve quality of care in a Kenya-based organization with low resouce using Value Stream Mapping (VSM) (Ramaswamy et al., 2017). Besides VSM, Kaizen is also a tool to obtain continuous improvement without much input (Abouzahra et al, 2014). Both VSM and Kaizen are tools to achieve Lean management without much resources and in the meanwhile engage employees at all levels. Thus, this article holds a positive attitude towards overall Lean success in healthcare settings. However, in Chinese public hospitals, it is indeed difficult to restrict over-clinical-treatment, due to the Chinese healthcare policies. Although public hospitals in China are defined as nonprofit organizations, there is intrinsic requirements that public hospitals should generate profits as to improve healthcare services as well as for further development to survive in the market competition. To overcome these obstacles, system redesign is needed at higher level in the government beyond hospitals. In this aspect, successful Lean in Healthcare is holistic and systematic which requires joint efforts involving not only employees at all levels within healthcare organizations but also healthcare policy makers in the government beyond hospitals. It is well recognized that Lean is not just a set of tools but a philosophy, and it should not be merely applied in narrow to tackle just some problems. Lean is a management philosophy helpful in identifying and tracing root causes, defining customers values, developing solutions for improvement and sustain continuous improvement of performance (Cheng et al., 2015).
Lean can have much greater effect and impact when engraved in the morale of everyone and becomes the culture of the organization. As Philip Cosby´s most frequently quoted phase goes: “If quality isn’t ingrained in the organization, it will never happen.” Quality is the key factor that contributes to the long-term profitability and success of an organization (Khoja et al., 2017). Thus, this study favors the point of view that lean healthcare should be implemented in a broader and holistic scale instead of merely localized area so as to pursuit success on an institutional level.

6.3 To be better prepared before Lean implementation

As Roemeling et al. (2017) indicated, “small investment in knowledge enables broader interventions.” Third party consultation entities can be a good resource for knowledge set up of employees in healthcare organizations, where clinicians and managers have only limited knowledge regarding lean. In multidisciplinary teams leading the lean projects, experts from the area of lean can also be included, whether from internal or external, to provide necessary guidance and precautions to prevent bias during the process of carrying out lean events. But it is worth mentioning that when employing external members, it is important to stress the significance of including experts from a professional institution. Such emphasis is to gain trust, confidence as well as respect, for internal and external members to cooperate and work together in problems solving. To achieve readiness before implementing lean in a healthcare setting, (Efe, 2016) has provided an example. DEMATEL method was employed to investigate the Patient Perceived Values (PPVs). The initial of this research is the attempt of managers to start lean healthcare management. Experienced doctors and nurses who deal with patients every day thus know what the patients want propose the basic criteria of the values. Through this scientific investigation, it can be defined what do the customers value and implement lean afterwards based on these values.

Besides, top management is also one of the key elements to achieve successful outcomes in lean implementation (Abouzahra et al, 2014; Mccann et al., 2015; Hasle et al., 2016; Hussain & Malik, 2016).

6.4 Sustainable continuous improvement

Sustainability of positive impact by implementing Lean is crucial for the organization to achieve continuous improvement, otherwise the success gained at one time adoption of Lean will eventually fades away and turns in vain. To realize continuous improvement, namely perfection, which is one of the Lean principles, PDCA can be an useful approach (Crema & Verbano, 2015; Langstrand & Drotz, 2016). Furthermore, with involvement of personnel, surveys of feedbacks, promotion and sharing the project, it can also achieve sustainability of continuous improvement (Crema & Verbano, 2015). In the case of (Collar et al., 2012), meetings among key stakeholders are held on a quarterly basis to discuss and review data regarding efficiency after the

accomplishment of the intervention. Necessary action of refinement will be adopted if there is new problems. This meeting enables the sustainability of improvements gained after the Lean project.

6.5 How should we face challenges in Lean healthcare

In real setting and practical terms, there are complaints, questions, doubts towards Lean in healthcare. Some would suspect why is defining who are the customers important and what is the point of spending so much time in defining what do customers value or what are the values a certain step conveys along a value stream mapping. And similar doubts towards lean no matter regarding its feasibility in healthcare settings or in terms of necessity are not rare. But as this literature review identifies, all the methodologies and tool of Lean have their own rationale and cannot be missing throughout the process of lean management in quality improvement. The reason why some cases succeed may be because the action is with involvement of experts in lean and systems engineers from a University, which set up knowledge preparation of Lean before the project takes place (Collar et al., 2012). It is indicated in the study of Collar and his colleagues that low efficiency in healthcare organizations is rather the problem of systematic impediments than individual motivation or laziness. With successful implementation of Lean in the OR, it is convinced that lean thinking has positive impact on an institutional level (Collar et al., 2012). As indicated in (Abouzahra et al, 2014), although lean was originally from manufacturing sector where there are machines that require conformity while patients in healthcare settings are not like machines in mass production industries, all work consists of a certain set of procedures and share some kind of similarity. The purpose of Lean implementation in healthcare sector is not to standardize everything and turn patients into machines, treating them like products in a stream line. The aim of lean healthcare is to detect the procedures that can be integrated and apply lean tools to refine the process in order to eliminate waste, improve efficiency and ultimately be able to convey values to the customers. It is indicated in the study of Collar and his colleagues that low efficiency in healthcare organizations is rather the problem of systematic impediments than individual motivation or laziness. With successful implementation of Lean in the OR, it is convinced that lean thinking has positive impact on an institutional level (Collar et al., 2012).

Therefore, this study holds a positive attitude towards the potential of lean in successfully realizing a leap in efficiency improvement and value creation for customers in the healthcare sector.

6.6 Meaning and Limitation of this study

By examining current literatures using different scientific approaches to study lean healthcare, this article describes an understanding in lean healthcare as well as summarize the key elements that worth paying attention to while carrying out lean projects in pursuit of successful outcomes. A number of barriers that hinders successful results of lean projects are identified and this helps us to perceive the gap between lean literatures in healthcare and practical terms. Exploration in literatures enables the observation of healthcare quality aims achieved and Lean principles adopted per study.

However, this study has not managed to present a clear picture of the correlations between healthcare quality aims and lean principles. This is because among the literatures reviewed, it is not always provided clear evidence of which tools achieve what outcomes, while this is vital to make it possible to associate a certain healthcare quality aim with specific Lean principles. What is more, since this study adopts a theoretical-conceptual approach, experimental control is not applied thus field statistics are not available to present to more vivid description of lean implementation in healthcare settings.

Chapter 7 Conclusion

This literature review includes a total of 52 articles in lean implementation in healthcare and classified articles obtained into categories according to the six healthcare quality aims proposed by IOM. In each category it is specified number of articles included, the country where the study was conducted in, what lean tools were used to achieve what kinds of results and the healthcare quality aim(s) that is (are) realized.

First coined by Prof. Womack and Prof. Jones from Massachusetts Institute of Technology during 1980s, the term of lean was later developed from the manufacturing industries to be healthcare settings in the beginning of the 21st century. Although experiencing enormous and notifiable success in mass production sectors, lean struggles to be embedded in the environment of healthcare organizations and fully adapt to this different industry.

Although it is indicated that not all lean tools and methodologies can be applied in healthcare settings, action research and case studies have shown that many lean tools are feasible for healthcare practice and have gained success in some of the large-scale hospitals like Virginia Mason and ThedaCare Medical center. Barriers are identified as hindering lean success in healthcare, such as lost in translation of lean lingos, difficulty to define customers in healthcare settings, narrow application of Lean instead of broad pictures, the lack of pursuit in continuous perfection of lean and readiness of Lean before implementation.

In the end, reflections are made towards Lean healthcare and suggestions are given for better adaptation of lean in the area. Generally speaking, this study embraces an optimistic mind towards the potential of lean in healthcare to achieve more efficient, affordable, effective, timely, and safe healthcare service delivery for patients and other stakeholder within this industry.

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Appendix 1 Table of paper classification

Paper	Healthcare area	Research method	Country or regions	Implementation	Quality aim	Lean principles
(Joosten et al., 2009)	General	TC	Netherlands	NO	E1; P; T; E2	V; VS; F; PE
(Yaduvanshi & Sharma, 2017)	Inpatient Department; Operating Room; Emergency Department; Laboratory; Diagnostic Imaging Department; Financial Department; Supply Chain Department	TC	India	Yes	E1; P; T; E2	V; VS; F; PE
(Patri & Suresh, 2018)	General	S	India	NO	N/A	N/A
(Pascale A M Simons et al., 2015)	Radiology	S	Netherlands	YES	S; P	V; PE
(Mccann et al., 2015)	Hospital	E	U.K.	YES	P; E2	V; VS; F; P; PE
(Stanton et al., 2014)	Emergency Department	CS	Australia	YES	T; E2	V; F
(Toussaint & Berry, 2013)	General	TC	U.S.A	YES	E1; P; T;E2	V; VS; F; P; PE
(Barach & Kleinman, 2018)	Pediatric Department	TC	U.S.A	YES	E1; P; E2	V; VS; F; PE
(Schonberger, 2018)	General	TC, CS	U.S.A	YES	P; T; E2	V; VS; F
(Grove et al., 2010)	Hospital	CS+E	U.K.	YES	P; E2	V; VS; F
(Roemeling et al., 2017)	Hospital	AR	Netherlands	NO	P; E2	V; VS; F; P, PE
(Tony Kinder, 2013)	General	CS	U.K.	YES	E2	V; VS; F; PE
(Cheng et al., 2015)	Hospital	AR	U.K.	YES	E1; E2	V; VS; F; P
(Johnson et al., 2018)	HR Department	AR	U.K.	YES	E2	V; F; PE
(Baril, Gascon, Miller, & Côté, 2016)	Oncology	CS	Canada	YES	T; E2	V; F; P
(Sinnott et al., 2015)	Department of Veterans Affairs (VA)	AR	U.S.A	YES	S; E1; P	V; F; PE
(Efe, 2016)	Emergency Department	CS	Turkey	NO	S; E1; P; T	V

(Doğan & Unutulmaz, 2016)	Department of Physical Therapy and Rehabilitation	CS	Turkey	NO	P; T; E2	V; VS; F; P
(Tortorella et al., 2017)	Sterilization unit	CS	Brazil	YES	P; T; E2	V; VS; F; P
(Mazzocato et al., 2012b)	Emergency Department	CS	Sweden	YES	P; T; E2	F; P; PE
(Chan, 2012)	Pre-consultation	CS	HK, China	YES	P; T; E2	V; VS; F; P; PE
(Ben-Tovim et al., 2007)	Hospital	CS+E	Australia	YES	S; P; T; E2	V; VS; F; P, PE
(Radnor et al., 2012)	Hospital	CS	U.K.	YES	S; P; T; E2	V; F; P; PE
(Langstrand & Drotz, 2016)	General	CS	Sweden	YES	P; E2	V; F; P; PE
(Blijleven, Koelemeijer, & Jaspers, 2017)	Information Department	CS	Netherlands	YES	S; E1; P; T; E2	V; F; P
(Hussain & Malik, 2016)	Hospital	CS	United Arab Emirates	NO	S; E1; P; T; E2	V; F; P
(Collar et al., 2012)	OR	AR	U.S.A	YES	T; E2	V; F; P
(Tay, 2016)	Hospital	CS	Singapore	YES	P; T; E2	V; F; P; PE
(P. Simons et al., 2016)	Radiology	CS	Netherlands	YES	S; E1; P; T; E2	V; F; P
(Roemeling et al., 2017)	Hospital	CS	Netherlands	YES	P; E2	V; F; P
(Hasle et al., 2016)	Oncology	CS	Denmark	YES	S; E1; P; T; E2	V; F; P; PE
(Crema & Verbano, 2015)	Hospital	CS	Spain	YES	S; E1; P; T; E2	V; F; P; PE
(Soriano-Meier, Forrester, Markose, & Garza-Reyes, 2011)	Hospital	S	U.K.	NO	T, E2	V; F; P
(Carvalho, Ramos, & Paixão, 2014)	Oncology	CS+S	Portugal	NO	P; E2	V; F; P
(Ljungblom & Ljungblom, 2014)	General	TC	Sweden	NO	E2	V; VS, F; P; PE
(Silva et al., 2014)	Hospital	CS	Brazil	YES	P; T; E2	V; VS; F; P
(Shijun & Nan, 2009)	Department of equipment	AR	China	YES	E1; T; E2	V; F
(Zhonghua, 2016)	Pharmacy	AR	China	YES	S; E1; P; T; E2	V; F
(Jinshang et al., 2015)	OR	AR	China	YES	S; E1; P	V

(Zhongkai et al., 2016)	Department of medical insurance	TC	China	NO	E1; P; E2	V; F
(Zhongkai et al., 2018)	Department of medical insurance	CS	China	YES	P; E2; E3	V; F
(Changhao et al., 2015)	Department of Equipment	CS	China	YES	P; E2	V; F
(Xunliang et al., 2013)	Department of Logistics	CS	China	YES	S; P; T; E2	V; F
(Yueyu, 2014)	Radiology	CS	China	YES	P; T; E2	V; VS; F
(Huizhong, 2015)	Hospital	TC	China	NO	S; P; T; E2	V; F; P
(Ramaswamy et al., 2017)	Hospital	CS	U.S.A	YES	P; T; E2	V; VS; F; P; PE
(Chaowu, 2015)	Hospital	TC+CS	China	YES	S; E1; P; T; E2	V; VS; F; P
(Wenqin, 2016)	Pharmacy	CS	China	YES	S; E1; P; T, E2	V; VS; F; P
(Yang et al., 2015)	Department of injection & transfusion	S	China	YES	S; P; T; E2	V; F; P
(Linlin et al., 2017)	Pharmacy	AR	China	YES	S; E1; P; T; E2	V; VS; F; P
(Zhuang, 2017)	Pharmacy; Department of Logistics	CS	China	YES	S; E1; P; T; E2	V; VS; F; P
(Xiaoxiao et al., 2013)	Department of injection & transfusion	AR	China	YES	P; T; E2	V; VS; F; P