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A framework for implementing lean principles in the supply chain management at healthcare organizations: Saudi's perspective

Abstract

Purpose – The main purpose of this paper is to present lean implementation in hospital supply chain management (HSCM) and propose a new conceptual framework tailored specifically to the needs of Saudi healthcare organizations.
Design/methodology/approach – This paper starts with an in-depth review of existing frameworks or models for lean implementation in healthcare in general and in the HSCM specifically. Based on the literature studies and taking experts' opinions into account, a new framework for lean implementation in the Saudi HSCM is presented.
Findings –A new lean implementation framework is therefore offered to decision makers in the healthcare organization for implementing a lean approach in HSCM practices.
Research limitations/implications – This study focused on healthcare organizations, which were selected from hospitals operated by ministry of health and only those hospitals that are accredited by both the Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI) and the Joint Commission International (JCI). The framework is limited to Saudi healthcare.
Practical implications The LSCM framework is easy to understand and use without much complexity. This simplicity makes the LSCM applicable in healthcare settings. Further, LSCM was validated in three different hospitals, and it helped them to identify and improve their non-added activities, thereby readying them for lean deployment in HSCM..
Originality/value – little attention has been paid to implementing a lean approach by healthcare providers in developing countries. This study presents a new framework that is considered the first of its kind for implementing lean in HSCM in Saudi. This framework could help HSCMs' decision makers to implement lean successfully in HSCM practices.

Keywords: framework; lean supply chain management; Saudi Arabia, healthcare

1. Introduction

The increasing pressure on hospitals due to resource constraints and limited financial support has driven more attention towards the continuous improvement of processes and practices (Adebanjo et al., 2016). It is obvious that hospitals face issues in balancing costs while improving care services (Mas, 2014). Healthcare organizations are required to reduce cost and improve healthcare service while supplying safe care for patients(Grove et al., 2010). Healthcare organizations suffer from a number of issues that can affect the quality of healthcare services. These issues can be classified into direct and indirect with the former including the continuously raising of the cost of supply chain operations. The indirect issues include the lack of inventory control that lead in many cases in excessive inventory levels, lack of information, product or service flow between parties, workflow interruptions, and increased health requirements(Mathew et al., 2013) All of these issues need to be solved in order to reduce overall costs and improve healthcare services and therefore patients' satisfaction.

Healthcare organizations spend a significant amount of money in order to improve their performance and productivity in various fields. Productivity for the healthcare sector can be defined as "the physical inputs used (labor, capital, and supplies) to achieve a given level of health outcomes in treating a specific disease"(Black et al., 2006). One of the driving stakeholders for productivity is hospital's supply chain management (SCM). Improving its performance has become increasingly important (Chen et al., 2013). Hospitals try to become lean in order to properly achieve patient needs and their hospital's mission. One of the highest potentials for improvement is to adopt SCM practices for medical supplies. Nabelsi & Gagnon, (2017) mentioned medical expenditure constitutes more than 40% of a hospital's operating costs while Machado et al., (2014) claimed that a healthcare organization's SC represent 25 – 40% of its budget.

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Lean is a management philosophy focusing on improving service processes among others. This methodology demonstrates its power to also improve healthcare processes (Sanders & Karr 2015). Lean is focused on maximizing value while minimizing waste and focuses on the continuous improvement of processes for achieving quicker flow, less variation, greater customer (patients) satisfaction and shorter cycle time (Sinclair et al. 2005), (Laureani & Antony 2017). It has been shown that lean implementation can result in improved quality in healthcare (Gijo et al., 2013). Recently though, there has been an increasing concern about implementation failures in organizations (Albliwi et al. 2014; Laureani & Antony 2012). On the other hand there are good examples of successful implementations in several healthcare organizations in various developed countries such as United States (USA), United Kingdom (UK) and Australia (Reijula & Tommelein 2012; Antony et al. 2016).

Lean is utilized on a systematic basis across the UK's National Health Service (NHS), with a number of healthcare organizations stepping up to focus on organization-wide value systems to achieve their strategic goals. Lean implementation in a healthcare setting has become increasingly important in the existing body of research (Sobek & Lang, 2010). Also, Vries & Huijsman (2011) stated that the supply chain is a crucial and ever-changing issue for healthcare administrators, and has a significant impact on healthcare management. While there are many studies related to lean supply chain, several organizations have struggled and have had difficulties implementing lean supply chain due to improper implementation approaches and a lack of awareness (Tortorella et al., 2017). An extensive literature review indicated that there is no framework developed for lean supply chain in a healthcare setting in Gulf Cooperation Council (GCC) countries and in Saudi Arabia in particular. In the context of this research, GCC countries present differences to other parts of the world in terms of SCM practices and culture. GCC has a unique culture and different health-care system. Culture is an important element in success of lean implementation. Alkhoraif & McLaughlin, (2018) discovered the impact of Organizational Culture in terms of facilitation of lean implementation. The present study aims to address this gap.

According to Alkhamis (2012), although the Saudi government has paid a great deal of attention towards the healthcare sector and has exerted efforts to improve the level of healthcare services, the health sector still faces many issues. Most expenses within the sector are due to the supply chain. Certainly, improving the performance of supply chain by applying one of the tools of continuous improvement (in this case, lean methodology) will save a lot of money. However, in Saudi Arabia, the supply chain operations are suffering from poor performance quality (Alkhamis, 2012). In addition, a considerable amount of money in each fiscal year has been spent on healthcare services by the Saudi government. For example, according to the Ministry of Finance (2015), healthcare accounts for the second largest expenditure of the total government's budget of SR 160 billion, as showed in Figure 1. According to Alkhamis (2012), the World Health Organization (WHO) ranked the Saudi healthcare system 26th among 190 international healthcare systems. Regardless of this high standing achievement, the Saudi health sector faces several issues that require new policies and strategies by the Saudi Ministry of Health (MOH).

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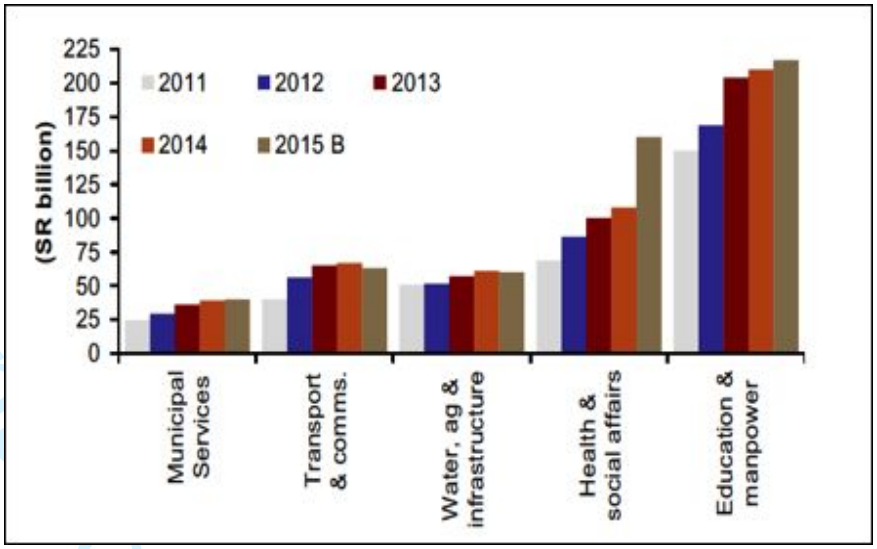

Figure 1 Governmental Expenditures on Healthcare Sector (MOH, 2016)

Although lean has been implemented in many Western healthcare organizations for more than a decade, its implementation in developing countries (i.e. Middle Eastern and GCC countries), such as Saudi Arabia, remains in the early stages (Albliwi et al., 2017; Almanei et a., 2017)). Also, integration between lean and SCM (LSCM) is relatively new approach (Liu et al. 2013).

This study is carried out in the context of the Saudi Arabian healthcare sector. The Saudi Arabia healthcare services are currently provided free of charge to all citizens and to expatriates working in the governmental agencies, mainly through the Ministry of Health. The Saudi Ministry of Health (MOH) is considered the regulator and controller of healthcare. Thus, MOH is committed to the goal of "health for all" (Albejaidi 2010). A total of 298 public and 137 private hospitals provide hospital healthcare services in Saudi Arabia. MOH provides approximately 60 percent of hospital services (MOH, 2016). Further, there are other government agencies providing health care, such as the Ministry of National Guard, the Ministry of Defence and Aviation, the Ministry of the Interior, Ministry of Education, and the Red Crescent Society (Albejaidi 2010). These agencies are independent of MOH in terms of the recruitment of medical personnel, management of health facilities, and budgetary allocations. Figure 2 shows that 59.5 % of hospital services are provided by the MOH and the rest are supplied by other governmental agencies and the private sector. Hospital bed capacity in 2016 was 69,394; more than 50% were operated by MOH. The main aim of this paper is to propose a new framework for implementing lean in hospital supply chain management (HSCM) practices in Saudi settings.

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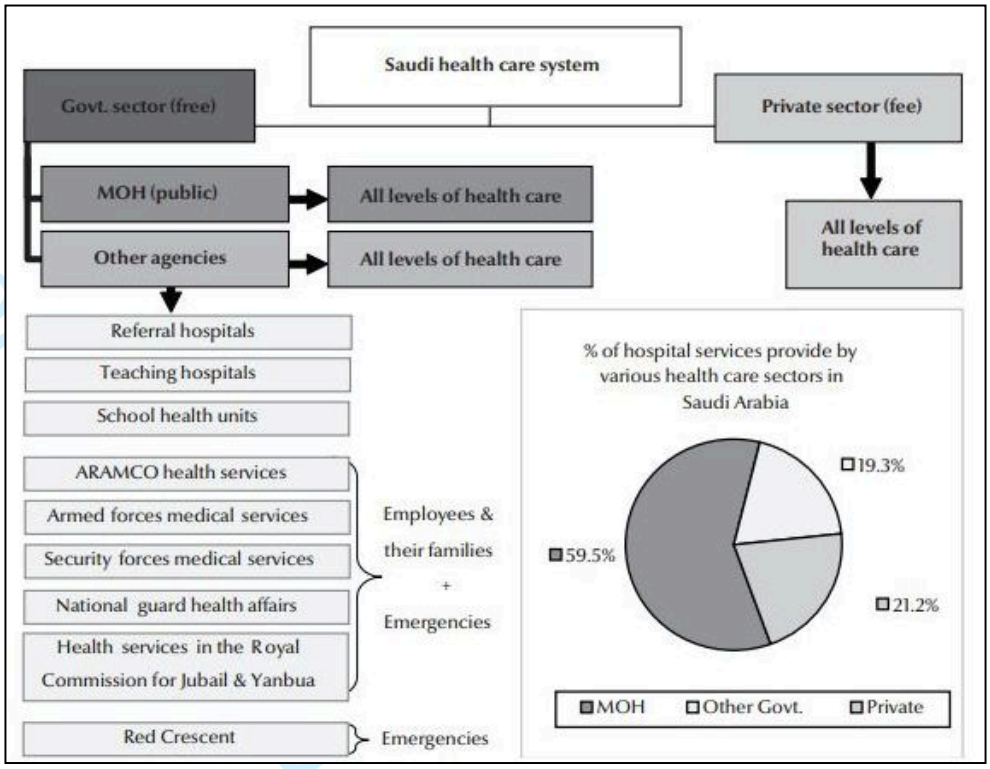

Figure 2 Saudi Health care system (Albejaidi, 2010)

2. Lean Supply Chain Management (LSCM)

Lean is seen by numerous researchers as a set of complementary methodologies that often work together in order to maximize the benefits achieved from improvement initiatives. Moreover, and just as importantly, it is about maintaining these improvements (Salah et al., 2010). Lean is one of the most substantial continuous improvement (CI) methodologies for achieving service and operational excellence in any organization. By and large, authors recognize five basic concepts of lean. These have their origin in Womack and Jones' (1996) original lean concept, as show in their lean thinking. The lean principles tailored to the healthcare SCM needs are:

a. Specify value desired by the patient

Value is always defined by the patient's requirements and needs for a specific service or product. In health-care, the ultimate goal of any hospital is to keep patients safe by meeting all their requirements just in time with good quality and right quantity. Identifying patients' value is the starting point to implement lean. The real value can be specified by the patient. Patient value can be maximized by eliminating wasteful activities as much as possible from patient services (SCM is one of the most element in patients care) (Westwood et al., 2007). For example reduction in error and length of stay of patients and improvement of medications delivery time can be identified by patients (Gupta et al., 2016).

b. Map the value stream or patient journey.

Once the end goal (value) has been identified, the next step is mapping the value stream. The main aim of the value stream is to identify all the non-added-value activities and steps from patients' perspective. For example, lead time of patients will be reduced by using value stream mapping for identifying areas of improvement. Further beds every year can be saved in addition to cost benefits. In addition, increase in on-time starts, number of cases rescheduled, decrease in operating room turnaround time. (Gupta et al., 2016).

c. Create Flow

After the waste has been eliminated from the value stream, the next step is to ensure that operations smoothly flow without delays, bottlenecks, or interruptions. Creating a flow in the processes enable

supply chain departments to explore problems that inhibit the smooth flow and take suitable corrective actions. In addition, flow without interruptions can reduce the processing time, lead-time and the overall operational cost (Womack & Jones,1996). In healthcare context, lean principle can streamline the patient flow and patients' demand in different healthcare departments including SCM. Improving patients flow reduces the possibility of overcrowding(Chan, 2014).

d. Establish Pull (Let the patient pull)

According to Womack & Jones (1996), "pull in simplest terms is that no upstream process should produce a product/component or service until the customer downstream ask for it". Once improved flow, time to patients (customers) can be significantly improved. This can enable an organization (e.g. healthcare) to deliver products (medicines, medical equipment, etc.) as needed. This means the patients can "pull" the medicines or medical supplies from supplier only when actually needed. As a result, medicines do not need to be supplied in advance or stored. Inventory management contributes substantially to the cost that should be reduced as much as healthcare organizations can. Patient pull is actually what accurate demand is. For example, in healthcare setting, improving pull can lead to the reduction of average patients waiting time (Gupta et al., 2016).

e. Pursue Perfection

After accomplishing the previous four principles, the fifth lean principle is to strive for perfection. While the previous four principles are a great start, the fifth principle perhaps is the most important. This principle creates lean thinking and makes process improvement part of health-care culture (organizational culture). At this level, each activity / process create value for the patient (customer). Westwood et al., (2007) assured that lean implementation in health-care setting can lead to the identification of the wasteful steps, safer health services to the patients without delays and provide better. Also, authors mentioned, five principle of lean enhance the quality of health services by eliminating waste and improving flow in the patient journey.

Lean implementation encompasses a wide range of administration practices that can be applied in the non-manufacturing and manufacturing industries. Some of these practices include total quality management (TQM). Implementation of TQM in hospitals context can improve healthcare services. TQM implementation mainly depends on existing of quality department and it plays a key role in success of TQM implementation in healthcare setting (Knapp et al., 2015). For example in healthcare, Value stream mapping (VSM), plays vital role in improvement in quality of physical environment, access time for services, reduction in length of stay (Gupta et al. 2016), and total productive maintenance (TPM) (Shah & Ward 2007; Camacho-Miñano, M. et al. 2013). TPM will be useful for healthcare providers. It can be employed to evaluate the performance of medical equipment and therefore improve it (Chompu-inwai et al., 2008). The lean supply chain is defined as "a strategy based on cost reduction and flexibility, focused on processes improvement, through reduction or elimination of all non-value adding operations" (Haq & Boddu 2014). Vitasek et al. (2005) defined LSCM as "a set of organizations directly linked by upstream and downstream flows of products, services, information and funds that collaboratively work to reduce cost and waste by efficiently pulling what is needed to meet the needs of individual customers."

In the supply chain context, performance improvement is becoming a must for those organizations looking for success. The optimization of an organization's resources is one of the most important roles of the SCM, which deals with raw materials and distribution to the customer (Hjaila et al. 2016). Also, a huge number of non-value-added activities are performed throughout the SC process. Lean principles help to eliminate waste activities across the SCM processes, and are tools that endeavour to improve quality and speed, and increase customer satisfaction (Laureani & Antony 2017). In addition, a lean approach improves quality in the healthcare sector (Peter & Lawrence 2002), (Gijo et al. 2013).

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3. Review and Evaluation of Existing LSCM Framework

This study seeks to develop an appropriate LSCM framework that suits the Saudi healthcare setting with a combination of in-detail review of existing LSCM frameworks and experts' opinion from Saudi healthcare sector study. First, it is important to know and understand what a framework is within a research context. Based on the literature, there is no consensus on the definition of a framework. The term framework is a very popular term used in a vague way, and thus it does not have a clear-cut definition. Several sources use the framework in the place of a model or vice versa (Jasti & Kodali 2016). According to Miles & Huberman (1994), a conceptual framework is defined as "a visual or written product, one that "explains, either graphically or in narrative form, the main things to be studied and the key factors, concepts, or variables and the presumed relationships among them."

Found & Rich (2007) suggested a lean supply chain (LSC) framework after conducting a survey. This study applied empirical research to find out the applicability of the suggested LSC framework, but did not include validity and reliability analysis. Further, researchers have developed LSC frameworks to fulfill the requirements of the manufacturing industry (Jayaram et al., 2008). Lee et al. (2011) developed a framework to investigate the innovation of supply chain in the healthcare sector to improve organizational performance. The data was collected from 243 clinics in South Korea (large hospitals, more than 100 beds), and the hypotheses were examined utilizing structural equation modeling. The results showed that there was a positive relationship between the innovation of supply chain factors and organizational performance. The design of supply chain innovation has a considerable effect on the choice of collaboration with improved supply chain efficiency, suppliers, and enhancement of quality management practices. However, the research was limited to the hospital's size.

Pasutham (2012) developed a framework for integrated performance supply chain in three case studies within the Thai manufacturing sector. These include integration of upstream (suppliers relationship management) with downstream (customer relationship management) and within a firm (internal supply chain management). However, the framework was suitable within the Thai context and was affected by context and culture. Furthermore, policy makers in healthcare cannot be disregarded, as the framework cannot work properly if the regulators and all players in healthcare do not embrace the same practices and standards. Kritchanchai (2012) developed a supply chain framework for the healthcare sector in Thailand. The framework focused on co-ordination and operations within healthcare players, integrated with government of healthcare policy in the public sector. Three projects were conducted during this study. The results showed that SCM is a new concept in Thailand and is still in its infancy in healthcare. Lega et al. (2013) developed a framework to evaluate and measure supply chain processes in the healthcare sector and applied it on Italian NHS. The study showed that there was an urgent need to quickly respond to changes in demand. In addition, due to the levels of variability, it is difficult to predict the demand of some medical departments, such as emergency and intensive care units (ICU). Furthermore, the criteria of warehouse management in the manufacturing sector are not suitable to be used in the healthcare sector (Lega et al., 2013). Finally, any problem in supply chain processes can lead to critical patient damage. Machado et al., (2014) proposed framework to implement lean concept in Brazilian hospitals through change of culture. Anand & Kodali (2008) developed a conceptual framework resulting in two concepts, including lean and agile. The proposed framework helped organizations in transforming from traditional supply chain into lean supply chain and was developed based on judgmental processes in the manufacturing context. However, the framework is not validated through case studies.

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Table 1 Summarizing LSCM frameworks

Author(s)(year)	Sector	Country	validation	limitation
Found & Rich (2007)	Manufacturing / packaging	UK	panel of experts	Lean supply chains Limited to packaging. Focus only on just in time
Jayaram et al., (2008)	Automotive	North America	panel of experts	The conceptual framework examined effect of lean practices on financial performance and building relationship.
Anand & Kodali (2008)	Manufacturing	India	panel of experts	The framework only attempts to evaluate the relationship between SC performance and LSCM practices
Lee et al. (2011)	Healthcare	USA	structural equation modeling	The framework focused on quality management practices more than lean practices and its impact in organizational performance
Pasutham (2012)	Food/ chemical/ textile	Thailand	panel of experts	One of the drawback of this framework is developed for Manufacturing sector
Kritchanchai (2012)	Healthcare	Thailand	Focus group	The framework propose use standardizing medication code to improve hospital supply chain.
Lega et al. (2013)	Healthcare	Italy	panel of experts	The framework concentrated on evaluation of SC performance more than implementing lean concept. The framework ignore evaluation of patient value (satisfaction)
Machado et al., (2014)	Healthcare	Brazil	N/A	The framework attempts to implement lean through change organizational culture.
Jasti & Kodali (2015)	manufacturing	India	Not validated	The proposed framework is developed for Manufacturing Indian companies
Tortorella et al., (2017)	manufacturing	Brazil	N/A	The framework is only for Brazilian context.
Primadasa & Alfarisi (2018)	Oil	Indonesia	additive weighting method	LSCM framework is built for oil industry in Indonesia
Chakraborty & Gonzalez (2018)	Healthcare	USA	Case studies	The framework was developed with the USA healthcare system and may applicable to the USA hospitals.
Meng (2019)	Construction	UK	N/A	LSCM framework is limited to construction sector in UK.

Agwunobi & London (2009) pointed out that the use of lean for improving high-volume purchasing and SCM in the healthcare sector lower prices saving a significant amount of money and improves healthcare. Moreover, a low purchasing level leads to a reduction of inventories and therefore, saves money. Aronsson et al., (2011) developed a framework by combining supply chain management and lean philosophy in the healthcare context. The framework used lean and agility in the hospital supply chain setting. Furthermore, a case study approach at one of the largest hospitals in Sweden has been adopted. The framework focused on organizational transparency and teamwork and the study shows that using a lean concept in supply chain at hospitals potentially works well for patient flow in hospitals.

Godinho Filho et al., (2014) presented the implementation of lean techniques in healthcare in the surgery department of a Brazilian hospital. The proposed lean approach is based on a set of nested improvement cycles that are employed to continuously improve the value chain. The findings of the implementation

illustrated improvement in savings in cost capacities and cycle time. Another important improvement was a significant reduction by 94% in the index of delayed surgeries due to the lack of materials and a reduction in post-surgery infection. Garcia (2017) wondered how lean management principles could be used to improve patient satisfaction scores and reduce wait time. Using lean methodology and implementing a PDSA (Plan, Do, Study, Act) cycle has shown to have a significantly reduced procedure cycle time and improved patient satisfaction. Implementation of lean principles leads to increased patient satisfaction by improving cycle times for procedure room turnover, developing methods to anticipate work ahead of time and improving overall cycle times. In conclusion, although there are many frameworks that addressed lean implementation in supply chain management, most of these frameworks are limited to certain industries such as manufacturing, food, small-medium enterprise (SMEs) or construction while other focus on in a specific region such as Taiwan and Portuguese.

It can be noted that all previous frameworks addressed either a single part in SCM (Gunasekaran et al., 2001; Chan & Qi, 2003;Gunasekaran et al., 2004 ; Huang et al., 2005; Bhagwat & Sharma, 2007; Robb et al., 2008; Lin & Li, 2010) or focused on non-healthcare sector (Bhagwat & Sharma (2007; Pasutham, 2012). Other researchers focused on the importance and the benefits gained from improving SCM performance such as preventing medical errors, improving healthcare provider (hospital) performance, decreasing waste, producing value added operations, improving operational efficiencies and helping to improve quality of care (Ford & Scanlon, 2007; Mustaffa & Potter, 2009; Kumar, Ozdamar, & Zhang, 2008; White & Mohdzain, 2009). Many authors mentioned that there is scarcity of studies concentrated on SCM performance improvement (Mustaffa and Potter, 2009a; Gopal & Thakkar 2012; Piotrowicz & Cuthbertson 2015; Hong et al., 2012; Al-Saa'da et al., 2013) while many tries have been made to create a helpful framework for improve SCM in different sectors, none of the present frameworks have attempted to develop framework for improving SCM by integrating lean and SCM within healthcare settings generally in the Middle East and especially in Saudi Arabia or gulf region.

4. Research Methods

In this section, the various research approaches will be presented. And based on the research context, aim and objectives, a research strategy is chosen. Therefore, the matters concerning to the data collection used are examined. The research methodology adopted includes four phases (Figure 3).

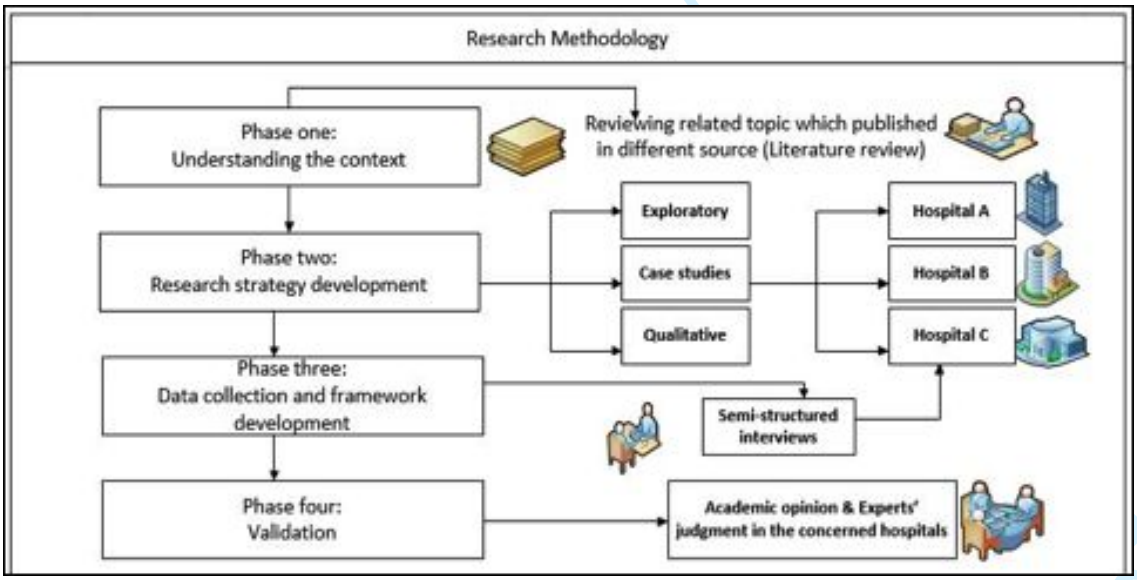

Figure 3 Research Methodology

Phase (1): This phase focus on understanding of lean and SCM and their surrounding areas by reviewing current literature. The research used several material sources, such as books, theses, reports, and many electronic sources, including Google Scholar, Emerald, Business Source Complete (EBSCO), Elsevier, Science-Direct, Scopus, and ProQuest. The literature reviewed and a number of areas were covered including lean services, lean implementation, lean SCM, hospital supply chain management, and leanness assessment. Then, the research problem and gaps were identified. And then, the research aim and objectives were proposed.

In this phase, research problem, aim and gap were identified and the appropriate research strategy was selected. According to Yin (2014), case study is suitable to investigate a topic which rarely has been conducted to understanding the nature of issue happened and most suitable of study for obtaining deeper understanding. Since the implementation of lean practices in hospital supply chain is a relatively new phenomenon and the investigation is based on a phenomenon that is related to and rooted in work-life experience, exploratory and case studies are a more appropriate strategy to understand real life situations **Phase (2):** According to numerous researchers and authors the purpose of the research could be one or more of exploratory, descriptive and explanatory (Yin, 2014). The research purpose may change over time, so it may have more than one purpose (Robson, 2011).

research is a worthy means to discover " what is happening; to seek new insights; to ask questions and to assess phenomena in a new light"(Robson 2011). It is useful to use this type of research to clarifying and understanding of phenomena. In addition, it used also if researcher is unsure of nature of a certain issue precisely. According to Saunders et al., (2009), there are three main ways of carrying out exploratory research: searching of the literature, interviewing expert in the certain field, and carrying out focus group interview. Exploratory approach endeavor to construct hypotheses instead of test them. However, to carry out exploratory research, data is probably to be qualitative (Saunders et al., 2007). The case study (hospital) was selected from those healthcare organizations are keen to implement lean practices in their SCM and which are accredited by both the Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI) and the Joint Commission International (JCI). The reasoning behind these criteria was to make sure there was a rigorous foundation on which to implement change initiatives such as lean. In addition, existing knowledgeable and experienced employees in healthcare organization is another reason for selecting certain organizations. At the beginning, due to the nature of healthcare service sensitivity, the researcher was asked to attend Web-based training course "Protecting Human Research Participants". The course is running by The National Institutes of Health (NIH) Office of Extramural Research (Appendix A). Three Saudi healthcare organizations were participated in the main study. The semi-interviews were carried out with experienced employees within the SCM in the healthcare sector of Saudi Arabia who qualified (for example, lean six sigma green, black or master belt, or who participated in continuous improvement projects). From the interviews, many important lean enablers/factors and barriers were identified by the respondents. According to Yin (2014) case study is suitable to study an area in which not a lot of studies have been conducted. In this study, since the implementation of lean practices in hospital supply chain is a relatively new phenomenon and the investigation is related to and rooted in work-life experience, case studies are the more appropriate strategy to understand real life situations. The study of implementation of lean practices in HSCM is relatively limited and can be considered as new phenomena especially in healthcare context in Saudi Arabia.

Phase (3): For collecting data and information, interviews were carried out with experienced employees from within the SCM in the healthcare sector of Saudi Arabia who qualified (for example, lean six sigma green, black or master belt, or who participated in continuous improvement projects). From the interviews, many important factors and operational considerations were identified by the respondents.

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Since all healthcare organizations participated in this study are competing to get the national quality award, the enablers and factors were grouped according to the King Abdulaziz Quality Award (KAQA) that represents the National Quality Award in Saudi Arabia. KAQA has the same enablers as European Foundation for Quality Management (EFQM) model. The reason behind this was to maximize the benefits from implementing the framework by facilitating implementing lean principles. In this study, KAQA was used for self-assessment and to identify areas for further improvement (Dodangeh & Yusuff 2011), which is an aim of this study. Further, KAQA can be used in certain subsectors in healthcare settings (in this case, supply chain departments). Due to the importance of hospital's consumers (physicians/patients), as both of them are the pillar of healthcare services, enablers for consumers have been independently identified. Also, any factors related to healthcare policy and strategy has been classified under leadership factors because the strong relationship between strategy and leadership and leaders is responsible for drafting, forming and executing the hospital's strategy. The development process of the framework was based on reviewing literature and interviewing experts from three Saudi healthcare organizations. The framework is built based on four phases as elaborated in the following section

Phase (4): The last phase of adopted research methodology is the validation of the final findings. The final LHSCM framework was validated by adopting common validation strategies. The framework validated qualitatively and quantitatively (statistical). In terms of qualitative validation, the framework was developed and finalized by working cooperatively with three healthcare organizations. The main purpose of those is to collect opinions about to make sure of the feasibility of the phases and activities of the framework. Using experts' opinions for the validation of the approach is common and used by many researchers (Haq & Boddu 2014). Quantitatively the framework was validated by using Minitab® 18 software.

4.1 Practical validation: three hospitals were visited and 15 experts were participated to validate the framework. Table 2 shows experts' data who participated in qualitative and quantitative validation. All respondents are working HSCM and have solid experience in continuous improvement initiatives.

Table 2 Experts Participated in Validation Process

No	hospital	Interviewee's role	Experience (Year)
1	X	Associate executive director for supply	25
2		Purchasing and Tendering manager	20
3		Material management manger	28
4		Medical equipment manager	15
5		Store manager	22
6	Y	Associate executive director for supply	18
7		Procurement and contracts manager	21
8		Demand planning and forecasting manager	19
9		Medical purchasing manager	17
10		Medical warehouse manager	21
11	Z	Associate executive director for logistic	19
12		Purchasing and Tendering manager	16
13		Material management manger	18
14		Medical equipment manager	15
15		Store manager	17

4.2 Qualitative Validation

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Using experts' opinions for the validation of the approach is common and used by many researchers (Haq & Boddu 2014). The framework was developed and finalized by working cooperatively with three healthcare organizations. There were 15 respondents that participated in the focus group process. Group discussions were held to capture experts' feedback and to check the validity of the framework. Group discussions were conducted in each hospital and validity-centered sessions were held about the following point: "To what extent the LHSC framework phases, activities and lean enablers considered to be vital for successfully implementing lean in SCM in healthcare organizations?" Figure 4 shows the validation process.

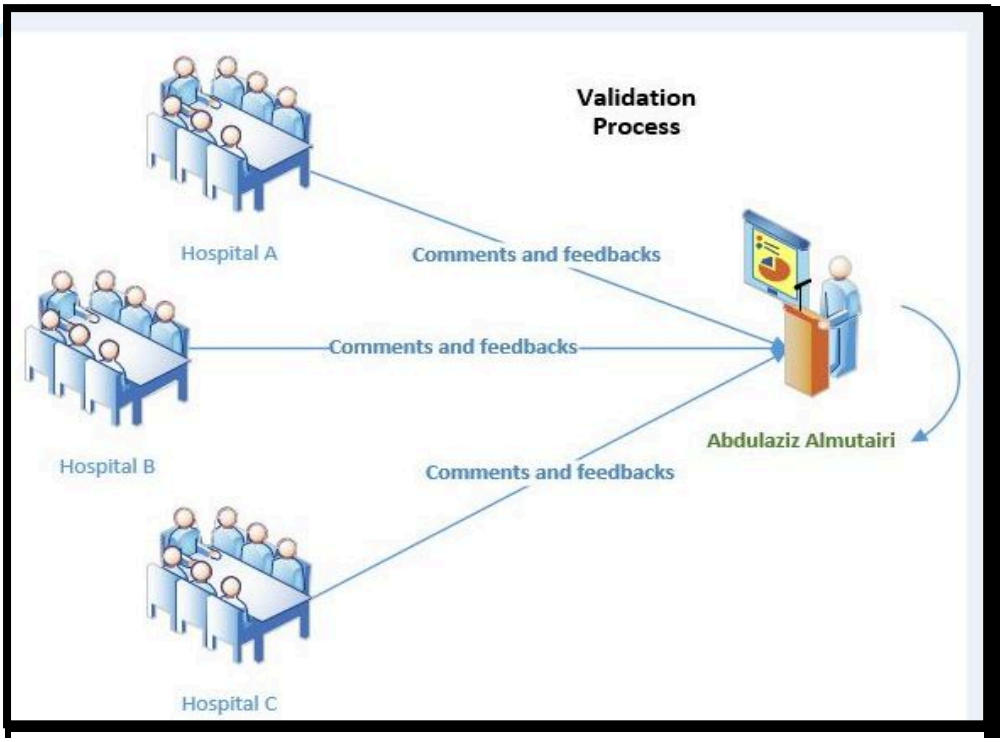


Figure 4 Group discussion process

After making 25 minutes presentations (on average) to each hospital supply chain experts, comments were summarised in Table3.

Table 3 Focus Group feedback

Hospital	Group's comments overview
X	It is an applicable and helpful framework. All of the hospital supply chain departments could implement lean successfully if they follow phases and take into account lean enablers and lean challenges. Also, the framework is useful in identifying the waste in SCM practices. The hospital should ensure that their people are ready to implement the lean initiative.
Y	The sequence of the phases within the framework enable the stages of lean implementation to be visualized. Decision makers in SCM should prepare their staff on how to use and implement lean tools, and select suitable techniques for this implementation.
Z	The framework is applicable if SCM staff have sufficient knowledge along with strong relationships with customers and supplier, which will enable them to effectively implement lean within the supply chain practices. There is need to train HSCM staff for lean implementation instead of relying of external consultant

4.3 Quantitative (Statistical) Validation

In order to test the acceptance of a "framework for implementing lean principles in a supply chain at healthcare organizations", t-tests were carried out. Managers from HSCM were asked the following questions for quantitative validation purpose. Participants were asked to give each question number from 0 to 10: (10 indicates applicable) as illustrated in Table 4.

Table 4 Questions were asked to participants

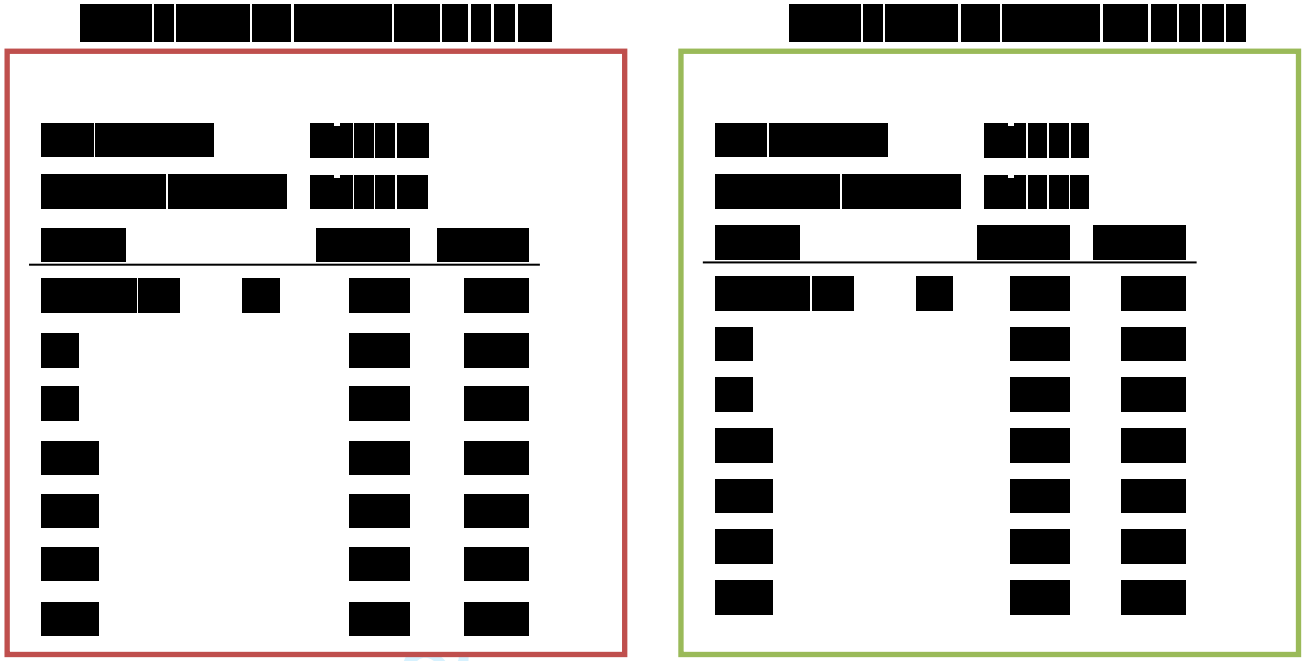
No	Question
1	To what extent do you believe that the lean implementation framework is practically feasible in your healthcare organization?
2	To what extent do you believe that the lean implementation framework is understandable by the hospital employees?
3	To what extent do you believe that the lean implementation framework represent the reality?
4	To what extent do you believe that the lean implementation framework will lead to: 4.1. Eliminate non-added value activities from supply chain practices? 4.2. Reduce the overall operational cost of supply chain? 4.3. Improve on-time delivery of medicines and other medical supplies? 4.4. Enhance patients / physicians satisfaction?

After experts answering the above questions, T-Test was conducted at 95% confidence interval. For all hospital, two trials were used. First trial was supposed each question will be implemented 100% (10 in the scale) as shown in Table 6, 9 and 12.

One-Sample T: Hospital (X)

Table 5 Descriptive Statistics

Sample		N	Mean	St Dev	SE Mean	95% CI for μ
Hospital (X)	Q1	5	8.400	0.548	0.245	(7.720, 9.080)
	Q2	5	8.400	0.894	0.400	(7.289, 9.511)
	Q3	5	8.200	0.837	0.374	(7.161, 9.239)
	Q4.1	5	8.400	0.548	0.245	(7.720, 9.080)
	Q4.2	5	8.400	0.894	0.400	(7.289, 9.511)
	Q4.3	5	8.800	0.447	0.200	(8.245, 9.355)
	Q4.4	5	8.800	0.837	0.374	(7.761, 9.839)

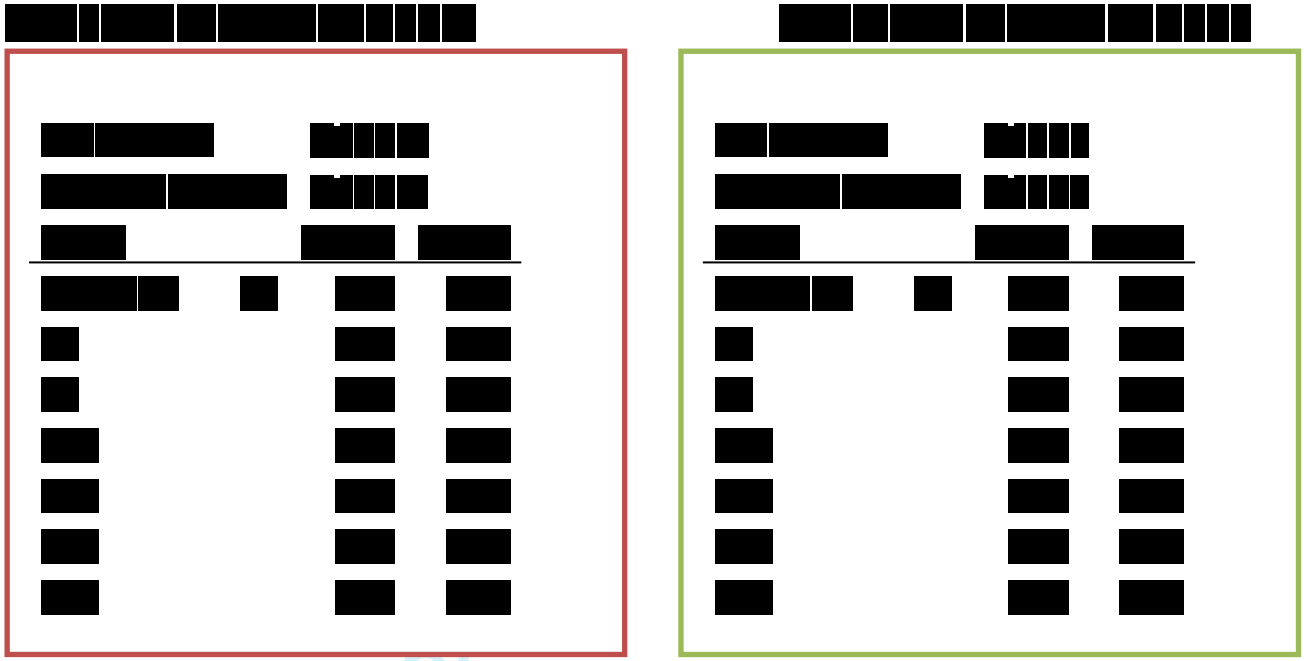


μ: mean of Hospital (X) *Q1, Q2, Q3, Q4.1, Q4.2, Q4.3, Q4.4*

After running the software, first trial was failed for all hospitals, then the second trial was supposed. The second trial was 90% (9 in the scale) as shown in Table 7, 10 and 13.

One-Sample T: Hospital (Y)
Table 8 Descriptive Statistics

Sample		N	Mean	StDev	SE Mean	95% CI for μ
Hospital (Y)	Q1	5	8.600	0.548	0.245	(7.920, 9.280)
Q2		5	8.800	0.837	0.374	(7.761, 9.839)
Q3		5	8.400	0.548	0.245	(7.720, 9.080)
Q4.1		5	8.400	0.548	0.245	(7.720, 9.080)
Q4.2		5	8.200	0.837	0.374	(7.161, 9.239)
Q4.3		5	8.600	0.548	0.245	(7.920, 9.280)
Q4.4		5	8.400	0.894	0.400	(7.289, 9.511)



μ: mean of Hospital (Y) Q1, Q2, Q3, Q4.1, Q4.2, Q4.3, Q4.4

One-Sample T: Hospital (Z)
Q1, Q2, Q3, Q4.1, Q4.2, Q4.3, Q4.4
Table 11 Descriptive Statistics

Sample		N	Mean	StDev	SE Mean	95% CI for μ
Hospital (Z)	Q1	5	8.200	0.837	0.374	(7.161, 9.239)
	Q2	5	8.400	0.894	0.400	(7.289, 9.511)
	Q3	5	8.600	0.548	0.245	(7.920, 9.280)
	Q4.1	5	8.400	1.140	0.510	(6.984, 9.816)
	Q4.2	5	8.400	0.894	0.400	(7.289, 9.511)
	Q4.3	5	8.000	1.225	0.548	(6.479, 9.521)
	Q4.4	5	8.200	0.837	0.374	(7.161, 9.239)

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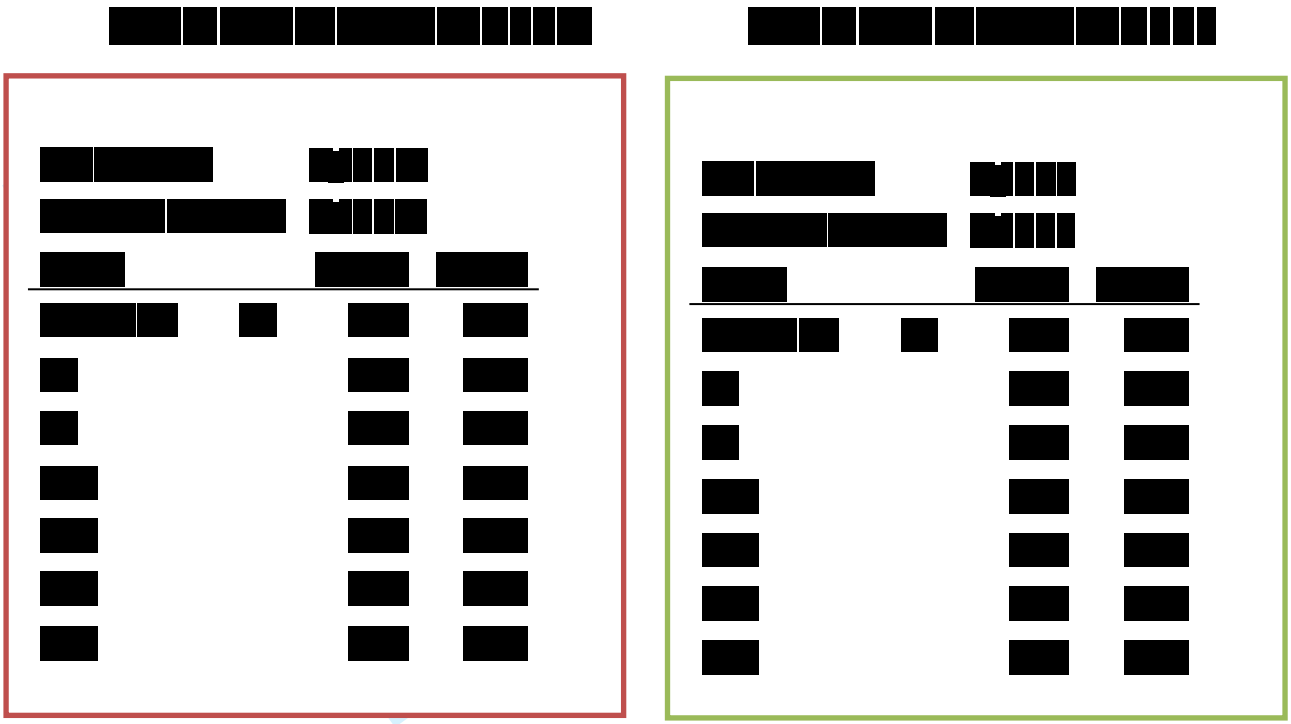

μ: mean of Hospital (Z) Q1, Q2, Q3, Q4.1, Q4.2, Q4.3, Q4.4

In hospital (X), (Y) and (Z) and based on experts' opinion, it noticed from Table 7, 10 and 13, that p-value for all questions exceed the 0.05 (95% confidence interval) which mean the null hypothesis has been accepted. This indicates that the successful of lean implementation in HSCM is 90 % from experts' perspective.

5 Proposed Lean Hospital Supply Chain (LHSC) Implementation Framework

The framework is built on four stages and each stage should be completed successfully before moving on to the next stage. Figure 5 shows the overview of stages of implementation. Thus, the four stages are:

- Stage One: Preparation state
- Stage Two: Assessment of the current state in terms of lean
- Stage Three: Developing the desired future state in terms of lean
- Stage Four: Steady (sustainable) state of new actions taken

(1) LHSC Implementation Framework Phase 1: Preparation State

Before initiating any lean implementation project, the decision makers should prepare their healthcare organizations to accept these changes and make them ready to contribute to its success with the new approach. Like other continuous improvement initiatives, lean needs a fertile ground for success. According to Achanga et al., (2012) an organization's lean readiness is critical for implementing lean practices. The degree of lean readiness is important for determining to what extent lean implementation will succeed. The steps (activities) in this stage should be addressed before moving to the next stage.

a. Activity 1: Commitment toward Lean Implementation by Hospital Leadership

Hospital's top management's commitment plays a vital role in the success of lean implementation. Hospital leadership is important in terms of facilitating the necessary requirements to allow lean implementation and willingness to be connected with problems during the implementation stage. Executives are in charge of actualizing the real involvement of hospital staff in a lean initiative and facilitating the needed resources to allow lean implementation. In terms of resources needed for lean

implementation, involvement and training for hospital employees should be provided in a lean initiative. Senior managers should be willing to show their support and commitment for any lean initiative whenever problems arise. As well, an increased supportive commitment towards lean projects from the top management is one of the main pillars of successful lean initiatives. In this stage, the hospital's top management provides assistance when any problems over lean implementation appear. As well, they support the goal of prompting necessary attitudes from all hospital levels to encourage successful lean implementation. Hospital leaders must show an interest in and allow the availability of needed resources to ensure forward movement of lean projects, which reinforces its position in a hospital setting. Without sustained and visible support from hospital leaders, lean initiatives cannot be implemented in healthcare settings (Pampanelli et al., 2014; Alves & Alves, 2015; Tsironis & Psychogios 2016;Kader Ali, 2016 ;Cherrafi et al., 2016;Albliwi et al., 2017).

b. Activity 2: Create Hospital Lean Vision

Executives should link lean initiatives with organizational visions and strategic goals to show that people confirm their visible commitment and serious support towards lean initiatives. Hospitals' senior managers need to set forth a clear lean vision and mission that indicates hospital goals for performance improvement. The hospital's vision should be translated into lean strategies and goals and communicated to supply chain employees, medical staff (physicians, pharmacists, and medical engineers), as well as medical suppliers by the use of a hospital's website, periodicals, or other social media. This allows them to imagine and visualize the hospital's mission, lean culture and commitments of the hospital (Spagnol et al., 2013; Antony 2014; Shokri et al., 2016).

Activity 3: Build Lean Steering Committee

Forming a lean steering committee is considered the cornerstone of success of lean implementation. This committee is comprised of representatives from different departments, such as top management, front-line employees, and quality management. The main roles of a steering committee are building a lean team, making sure lean team members have sufficient knowledge in terms of lean, how to implement it and identifying the appropriate lean tools and techniques suitable for the nature of hospital supply chain, changing the culture, and identifying lean resistors. Also, steering a committee provides the required and necessary lean training to the staff of the hospital. In addition, the issue that needs to be solved should be clearly identified before embarking on the lean journey(Sanders & Karr, 2015). In the case of lean experts being unavailable within the hospital, the hospital can be assisted by external lean experts, along with giving lean training courses for employees who need them. In addition, a qualified steering committee is responsible for assessing supply chain leanness levels and identifying the main challenges of lean initiative implementation. Also, a steering committee (lean team) would help hospital senior executives establish a corporate lean vision and then translate it into action plans. Lean teams should publicize the lean vision and guide lean objectives in an effective way. Moreover, the committee is responsible for improving organizational culture. Lean practices should be linked to organizational missions and strategy, where lean approaches become part of the organizational culture (Hines et al. 2008; Jeyaraman & Kee Teo 2010; Radnor & Bucci 2011; Burgess & Radnor 2013).

c. Activity 4: Identify Lean Implementation Challenges

The next step in this stage is to identify lean implementation challenges. Identifying implementation challenges before applying lean is important and can help a hospital to evaluate its ability and capabilities in implementing lean effectively or not. Barriers prohibit lean implementation from successful (Grove et al. 2010). A steering committee then identifies the main challenges and gains the approval of the senior management that all the issues facing the implementation of lean initiatives can be treated. Continuity without the approval of decision makers may cause the failure of lean implementation. The main reason for this step is to make sure that all challenges can be resolved in the future. In some cases and due to the lack of a hospital's capabilities, a hospital cannot overcome some of the challenges in its current situation. In this case, lean initiatives are postponed until the challenges

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are resolved (Kim et al. 2006; D'Andreamatteo et al. 2015). After verifying, the steps in this stage are working effectively the hospital can then move on to the next stage.

After achieving these steps, the decision makers at healthcare organization should ask themselves "is our organization ready to implement lean principles?" After finishing this phase, the healthcare organization will be able to ready "readiness" implement lean and now should move to the second phase.

(2) LHSC Implementation Framework Phase 2: Lean Assessment State

After establishing the commitment and support from hospital's senior management, building a qualified lean team, linking lean with the hospital's vision, resolving all lean implementation challenges, and then steering the committee; the lean implementation team can then move on to the second stage. This stage is considered to be a diagnostic tool for hospitals in terms of lean and can determine the actual level of lean implementation. In light of this diagnosis, areas that need further improvements will be identified. This stage enables supply chain in hospitals to define the actual gap between the current situation and the desired outcomes. This stage requires a thorough audit to document what is actually happening in a hospital by interviewing experienced supply chain employees (Almutairi et al., 2018). Before visiting hospitals, there is a need to achieve all the steps in stage one.

The implementation of lean and the assessment of leanness are different from industry to industry and from one organization to another because they depend on its situation and conditions. This means that there is no agreed step by step or roadmap to leanness level and lean implementation (Anvari et al. 2011). Lean implementation is not clear-cut of actions or steps that should be strictly followed for every lean implementation because every organization has its own systems, culture, policies and type of waste; thus, a customized approach is widely accepted.

a. Activity 1: Define Lean Assessment Attributes

This activity can be considered the most critical step of the framework because it is directly related to the evaluation of the current situation in terms of lean. After making sure all challenges can be overcome, the steering committee should evaluate and assess the supply chain leanness level using the developed assessment model. The assessment model of hospital supply chain (HSC) leanness level includes five lean enablers. These enablers are medical management responsibilities, HSC processes management, medical human resources, consumer relationships and supplier relationships.

The HSC Leanness Assessment Model (HSC-LAM) was developed based on main three levels (Almutairi et al., 2018):

- The first level includes five lean enablers
- The second level contains ten criteria
- The third level consists of thirty eight attributes

The first task that should be performed in this activity is identifying the correct factors that achieve lean goals. Failure to correctly identify lean enablers, success factors and attributes can lead to the failure of lean implementation. This can be achieved through lean champions, lean six sigma black belt (LSSBB) holders, as well as lean six sigma master black belt (LSSMBB) certified or qualified teams from different departments(Jeyaraman & Kee Teo 2010). The second task is to make sure all assessment model elements lead to real-life improvements and achieve patients' needs and requirements. This task can be performed by supply chain decision makers in cooperation with their stakeholders. There are many tools that can be used to perform this task, such as brainstorming, focus groups, benchmarking or others (Almutairi et al., 2018) .The purpose of this step is to generate ideas and take opinions and feedback from different angles.

b. Activity 2: Compute Supply Chain Leanness Index

After developing the HSC Leanness Assessment Model, a mathematical calculation can be performed through software, such as Microsoft Excel, by the committee steering (improvement team) or lean champions. The value of the leanness index is considered the real step toward the improvements. After quantifying the leanness level, decision makers in hospital supply chain are

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numerically aware of their healthcare organizations' position in terms of lean. The computation of HSC leanness index contributes significantly in the success of lean implementation because it works as a diagnostic tool for lean performance and helps hospital leaders to take corrective actions. Also, the leanness index is considered the real starting point for applying lean in HSC (Almutairi et al., 2018). After accomplishing phase one and two, the healthcare organization can move to the third phase.

(3) LHSC Implementation Framework Phase 3: Lean Developing State

Identifying a gap between "what is' and "what should be" and the desire to take corrective actions is considered to be the main step towards success. Value stream mapping can be used for identifying current and future state (Mostafa et al., 2013). Improving lean enablers' performance is considered the main aim of this stage by capturing the best methods that enable a hospital to implement lean successfully in the supply chain.

(a) Activity 1: Lean Gap Assessment

Almutairi et al., (2018) assured that lean assessment at supply chain in healthcare organizations is gaining vital importance and before implementing lean initiatives, it is crucial to assess leanness in the supply chain practices. After determining the HSC leanness level by computing leanness index, the steering committee is responsible for identifying future levels of lean. Determining the lean current level and identifying the lean future state will enable lean champions / steering committee from proposing improvement actions. Lean gap assessment can be achieved by evaluation the current situation in the organization in order to identify weakness (wastes) to implement lean by using value stream mapping (Mostafa et al., 2013). The lean future state depends on the hospital's vision, strategic plans and availability of resources (human, financial, technical, infrastructure, stakeholders) and can be calculated by using the developed model (Phase 2: Activity: 1). The proposed actions fill the gap between the current state and future state and move the hospital supply chain from one position to another towards operational excellence.

(b) Activity 2: Identify Improvement Areas

Almutairi et al., (2018) mentioned that lean assessment is the most appropriate starting point to identify potential improvement areas. As a result of the previous step, the lean implementation committee has the ability to determine the gap between the current situation and the desired future state. The leanness level index in supply chain will enable the steering committee to identify the areas that need further improvements and develop improvement actions with respect to the five lean enablers. Now, the steering committee (lean champions) understanding the current situation in terms of lean have all the information about how lean the hospital supply chain is. After identifying leanness level, the committee is ready to improve the five lean hospital supply chain enablers and adopt the appropriate lean tools to improve and enhance each enabler in light of the hospital's vision, strategy, capabilities and ability to overcome lean implementation challenges. Identifying improvement areas (opportunities) supports lean transformation by eliminating wastes (Cottyn et al., 2011). After accomplishing phase one and two, the healthcare organization can move to the third phase.

(4) LHSC Implementation Framework Phase 4: Steady (Sustainable) State

Stabilizing the new way of operations is a crucial point and should be under concentration. Keeping the new proposal's improvements running continuously in operation is considered a step forward to achieve a new level of lean.

(a) Activity 1: Monitoring the Achieved Results (Lean Monitoring/sustaining)

Lean monitoring (sustaining) is recommended to make sure that lean implementation on the track and works as planned (Mostafa et al., 2013). In this stage, the first step is monitoring the lean implementation. The monitoring process is making sure that the implementation on lean hospital supply chain is going the right way. The main purpose of the monitoring process is sustainability of

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lean implementation over the long term. In this step, the real (actual) performance is measured in terms of lean and compared against the target goals (desired lean level). This monitoring process plays a vital role in making sure the lean implementation is done as planned and to take corrective actions if the implementation process deviates from its course. Frequent assessment and communication on lean results will provide the chance to identify potential opportunity for improvement (Jeyaraman & Kee Teo 2010).

(b) Activity 2: Continuous Improvement (Pursue Perfection)

Continuous improvement should be implemented to attain certain level of lean implementation (Mostafa et al., 2013). Again, the steering committee (implementation committee) will use the lean HSC assessment model to measure the real (actual) performance attained and compares the outcomes with initial findings from the first stage. The obtained feedback from this stage enables the hospital to take corrective actions in case of deviation during the implementation process.

(c) Activity 3: Computing HSC Leanness Index (To-be) and (As-is)

The steering committee will use the lean HSC assessment model (Phase 2; Activity1) to measure the real (actual) performance attained and compare the outcomes with initial findings from the second phase (Phase 2; Activity 2). The obtained feedback from this stage enables the hospital to take corrective actions in case of deviation during the implementation process. Almutairi et al., (2018) proposed leanness index model for computing leanness index for HSC. By using the developed HSC assessment model, current and future state leanness can be evaluated.

(d) Activity 4: Identify Lean Gap Assessment

Again, after identifying the lean level (second round, the first one was in Phase 3; Activity 1) and comparing it with lean level in the previous phase, supply chain decision makers in a hospital can implement improvement actions, which are identified in the next step. Identifying lean gap can be attained by assessing (AS-IS) and (To-BE) situation (Mostafa et al., 2013).

(e) Activity 5: Identify Improvement Opportunities

By identifying the areas that need further improvement through the model that was developed in Phase 2, the proposed improvements for lean enablers could be the following and based on either literature or experts' suggestions:

The first lean enabler in hospital supply chain is medical management responsibility (MMR) (hospital leadership). This enabler can be improved by several steps. Since a majority of development initiatives in healthcare sector are directed top-down and not bottom-up, this kind of leadership should be improved by changing leadership style to a bottom-up leadership approach. Such an approach will encourage employees to strongly participate in lean projects a majority of development initiatives are directed top-down and not bottom-up. Leaders should refer to personnel and look to them as associates. Leading by example is another way to improve leadership style. In addition, MMR can be enhanced by management commitment (MC) Al-Borie & Abdulla (2013),
MC can be improved by the introduction of quality policies and by conducting management reviews. Linking lean implementation with organization vision and strategic goals is considered critical point in success of lean implementation. Also, increase supportive commitment toward lean projects from top management is one of the main pillar to success lean initiatives. The second organizational area which needs further improvement is patient-oriented. The hospitals must become patient-oriented in order to achieve hospital mission and patient needs. SC can only be successful if it is truly patient-oriented. Patient-oriented care processes require a supportive supply chain adhering to strong principles of fully-integrated and seamless inventory-sourcing processes. SCM and inventory automation are necessary for lean patient-oriented processes. This organizational area can be improved by clearly identifying patients' needs and linking these needs with the hospital strategic goals. One of the main factor that contribute significantly in success lean initiative is culture. (Nabelsi & Gagnon 2017).

Organizational culture (OC). Since the patient's safety is the ultimate goal for any healthcare provider, hospital leaders should enhance patient's safety culture. OC plays a vital role in patient

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safety (Dobrzykowski et al., 2014). Lillrank et al. (2011) mentioned, in healthcare settings, how the organizational culture leads to decreasing medical mistakes. Also, a study conducted on a large number of American hospitals shows the relationship between organizational culture and the reduction of medical errors. In this research, OC refers to "need and belief about ongoing improvement" (Noori 2015). This area can be improved, starting with top management. Patient safety starts with a transformational leadership, which in turn leads to the formation of a culture of safety, the adoption of patient safety plans, and to development in patient safety outcomes. This enhances the culture of patient safety**.** The significance of OC in the supply chain is undeniable. There are two main reasons for focusing on OC. First, OC plays a significant role in SCM. Second, OC is more intractable than other factors, such as information or technology. According to Schilke & Cook (2014), OC shapes the attitude of staff with respect to risk-taking, teamwork and information sharing. Appropriate organizational culture improves trust and inter-firm associations.

The second enabler that needs further improvement is Hospital SC processes management (HSCPM). HSCPM can be attained by creating the department, such as Business Process Streamlining Department (BPSD) that is responsible for continuous improvements processes. This department is linked directly to the Chief Executive Officer (CEO) or executive general manager for supply. This intervention was suggested by interviewees during focus groups. A form improvement team, which might include physicians, pharmacists or medical equipment engineers working closely with SC decision makers, is necessary to improve SC processes. The improvements can be done through medical procurement processes. Ordering the right medical devices for daily processes puts pressure on hospitals to look for opportunities to deliver a high quality of patient care, and to improve supply chain operational efficiencies. Redesigning supply chain processes by implementing Business Process Re-engineering (BPR) will improve workflow, reduce cost, and improve quality. For example, link procurement department directly with CEO in organizational chart (normally under supply chain department). Also, redesigning the OC to reduce the number of decision-making levels will contribute significantly to accelerating the purchasing process.

Information exchange in hospital supply chains is another area that need more improvement. The timely sharing of relevant information along the SC can dramatically reduce the "bullwhip effect". The coordination between all hospital supply chain departments and medical departments should be done in the proper way to avoid unexpected medicines demand. Information exchange forms are the very basis for effective coordination that forms the core of efficient hospital supply chain management. Also, prompt information exchange plays a vital role in meeting patients' needs. Information exchange relationship between healthcare providers is necessary to achieve desirable patient outcomes. These actions may improve information exchange throughout hospital supply chain (HSC) if implemented properly(Blome et al., 2014)

Process streamlining (PS). PS in HSC can be improved by adopting value stream mapping and visualizing communication. The implementation of lean methodology in healthcare, and using value stream mapping (VSM), can deliver value for customers (in this case, patients) by eliminating waste and providing value-added services at a reasonable cost. This will help organizations save, and make them sustainable in this sector. Also, VSM has been used as a lean SCM tool to reduce lead time and cost, and to enhance quality (Mostafa et al., 2013; Wee & Wu 2009) .

In the healthcare supply chain, the breakdown of effective communication between the different departments/parties within the procurement process has led to dysfunctional. The lack of communication within the healthcare sector is one of the main challenges for lean implementation(Grove et al., 2010). Communication can be improved by exchanging information between the different departments/parties involved to improve purchase of the correct medical devices needed for daily operations, to minimize the cost of distribution, and to reduce time of delivery, while meeting doctors' and surgeons' needs(Al-Karaghouli et al. 2013).

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The third lean enabler in HSC is Medical human resource (MHR). Medical staff related to the supply chain is considered important factors when adopting any new change initiatives. In other words, without the effective participation and support of staff, lean practices in the hospital supply chain are useless. The importance role of employees in adding value to the organization. Human resources in hospitals can be improved by concentrating on training supply chain employees, while adopting job rotating systems to increase the ability of the employees to perform more than one role can help employees overcome issues related to quality. Training HSC employees is essential to implementing the lean initiative. Also, empowering HSC staff to take suitable actions and minimize centralization will improve decision making at the lowest level of supply chain employees. Empowerment of HSC increases motivation and productivity(Womack & Jones 1996).
The performance of lean supply chain management not only depends on decisions taken by executive managers, but also on the execution method and the involvement of hospital employees in the implementing process(Jasti & Kurra 2017).

The fourth lean enabler that needs improvement is the customer relationship. Because patients often rely on the advice of physicians, patients can consider as end user while physicians can considered as "surrogate consumer" and at the end both of them are considered to be consumers. Medical staff in other hospital departments, such as physicians or pharmacists, plays vital roles in making sure the hospital supply chain is lean. Disagreement between physicians, in terms of a certain type of medicine, slows supply chain processes and increases delivery lead time. Physician Preference Items (PPIs) constitute 40% of total medical supply spending for a hospital (Toba et al. 2008) and this can be improved by physicians' buy-in. This is a main area for SC savings, especially with respect to the use of high-cost clinical items and changes in purchases. Physicians' involvement in continuous improvement is very important to implementing lean successfully via the supply chain. The role of consumers as value co-creators in hospital supply chains. Also, this enabler can be improved by increasing physician involvement.

The fifth lean enabler that needs improvement is supplier relationship. Hospital-supplier integration plays an important role in improving hospital supply chain performance. Hospital-supplier collaboration has an impact on hospital supply chain performance (Chen et al. 2013). Enhancing and creating long-term relationships with key suppliers contributes significantly to reducing fluctuation in demand and minimizing medicine shortage. Medical purchases are the key purchases for any healthcare provider, as medical supplies can often constitute more than 40% of a hospital's operating cost. This cost can be improved through SC practices (Nabelsi & Gagnon 2017). Alliance with other healthcare providers is one of the most important factors to reducing the total cost of medical supplies. Group purchasing organizations (GPOs) have provided significant cost saving opportunities for healthcare providers by taking advantage of economies of scale and purchasing from select suppliers/venders for many hospitals at once. GPOs reduce hospital supply chain costs up to 15%. Hospital supply chain costs decreased for providers using GPOs, but group purchasing also helped to optimize the supply chain. Kwon et al. (2016) indicate that GPOs manage more than 70% of healthcare expenditures.
One of the main reasons GPOs are advantageous is that they have a global network of suppliers, which gives healthcare organizations the leverage to access more suppliers. Also cooperation between healthcare organizations play vital role in reducing the overall cost of healthcare provider. Recent developments demonstrate the extent to which SC is gaining the attention of hospital leaders. GPOs have provided significant cost saving chances for healthcare providers by taking advantage of economic scale in purchasing from select suppliers / venders for several hospitals at once(Toba et al., 2008). Using GPOs help hospitals in provides cost savings and streamlines purchasing process.

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Most departments turn to a GPO to find main suppliers and negotiate contracts; others use the stockless approach, calling on medical supply distributors to deliver medical products directly to nursing stations. The responsiveness of suppliers is a sensitive point for hospitals, as any delay of medical supplies constitutes a possible threat to patients' lives. Lead-times of medical supplies and unpredictable patient demand are key points that should be dealt with seriously. Also, working with other healthcare systems which is not working under Saudi Ministry of Health such as health services at Ministry of Defence and health services at Ministry of Interior. Integration between these different healthcare systems will lead to save a huge amount of money. Since Saudi Arabia (SA) apart from GCC, hospital in SA can benefit from GPO concept to reduce the medical items cost and absolutely adopting this approach will lead to reduce significant amount of cost.

Medical shortages (MS) are another factor which is very important for healthcare providers. Medicine and equipment shortages have been increasing in recent years (Hedman, 2016). MS put patient health at risk, and possible medication errors, non-treatment and under-treatment can result from attempts to substitute missing medicines. Shortages of medicines and technologies can be avoided by improving coordination between countries, while an end-to-end approach across the healthcare system is needed to mitigate the impact on patients and public health. Global healthcare leaders will be required to move forward on priority problems/issues for improving access to needed medicines in healthcare systems and will need to develop an approach to market shaping in collaboration with global partners. In addition, work with partners such as global industry representatives and professional associations to develop good standards practices in managing shortages. Moreover, information technology systems that facilitate the collection of information need additional support(Hedman, 2016).

Activity 6: Implementing Improvement Proposal

During the monitoring of the actual achievement, the hospital will be able to identify influencing factors that may impact the implementation process and take actions if necessary for any unexpected situation. Without a monitoring process on lean implementation, the lean implementation may fail. At the end of this stage, the implementation process either goes back to the first stage if the level of lean has not be achieved or remains on the desired level by monitoring the process.

After accomplishing four phases, the healthcare organization can implement lean successfully.

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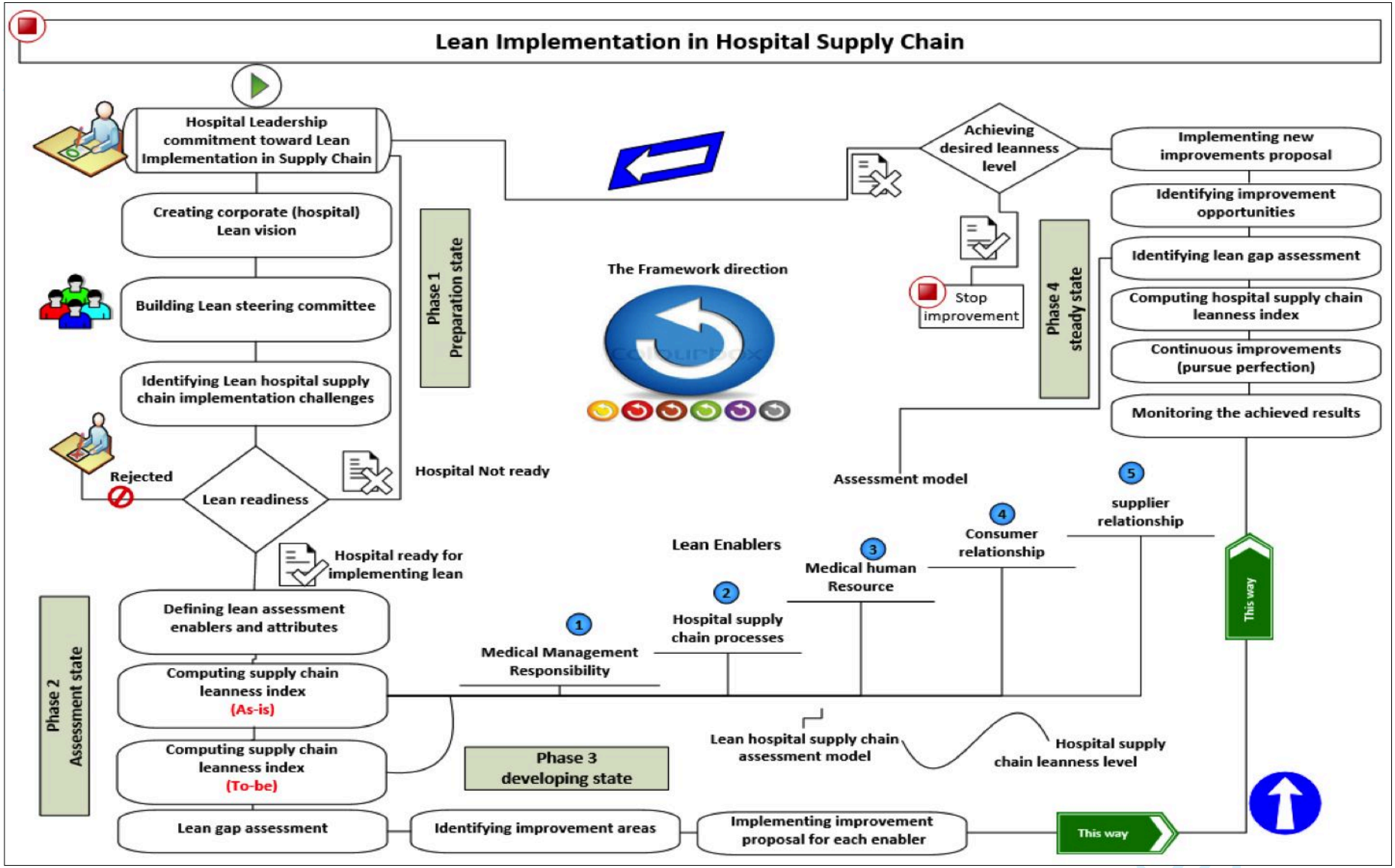

Figure 5 Lean Implementation Framework in Hospital Supply chain Management

6 Managerial Implications and Limitations

Hospitals could improve their current supply chain processes by implementing the proposed framework. This improvement could contribute significantly to enhancing supply chain performance, reducing cost, eliminating waste and ensuring on-time delivery. The developed framework may provide a useful guide for healthcare leaders and policymakers for implementing lean initiatives and enhancing the lean culture in the public healthcare sector. In addition, by implementing the developed framework, flows of medical items and information can be sustained, thereby avoiding shortages of necessary medical items and increasing patient safety. Furthermore, the proposed framework will enable HSCM managers to evaluate supply chain processes in terms of nonvalue-added activities (wastes). However, practitioners should avoid the barriers of the lean implementation in HSCM before starting lean journey. By overcoming these barriers, healthcare leaders can easily implement lean thinking. Finally, hospitals leaders can identify to what extent HSCM practices are mature (level of lean implementation).

This study does, however, have a number of limitations. First, the developed framework was limited to the Saudi hospital context, restricting the findings to a geographic area. Second, the targeted sample only included hospitals that are accredited by both the Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI) and the Joint Commission International (JCI). The hospitals that are not accredited by the CBAHI and JCI were excluded. Furthermore, the framework is limited only to governmental hospitals operated by the Ministry of Health, which has its own healthcare system. This means that hospitals operated by other governmental institutions were not included.

This study also suffered from a relatively limited number of hospitals. Identifying lean implementation barriers is considered part of this framework, but these barriers may change depending on the healthcare system and its needs. In addition, the framework was only developed and tested theoretically by fifteen experts from three hospitals (five per each). As previous noted, the findings presented in this research were limited to a small number of Saudi hospitals and without any attempt to generalise the results. The authors will address these limitations in future research. Nevertheless, this framework could help decision makers incorporate lean practices successfully into HSCM.

7 Conclusion

The increasing pressure on healthcare organizations due to limited financial constrains has driven more attention towards the continuous improvement of hospital supply chain practices. A novel framework has been developed for implementing the lean at hospital supply chain. Four phases has been has been proposed to implement lean principles in hospital supply chain management. The framework has been validated qualitatively and quantitatively via 15 experts from three different hospitals. All participants are working in hospital supply chain area. The experts believed that the implementation of lean in HSCM is not easy task and has its complexity. In order to gain significant improvement on the supply chain management performance, it should be sure that the healthcare organization is ready in advance to implement lean successfully.

.The findings of this study confirm previous studies that mentioned lean implementation is still in early stage in Saudi Arabia. Also, there is a chance for future researchers to investigate lean activities in other Saudi industries and in other Middle East countries as well. Like other study, the current study have some limitations, which can formulate the future agenda for further investigation.

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In the future, this study could be extended in many directions. The developed framework has been validated in only three hospitals. In future, more hospitals should be evaluated using the developed framework to ensure its practical validity and enhance the application of lean implementations in the HSCM setting. Also, this study was conducted in Saudi Arabia; therefore, other regions of the Middle East and Gulf States could be an opportunity for further examination. In addition, this research requires further investigation in order to illustrate the differences between governmental hospitals and private hospitals in terms of lean implementations in the HSCM. Comparing two different healthcare systems may be another point for future research. Also, the proposed framework was only tested theoretically. Practical test in real-life scenario can be considered a starting point for future research. Moreover, the role of culture in developing framework could be a chance for further investigation. In addition, the proposed framework specifically developed for healthcare sector so developing lean framework for different Saudi industrial sectors (service, manufacturing and small-medium enterprises) could be another starting point for further examination.

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