ORIGINAL ARTICLE

Using Lean management to leverage innovation in healthcare projects: case study of a public hospital in the UAE

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ABSTRACT

This paper demonstrates that Lean management serves as a foundation to leverage innovation throughout the healthcare projects. An organisation that successfully accommodates both Lean and innovation will gain higher competitive advantage and reach long-term sustainability. Innovation in the healthcare sector in the United Arab Emirates (UAE) is encouraged through responses to the challenges of patient needs and government pressure on the organisations towards innovation and sustainability concerns. The objective of the paper is to investigate critical success factors (CSFs) for effective diffusion of Lean innovation in healthcare projects in the UAE. A conceptual model is developed to explain the CSFs for diffusion of Lean innovation in the healthcare projects. A public hospital that implemented Lean innovation projects in the UAE was selected as a case study and the data provided through the interviews were reviewed and analysed. It is concluded that the successful implementation of Lean innovation had outstanding implications: It has markedly and sustainably decreased patient access and waiting time, improved safety and patient satisfaction and supported the hospital culture of empowering front-line caregivers. The championing role of leadership commitment and management support, and employee involvement across all levels is required for successful implementation.

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INTRODUCTION

In times of economic growth, competitiveness and emphasis on affordability, organisations need effective and efficient innovation in order to gain higher competitive advantage and reach longer term sustainability. In most of the services industry, while innovation is considered as a source of pressure and chronic stress, however, 'it is clear that innovation is a major driver of organisational success'.[1] According to the study of Dulaimi *et al*,[2] innovation has been defined as:

> The generation, development and implementation of ideas that are new to an organization and that have practical or commercial benefits. This definition also encompasses adoption and implementation of products or processes developed outside the organization.

For organisations to survive and succeed in today's marketplace, a strategic decision is to leverage innovation competence through an effective development of changing unmet customer requirements into successful products and/or processes, which creates value for customers, the organisation and other stakeholders.[3]

In the United Arab Emirates (UAE), as in many other countries, the service sector is facing the challenge of a growing demand with quality and efficiency services that do not develop to the same level as the requirements. Therefore, in some cases, the need for change and innovation is forced by the government on the organisations by making the innovation strategy part of the country's strategy that integrates the innovation goals and sustainable development. It has been proposed that "to foster sustainable development, an innovation strategy must have vision that transcends a maelstrom of complex, and sometimes contradictory, demands".[4]

Recently, this is what actually happened in the UAE when Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE, announced the vision of the National Innovation Strategy "to make the country one of the world's most innovative within 7 years".[5] He also clarified that the UAE innovation strategy would focus on seven sectors; one of these is the healthcare sector.

These initiatives around innovation had enhanced the UAE organisations in the healthcare and other sectors to start a new dynamic phase in their services to deliver new horizons of successful and sustainable innovation.

An urgent need in healthcare in the UAE is to improve quality and efficiency while monitoring costs in the provision of optimal patient care. A growth in population, an increase in innovative treatment techniques, patients became more educated and have access to much knowledge, are some of the factors that may drive the cost and increase the expenses in healthcare. All this made the healthcare sector face higher and newer demands on their services. This raised a crucial issue of improving the healthcare service efficiency and capabilities in order to gain a higher competitive advantage. For that reason, a number of solutions have been suggested to solve parts of these problems by adopting many quality initiatives, one of which is Lean. Practitioners, as well as researchers, support the fact that successful Lean implementation is a feasible solution in a variety of hospitals and clinics in various countries. Moreover, Lean hospitals show evidence "for improving quality patient safety and employee satisfaction".[6] Other scholars argue that Lean is "an innovative management approach that has proven successful in healthcare organisations".[7]

Lean is a management philosophy based on the Toyota Production System (TPS), which is most commonly associated with Japanese manufacturing and was developed by Engineer Taiichi Ohno in the 1950s. Lean creates "an innovative philosophy which aims at using fewer resources compared to traditional mass production systems, focusing instead on general principles at a strategic level and tools and techniques at an operational level".[8] Lean was defined as "a series of activities or solutions to minimise waste and non-value added (NVA) operations, and improve the value added (VA) process".[9] Seven types of wastes (Muda in Japanese) were highlighted in the TPS: overproduction, waiting, over processing, transportation, excess inventory, motion and defects.[10]

This work demonstrates how the Lean management approach serves as a foundation to leverage innovation throughout the healthcare organisation. It is an innovative process that increases value and minimises waste. The amount of waste in healthcare services averages 40–50% in most of the literature. A 2010 Mazzocato *et al*[11] report on the outcomes of Lean application in healthcare indicated that the benefits are: time-savings, timeliness of service, cost reductions/productivity improvements, quality improvements—fewer errors/mistakes, improved staff and patient satisfaction. The General Secretariat of the Executive Council (GSEC) of Abu Dhabi Government identified patient access and waiting time as top priorities for healthcare in the UAE.

Hence, the purpose of this study is to investigate critical success factors (CSFs) for effective diffusion of Lean innovation in healthcare projects in the UAE. Public hospital implemented Lean innovation projects were selected as a case study.

This paper is organised as follows. The following section summarises a literature review and provides a critical analysis of the drivers and opportunities for Lean innovation in healthcare projects, then a review of conceptual models that researchers have developed to explain the CSFs for diffusion of Lean innovation. In section 3, the case studies are presented. In the last section, the conclusions and recommendations are provided.

REVIEW OF THE LITERATURE

Drivers and opportunities for Lean innovation in healthcare projects

This section examines the factors driving innovation in the healthcare sector. It specifically explores and analyses the drivers and opportunities for Lean innovation at a project level in the public healthcare in the UAE.

Researchers have shown that organisations in different sectors initiate and implement new ideas in response to several different factors. For example, Baker in his book identified some primary drivers of innovation and factors that influence the need of any organisation to innovate, such as: financial pressures to decrease costs and increase efficiency; increased competition; value migration; stricter regulations; industry and community needs for sustainable development; community and social expectations; demographic, social and market changes; rising customer expectations regarding service and quality; and the changing economy.[12] The author maintained that 'regulatory drivers have become more important in the last several decades'. He further argued that 'companies increasingly feel they must promote their image and this has become a major driver of environmental and sustainable development innovations, a good image can help promote both customer loyalty and a company's growth strategy'.

In the healthcare sector, innovation has its own unique requirements and any effort to realise the innovation process must initiate with a detailed analysis of its drivers. In one of the comprehensive studies about innovation in healthcare,[13] the researchers summarised five key stakeholders with their unique needs and expectations that describe the need for innovation as follows:

- Physicians and other caregivers: improved clinical outcomes, improved diagnosis and treatment
- Patients: improved patients' experience, improved physiological well-being, reduced waiting time, reduced delay
- Organisations: enhanced efficiency of internal operations, cost containment, increased productivity and quality and outcomes improvement
- Innovator companies: profitability and improved outcomes
- Regulatory agencies: reduced risks and improved patient safety.

Recent studies have predicted that the main drivers for Lean innovation implementations in healthcare projects are: 'change of leadership, struggle with performance indicators, introduction of a new technology, government agendas, recommendations, changing policy environment, threat of competition, demand for increased efficiency and service expansion with limited resources'.[6] Furthermore, it has been claimed that the key drivers for Lean innovation adoptions in hospitals are 'to improve business process, reduce waste, reduce defects, reduce cycle times, fast delivery at the minimal cost and accelerate the process in identifying the best solution practices for ensuring excellence in operational and service management'.[14]

Lean innovation drivers and opportunities at a project level: a public hospital in the UAE

A lot of external and internal drivers can inspire Lean innovation in hospitals. In this work, the researchers focus their attention on addressing and analysing the most important drivers and opportunities related to the Lean innovation projects in a public hospital in the UAE as an example from a real situation. These drivers can be summarised as shown in table 1.

External drivers

High governmental expectations

The government of the UAE has a wise strategy of providing world-class healthcare services in the UAE. According to the UAE government strategy, the major directions for public policy within this area are "the development of the organisational, legislative and legal frameworks based on International Best Practices in order to upgrade the private and public sector health services capabilities, and formulate a public policy that sets the priorities for health services development within the sector".[15] Alignment with the strategy has driven the hospital towards Lean innovation adoption to start its excellence journey where creativity and innovation are a must.

Table 1 Examples of external and internal drivers for Lean innovation in healthcare projects

External drivers	Internal drivers
High governmental expectations	Patient quality of care and safety
Governance expectations	Staff satisfaction and empowerment
Reputation	Setting the culture of innovation
Corporate social responsibility (CSR)	Providing creative tools for project management
Competitive market	Meeting internal KPIs
Accreditation Joint Commission International (JCI)	

Governance expectations

The governance of the public hospitals aligned with UAE government. For example, the Abu Dhabi Health Services Company (SEHA) was created by the Government of Abu Dhabi 'to own and operate the public healthcare system of the emirate, and to upgrade and improve healthcare delivery through that system to the public on a level comparable to the best healthcare delivery systems in the world. SEHA follows its values as a socially responsible, reliable, quality oriented, and innovative organisation'.[16]

The hospital has been driven in line with governance plans that regulate its operating framework. Expectations were raised and targets were set. This cultivated the process further by focusing on quality and efficiency. Access and waiting time are top priority; Lean innovation is well established as a powerful tool to address these challenges.

Reputation

The pressure to enhance hospital reputation through improvement in patient services, and hence increase in satisfaction, customer loyalty and employee engagement is a major driver for Lean implementation. This has driven the hospital to rethink its methods of providing effective and efficient healthcare services through Lean innovation approaches.

Corporate social responsibility

Corporate social responsibility (CSR) can be seen as an innovation in itself. With the aim of behaving ethically and contributing to economic sustainable development while improving the quality of life of the people and society, Lean innovation projects were the best choice in the hospital. These goals fit well with Lean innovation through engaging employees in identifying and eliminating non value-added (NVA) activities, particularly when environmental wastes are included. By adding environmental wastes to Lean's deadly wastes, hospitals can control the powerful drivers behind Lean innovation projects to make services more competitive while decreasing environmental wastes and impacts.

Competitive market

Hospital management was driven by the vision of structural strategic changes in an effort to remain sustainable in order to gain higher competitive advantage, by focusing on generating long-term innovation capability in the hospital instead of focusing on short-term operational benefits. Lean innovation projects

that focus on continuous improvement processes were the strategic decision to maintain the competitive edge in the highly competitive UAE market.

Accreditation of Joint Commission International

Joint Commission International (JCI) standards expect performance improvement with innovative processes. Government hospitals in the UAE are expected to receive JCI accreditation; the intent is to obtain a thorough assessment of service providers and to have an international benchmark. This markedly raises the bar with expectations of adherence to JCI standards.

Internal drivers

Patient quality of care and safety

Patients are the core of all activities. Value is defined by the patients. Activities that do not add value to the patient are considered as waste. Patient safety and optimal clinical care drive innovative Lean projects tremendously. They give the employees a sense of focus and purpose. Hospital management initiated Lean innovation projects with a focus on customer value-adding activities and waste reduction in the patients' pathways with the aim of improving patient services and making the hospital more efficient and responsive to patient needs and expectations.

Staff satisfaction and empowerment

Employee satisfaction and empowerment are the foundation and enabler to quality of care and patient safety. Lean is all about involving all staff and empowering them. The key principles of Lean management are to 'observe, engage and improve'. Hospital management was driven by these principles in order to create a new innovative culture at the project level built on a new leadership and empowerment where all employees are involved in innovative improvement efforts. It is often expected that patient value is attained by improving strategic employees function and decreasing their dissatisfaction.

Setting the culture of innovation

Transforming an organisation into an innovative culture with supporting processes and infrastructure to benefit both patients and employees and creating a great healthcare culture was one of the main drivers for change towards a Lean innovation adoption in the hospital. An essential element of an effective, lean-driven culture is lean leadership. Lean leadership is the commitment of an organisation's leaders to empower its employees to continuously identify and implement changes that will improve customer value.

Taking this approach, the application of lean principles contributes to the creation of an organisational culture in which continuous improvement is the rule and not the exception.

Long-term changes of organisational culture are based on changing the mindset of the people that sustainable change and improvement drive and encourage Lean innovation projects in the hospital.

Providing creative tools for project management

Hospital management was driven by the applicable process improvement, leadership and project management skills to drive the changes for longer term sustainability.

Lean with its principles and techniques provides creative tools for project management. Hospital Lean projects are structured to deliver services while maximising value and minimising waste that will ensure the effective management of hospital projects to offer a sustainable improvement mainly in patient quality of care and safety.

Meeting internal KPIs

Strict key performance indicators (KPIs) were set by governance and in line with the hospital competitive targets. This led to a multidisciplinary team meeting, brainstorming and implementation of creative strategy. Hospital management was driven by a vision of development of the overall system's performance. To fulfil this vision, hospital management stresses the requirement of a cultural change built on new human and sociotechnical aspects of the high-performance work system which lies in the Lean innovation approach. Similar metrics were used to follow progress of performance in Lean projects in all departments of the hospital.

All in all, attention must be paid to the different forces within and outside the hospital using sense-making information since these might create opportunities for innovation. As the UAE population grows and changes and develops different healthcare needs, the demand rises for more patient-focused healthcare plans. The hospital plan aimed at improving healthcare quality and patient safety through Lean innovation projects. Lean management improves the current business performance, as well as prepares the hospital to meet the challenges of the next customer's demands and of steadily developing opportunities for innovative healthcare services.[17 18]

A Lean innovation tool engaging employees is seen as a critical aspect of the hospital plan. Thus, it offers an opportunity for tapping into the creative ideas of hospital staff, mainly through the value stream mapping tool that gives members a chance to visualise the opportunities allowed to improve the current process by converting waste into value from the customer's viewpoint. As well, kaizen methodology that effectively can help everyone, managers and employees to develop innovative products and processes and improve existing ones. Moreover, since the Lean leadership style motivates people to take responsibility, it also becomes a process for turning organisations into dynamic and innovative teams. By its efforts to transform everyone to become a master problem-solver,

Lean creates a vast organisational capability to generate innovative ideas and solutions all the time.[17 18]

CSFs for diffusion of Lean innovation in healthcare projects: a review of conceptual models

A systematic review was carried out to find publications on CSFs frameworks for diffusion of Lean innovation in healthcare. Databases of journals useful for reviewing or critiquing frameworks were used and an effort was made to develop a conceptual model illustrating the successful diffusion of Lean innovation in healthcare projects. No frameworks specifically for diffusion of Lean innovation in healthcare projects were found. However, two less specific conceptual models were found and these will be examined below using the CSFs approach.[19]

A common approach used in developing the Lean innovation framework is 'to identify factors/elements that are believed to be critical to the successful implementation of these concepts';[19] where the intention is to diffuse the innovation within a service industry. For that matter, recognising CSFs for diffusion of Lean innovation is useful. For example, support of top management is generally involved on a list of CSFs. There are several studies on CSFs correlated to the success of Lean innovation implementation. Some studies are discussed below.

A recent study predicted four key factors that are fundamental and critical for the successful Lean innovation diffusion.[20] They include: 'leadership and management, finance, skills and expertise, and culture of the recipient organisation'. Of these factors, the authors have recognised leadership and management commitment of the most important championing roles in regulating the success of Lean innovation at a project level.

In another study, the researchers scrutinised the following CSFs in small and medium-sized enterprises (SMEs) in the UK in order to define the implementation status in the context of project management in that country.[19] These are: 'management involvement and commitment, cultural change, communication, organisation infrastructure, training, project management skills, project prioritisation and selection'. In addition, Lean innovation links business strategy to customer satisfaction and human resources.

Comprehensive research by Organizational Behavior in Healthcare (OBHC) to study organisational factors influencing diffusion of Lean innovation in a Lean public health projects[21] has found that the key organisational factors are: 'culture and climate, leadership style, power balances, social relations, attitudes to risk taking, interorganisational networks and collaboration, absorptive capacity for new knowledge, effective Human Resource Management, structural determinants (including size), system readiness for innovation (including tension for change and availability of time and resources), intraorganisational communication, external change agents and effective data capture systems'.

A review of conceptual models

Two less specific conceptual models were found in the literature to be analysed against CSFs related to diffusion of Lean innovation. They are briefly described below.

A Lean innovation conceptual model developed by Furterer[22] (see figure 1) is specifically designed to meet the needs of the public/government sector. The development of the model was based on the literature and on Furterer's experience as a consultant. The justification and validation were unclear and detailed guidance linked to implementation of Lean in the public sector was not provided.[22]

The seven elements of the model were mainly referred to the Quality Award models such as EFQM (formerly known as the European Foundation for Quality Management) and The MBNQA (Malcolm Baldrige National Quality Award). Moreover, Furterer's research symbolised the application of several Lean tools to explain the problems present in the Government's work. However, this model has been criticised by another researcher[22] who argued that "it cannot be used as a justification that her framework can work well. It needs to install all the elements of her proposed framework and measure the current performance of the Government agency". He suggested that the framework has to be installed and validated. Furthermore, he has proposed the element of training and education to be used in her framework; he also claimed that "as found in several literatures, training is important and critical to the implementation of Lean and should be put as a factor in her framework".[22]

Meanwhile, a new conceptual model was developed specifically for SMEs context.[19] The conceptual model can be seen in figure 2.

In this model, management commitment towards Lean innovation has been recognised as a key factor, often called a 'champion', for the success of innovation diffusion, such as in innovation studies that have been conducted by Rogers (2003).[22] The framework

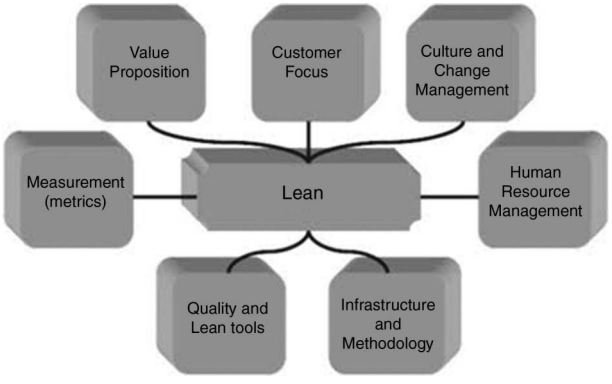

Figure 1 Furterer (2004) conceptual model.

highlighted the need for culture change and external support factors. The researcher explained that the culture change factor is affected by the presence of a change agent such as government or other parties related to SMEs, which have a role in supporting the implementation of any new approach/concept in the organisation.[22] Also, the external support 'will overcome the complexity of implementing the concept, for example, training provision, consultation and etcetera'.[22]

In both conceptual models, it can be seen that the models are particularly weak in their explanations and justifications with respect to the successful Lean innovation implementation. The development of models was relying more on the correlation with 'a number of the key constructs that Rogers' diffusion of innovation approach suggests should be considered in an implementation framework'.[19] Although they are considered somewhat strong in alignment with Rogers' theory, they are still relatively weak in discussion about the factors related to implementation, how to bring these factors into implementation, and how such frameworks have impacted the success of the Lean innovation. This is what motivated the researchers to develop a specific conceptual model with detailed CSFs for diffusion of Lean innovation aimed at the needs of healthcare projects.

A proposed conceptual model for the study

Several organisational factors influence the degree of successful diffusion of Lean innovation that focuses on continuous improvement processes for sustainable development. Some of these factors have been identified by the researchers as CSFs, in line with the aim of this paper and based on some of the elements of the two models mentioned above, and in specialist journals in the area of Lean innovation in general and in healthcare specifically. The conceptual model elements that are found to be critical to the successful diffusion are: leadership and management, organisational culture, employee involvement, Lean healthcare practice, financial capability and measurements (metrics). The model success factors for Lean innovation diffusion will be examined in terms of leadership commitment and management support, openness of the culture and the degree of transparency and communication skills, a broad range of employee involvement and their direct impact towards a successful diffusion, and a correct application of Lean tools and techniques in healthcare projects. In addition, the financial capability will be examined in terms of training and education support and rewarding, and the measurements in terms of measuring for the progress of Lean innovation implementation which will explain the diffusion and success of Lean innovation.

By examining the factors, the researchers have recognised the leadership and management, and employee involvement as 'champions' for the success of Lean innovation adoption, the explanations are discussed below. These CSFs are summarised in a continuous cycle of the proposed conceptual model as shown in figure 3.

Leadership and management

Leadership and management qualities with excellent project management styles would enable the integration of all the basic physical and organisational structures needed for the operations within an organisation.

Poor leadership and a lack of continuous support and commitment from top management are considered challenges faced through Lean innovation diffusion. Therefore, at a project level, line managers and senior managers must always retain the authority and responsibility for Lean projects implementation. A Lean project manager will play a champion role to make Lean process innovations stick. With his management support and efficient and frequent communications, he will have the ability to inspire people and organisational excellence, as well as to build and attain a similar vision towards a strategy of a successful performance of Lean innovation.[14]

Organisational culture

To adopt a Lean innovation project effectively within a positive environment with willingness to change for the better, which will ensure the freedom to diffuse innovative ideas, a clear link should be established between organisational goals, key objectives and Lean project activities, in addition to transparency so that everyone can see everything.

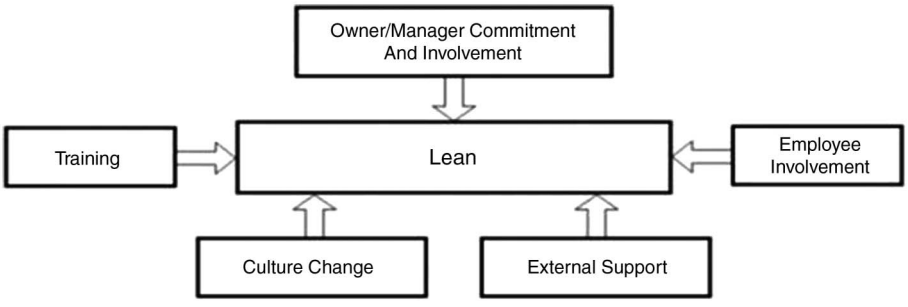

Figure 2 Amar and Davis (2010) conceptual model.

Figure 3 A proposed conceptual model. Critical success factors for diffusion of Lean innovation in healthcare projects.

A recent study highlighted the fact that 'the ability to operate in diverse environments is a pre-requisite for managers'; the study has clearly shown that 'it is highly desirable to have some degree of communication skills, long-term focus and strategic team while intending to implement any new initiative'.[20]

Employee involvement

Other than leadership style and management support and commitment, employee involvement as well has been recognised as a champion for the success of Lean innovation and long-term sustainability of the continuous improvement process.

It has been found that 'to implement Lean innovation on a long-term basis, participants have to be involved and get used to a continuing improvement process'.[23] Therefore, the employee involvement factor in Lean innovation adoption is not a system of individuals but rather a mindset of involving all participants on customer/patient-driven processes. Employee involvement, employee empowerment, employee participation, teamwork, recognition and rewards have a considerable direct impact on employees' performances towards a successful diffusion of Lean innovation.[14]

Lean healthcare practice

'Lean theory, principles and techniques, taken together, provide the foundation for a new form of project management'.[24] In this study, the researchers proposed some key points of Lean techniques at a project level in hospitals that will ensure the effective management for the diffusion of Lean innovation to offer a sustainable improvement mainly in patient care as follows: to identify and manage the whole value stream; to develop a plan to standardise tasks and work processes without sacrificing employee creativity while sustaining a healthy level of Lean practices; to seek to prevent problems and waste (waste is anything that does not add value to the patient, that could delay his service; it can be viewed on waiting and access time, space, equipment and materials… etc); and correct application of Lean tools and techniques.

Financial capability

In general, for the purpose of success in any project, financial capability is considered an important factor. In Lean innovation projects, finance 'covers the avenues through which other useful provisions like consultancy and training can be made'.[25] Financial inadequacy could consequently be a main limitation to the successful implementation of Lean innovation.

Furthermore, it has been argued that 'the importance of financial capability towards the success of Lean implementation can be considered in terms of reward and compensation and infrastructure'.[26]

Measurement (metrics)

The researchers have identified this element as one of the CSFs for diffusion of Lean innovation as a measure for the progress of Lean innovation implementation in healthcare projects, which will explain the diffusion and success of Lean innovation by using time as the best overall measure; and a regular review and measurement of progress against predetermined targets. Considering that Lean innovation will suffer the risk, if it is left unmeasured, 'Without such evidence, support and confidence from top management to sustain it will diminish'.[25]

CASE STUDY—TWO PROJECTS

The researchers will hereby discuss two projects where Lean innovation led to remarkable employees and customers' outcomes. Both projects were planned and implemented in a tertiary healthcare centre and a government hospital in Abu Dhabi city, UAE. The data were collected using an interpretive case study methodology. Primary data came from interviews conducted in the hospital and the information collected from the interviewees was reviewed and verified by a Lean project leader at the hospital, while secondary data came from peer-reviewed publications-related work. The researchers will investigate the implementations and diffusion of Lean principles in the case study based on the proposed conceptual model. The adoption of Lean principles by management is examined as to its role in setting the foundation to leverage innovation in healthcare projects, as a means to reach long-term sustainability and gain higher competitive advantage.

Door-to-balloon time project

Cardiovascular diseases are the leading cause of death in the UAE. Prompt reperfusion access is essential for patients who have myocardial infarction with ST-segment elevation as they are at a relatively high risk of death. Guidelines recommend that the interval between arrival at the hospital and intracoronary balloon inflation (door-to-balloon (D2B) time) during primary percutaneous coronary intervention should be 90 min or less. The aim was to decrease the D2B time for patients with ST-segment elevation myocardial infarction (STEMI) who come through the emergency department to meet the standard of less than 90 min. A multidisciplinary meeting involving concerned stakeholders was called in order to determine the project's viability as a Six Sigma project, prior to the creation of the project charter which authorised, formalised and assigned responsibilities within the project. A viability matrix was formed and the total score based on the agreed matrix is 4.16. Having a score greater than 3 meant that the process would lend itself well to Lean Six Sigma. The choice of Lean Six Sigma methodology was based on the remarkable wastes noted; limited resources and the significant variation of the process. Lean Six Sigma methodology was used to reduce D2B times in patients with STEMI presenting to the tertiary care centre. Specific steps in STEMI care were determined, time goals were established, and processes were changed to reduce each step's duration. Outcomes were tracked, and timely feedback was given to providers. Several strategies implemented at each D2B interval in the protocol have contributed to the ability to obtain D2B times of ≤90 min in a large proportion of patients with STEMI. Changes in flow of care, communications, cardiac catheterisation team activation and data collection were made. Changes in practice implemented at the organisation were based on prior published suggestions on how to decrease D2B. Other changes were made on the basis of the define, measure, analyse, improve and control cycle performed through this project. The multidisciplinary team analysed each phase in the D2B process using the data collected, and then applied current process reviews, lean thinking and brainstorming. The team came up with the fishbone diagram which clearly identifies the causes of the delay in the D2B and value stream mapping was performed. With the D2B process significantly improved, the percentage of patients meeting the 90 min window improved from 58% to 98%. Improvements from there on were sustained and targets were achieved. Strong and optimal interdepartmental communication was also observed since the roles of the different departments in each of the care processes were determined, clarified and agreed on. It also ensured that prompt feedback of time-based results to staff involved in the care of the patients with STEMI were shared and discussed. Implementing the Lean Six Sigma methodology resulted in having processes that are leaner, more efficient and minimally variable.

Outpatient pharmacy Kaizen project

The project started with focus on the importance of improving customer satisfaction: 'Access and Waiting Time' as the top two priorities. This granted the necessary sense of urgency and support to initiate a complete change process with ambitious goals. Comprehensive analysis of the data was used in identifying the possible root cause. Current workflow was evaluated including suboptimal communication with the physicians, non-lean pharmacy space distribution, many options in the Q-matic machines, no greeting booth or information desk and poor physical design of the pharmacist–patient counters. The goal was to cope with the increasing number of patients/prescriptions processed and improve wait times for the patients, which was a constant challenge. To address these issues, determining the areas of the outpatient pharmacy process as well as spaces in need of improvement was carried out. The project was presented as an access improvement project rather than as a pharmacy project, with focus on the impact on patients. The success was promoted as a hospital success rather than as a pharmacy success. The multidisciplinary team involved the stakeholders earlier in the process from the planning phase till the sustaining phase, and communicated frequently and extensively with them. One of the biggest achievements besides the substantial reduction in waiting time and patient symptoms was empowering and engaging the pharmacy staff from day one, which had increased their morale and satisfaction, as well as boosted their self-confidence and unleashed their creativity and innovation. The team, using small Plan-Do-Check-Act cycles and continuous test of change by piloting the ideas on the ground before the final solutions were selected, got enough confidence to alter to the main process flow recommendations after the piloting phase. This is by itself one of the highlights of this project. The waiting time dropped from an average of 45 to 60 min to an average of 4 to 6 min. The process of improving the waiting time in the Outpatient Pharmacy has been a very interesting journey. What started out as a specific Kaizen Blitz project to improve the patients' waiting time ended a cultural shift paradigm in the pharmacy operations and the work environment. The outcomes of the project exceeded the expectations in all aspects.

In the following discussion, the researchers will outline from the above two projects how the innovative ideas were diffused with discussion of the approach that led to the eventual success, based on the proposed conceptual model shown in figure 3.

Leadership and management

A senior management team role was paramount in setting priorities, providing directions and, most

importantly, implementing the innovative Lean reverse pyramid model of leadership, empowering the front-line staff who own the processes. In addition, the leadership had four key activities, starting with making a commitment at the highest level and changing the culture within the organisation, then planning for the deployment of Lean management within the organisation. This was followed by putting the Lean system in motion through processes and kaizen project teams. Finally, the senior management team supported 'keeping Lean going' by assuring sustainability through reviewing and recognising the staff and the processes.

Organisational culture

Deming's view is that successful quality improvement requires the building of a supportive organisational culture. Hence, several steps had to be taken to improve the hospital culture by having decisions made from the down up when appropriate, empowering the caregivers, shared communication, making patients' interests as top priorities, just culture and focusing on teamwork. The hospital works collaboratively to build a culture supportive of quality improvement. The hospital made Lean an organisational culture that develops from a philosophy, management steps and sets of tools. Executive leadership and involvement focus on problem-solving, engagement of front-line caregivers and managers to make key improvements to their processes. Lean was initiated in two model areas to set an example for others: focusing on making Lean a new tool and a culture, as well as part of the vision and strategy at the hospital.

Employee involvement

The essence of Lean is 'engaging everyone' in identifying and solving problems.

In order to optimise employee engagement, one key initiative was implemented: empowerment and respect to front-line staff through 'Gemba Walks' (walking to where the action and the value is) were initiated with focus on the above two projects. The hospital adopted the Toyota process of 'go see, ask why and show respect' leading to optimal improved employee engagement.

Lean healthcare practice

Training and developing staff in Lean tools and techniques aiming at building knowledge was key to the projects' success. Using value stream mapping, a tool recently taught to the staff, helped them identify opportunities to eliminate process waste; this led to a marked reduction in delay and waiting time.

Financial capability

One key benefit of Lean innovation is that it reduces cost, reduces risk and focuses on human efforts more than technology. Actually, Lean innovation does not focus only on quality; it actually provides a decrease in lead time and, importantly, decreases in cost.

There were financial investments instituted to support training and education and rewarding. These were feasible and manageable in view of the Lean innovation model implemented.

Measurements (metrics)

'You cannot improve what you cannot measure'. The focus in both projects was reduction in time. The first step in both projects was to secure reliable and valid measurements. The project team used time as the best overall measure. By using the measurements at each and every step in both projects and adding them to value stream mapping, the teams excelled through brainstorming and deep analyses. They identified opportunities to minimise waiting time and created the basis for the Lean innovation implementation plan. In addition, the project teams used the metrics to celebrate success and optimise respect to the front-line staff. This secured strong participation by all, secondary to a heightened belief in the innovative Lean and kaizen methodology.

In summary, and as shown in both projects of the hospital, the innovative implementation of Lean philosophy had outstanding implications: It markedly and sustainably decreased patient access and waiting time, improved safety and patient satisfaction and supported the hospital culture of empowering front-line caregivers. Lean project management led to a hospital-wide change process. Successful implementation of Lean required leadership commitment and management support, and employee involvement across all levels.

CONCLUSIONS AND RECOMMENDATIONS

The adoption of Lean has triggered and driven change in the culture that has supported many innovations in hospital projects. In both hospital projects, it markedly and sustainably improved the patient access time to the services and reduced the patient waiting time. In the D2B time project, the time compliance improved markedly from 58% to 98% and the results were sustainable, exceeding the international benchmark, and in the outpatient pharmacy Kaizen project, the waiting time dropped from 45 to 60 min to 4 to 6 min on average and was sustainable.

Moreover, Lean project management led to a hospital-wide change process; it improved safety and patient satisfaction and supported the hospital culture of empowering front-line caregivers. By examining the model factors, the researchers have recognised the importance of the leadership and management, and employee involvement, often called 'champions', for the success of Lean innovation adoption. The study demonstrated how a Lean project manager influenced the Lean innovation mechanism, through his championing behaviour, by making a continuous commitment for change to Lean at the highest level and changing the culture to drive innovation and maintain

employee involvement across all levels. Employee involvement, employee empowerment, employee participation, teamwork, recognition and rewards have shown a considerable direct impact on employees' performances towards a successful diffusion of Lean innovation.

On the basis of the case study, the researchers discussed model implications to help foster Lean innovations in healthcare during the execution of the project. The dynamic Lean innovation model presented in this paper has provided the researchers and policymakers with a common understanding and insights to nurture Lean innovation in healthcare projects. It is believed that effectiveness and efficiency will improve throughout the public health system.

The limitations of this study include the fact that the two projects illustrated successful diffusion processes. The inclusion of examples of lesser success would have potentially provided additional insight into the process. Furthermore, research conducted through a single hospital case study is exposed to the criticism that its results are not generalisable, but it has provided a practical approach of obtaining an explanation of a condition and an understanding of the appropriate factors affecting diffusion. An extensive study and analysis is needed to further examine the dynamics of Lean innovation in healthcare projects. The researchers' future work will address this topic further in view of space limitation in the current paper. In addition, the research conclusions need to be further validated.

Implementation of Lean innovation in the healthcare sector in the UAE is still at a fairly early stage. The two successful projects of the hospital provided in the paper are aligned with the UAE National Innovation Strategy to start a new dynamic phase in the hospital services to deliver new horizons of successful and sustainable innovation. This study recommends further implementation of Lean innovation in healthcare projects. It will make the health service better, such as more responsive and closer to society, by improving patient services and making the hospital more efficient and responsive to patient needs and expectations. In addition, it is considered as a powerful tool that inspires the CSR aspects to behave ethically and contribute to economic sustainable development while improving the quality of life of the people and society. These goals fit well with the Lean innovation tool engaging employees in identifying and eliminating NVA activity, particularly when environmental wastes are included. By adding environmental wastes to Lean's deadly wastes, the hospital can control the powerful drivers behind Lean innovation projects to make services more competitive while decreasing environmental wastes and impacts.

This paper gives a growing body of research into Lean innovation implementation in the context of project management within the healthcare sector. This is the first study to develop a specific conceptual model illustrating the successful diffusion of Lean innovation in healthcare projects. The conclusions made potential justifications for success factors and valuable practical recommendations for situations required to foster such innovation in public healthcare.

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