

An Evaluation of the Application of Lean Six Sigma Methodologies in Libyan Healthcare Services

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Abstract

In the last few decades, the use of the Lean Six Sigma methodology has spread in improving health services in the developed and growing world. Previous studies have shown great successes in developing various health services that are provided to patients using the Lean Six Sigma methodology. Therefore, it has become necessary for Libyan health facilities those providing services to patients to take the use of this methodology seriously and to benefit from the experiences of countries that preceded us in using this methodology. This study aims to reveal the extent to which Libyan health facilities apply the Lean Six Sigma methodology in various hospitals and health facilities.

Through designing, distributing, and analyzing a questionnaire at the level of the state of Libya by taking samples to conduct this study represented by a number of hospitals and health complexes in the city of Tripoli and its surroundings, numbering seventeen health facilities between a hospital and a health complex. This research evaluates the implementation of Lean Six Sigma methodology in Libyan health facilities, in addition to identifying the most important critical success factors necessary to implement programs to improve the quality of services in Libyan health facilities using the Lean Six Sigma methodology.

The findings of this paper indicate that the application of the Lean Six Sigma methodology is non-existent in Libyan health institutions, and therefore efforts should be made to introduce this methodology and develop programs to start applying it. The study also identified some of the most important obstacles hindering the application of this methodology and recommended the removal of these obstacles. Several critical success factors have been identified that must be taken into account for the success of any future development and improvement projects for health services in Libyan hospitals and health centers.

This work is the first study to examine the status of implementing the Lean Six Sigma methodology in health care delivery institutions in Libya, the obstacles to its implementation, and the proposed solutions to remove these obstacles. There is no doubt that this research and its results will knock on the door and ring the bells about the necessity of starting to implement methodologies that have succeeded globally to be the nucleus of a serious national program to improve the quality of health services in Libya.

Keywords: Lean Six-Sigma, Health care improvements, Critical Success Factors, Quality of services

1. Introduction

The importance of applying modern quality concepts has increased recently. In light of the global competition, institutions have become accelerated and raced to upgrade the level of their outputs of their products and services they provide to their customers, to achieve a distinguished position for them among their competitors at the local and global levels. Because the health sector is one of the important sectors, there is a need to adopt modern quality concepts, apply advanced methods of quality management and improve their performance.

Quality is a term that indicates the extent of conformity to the standards or requirements. In the context of business, the quality indicates the extent to which products or services are met with customer requirements and needs. One of the most common definitions is that it is 'congruence with requirements'. (1). This means that the product or service must provide the specific needs of customers (2). To ensure the quality of the product or service, the causes of the problem must be studied from their roots, proposing improvements, and start implementing these improvements. Quality improvement aims to reduce defects and errors, increase customer satisfaction, reduce costs and increase efficiency (3). Quality improvement could be achieved by many ways and methods, including Lean Six-Sigma (LSS) method, which is a methodology aims to reduce defects in the process using tools and statistical techniques to determine the sources of variability and get rid of them, as well as reduce waste and eliminate operations contain non-value-added activities. This methodology considered as one of the most famous contemporary administrative strategies in the philosophy of continuous improvement. By using this methodology, it is possible to determine the problems and bottlenecks that hinder the industrial or service process accurately and show improvements using data to achieve the desired goal of the institution (4). It is used in a variety of industries including manufacturing, financial services, health care and public services, and aims to raise the levels of productive and service facilities in all financial, administrative and technical aspects (5).

Lean Six Sigma (LSS) combines two concepts; First is the principles of lean manufacturing, which is a methodology that focuses on reducing waste and increasing flow and efficiency by identifying processes and non-value-added activities and eliminating or reducing them to a minimum. Waste includes anything that does not add value to the product or service (6). The second concept is Six Sigma (SS). This methodology focuses on reducing defects and variability within the process, enhancing quality, improving efficiency, and increasing customer satisfaction (7,8). Lean is primarily useful for a quick, initial round of improvements, while SS is suitable for long-term, complex problems where the solutions are often unknown (9)

LSS consists of five basic stages called (DMAIC) (10) which are: Define: Identify the problem and determine the scope of improvement. Measure: Identifying and collecting data about the process having the problem. Analysis: Identifying the causes of defects. Improve: Develop and implement solutions. Control: Establishing a system to ensure sustainable continuous improvement (11).

2. Lean Six Sigma in health care

Healthcare is the set of services provided by health organizations to patients, with the aim of maintaining, improving, or restoring health. Healthcare includes a variety of services, including disease prevention, diagnosis, medical examinations, treatment of various types, physical and psychological rehabilitation (12), health care and clinical care, and medical education (13). Health

care faces major challenges all over the world, especially third world countries, including poor quality of services provided to patients, high levels of medical errors and an increase in mortality rate (14). Lean Six Sigma (LSS) is a powerful tool for improving the quality and efficiency of health care. This methodology helps to improve health care quality, reduce costs, patient safety, remove waste in the health sector, and increase efficiency (13,15).

3. Research problem

Previous studies on the applications of the Lean Six Sigma methodology in improving and developing services in health fields have demonstrated great success, progress, and significant gains achieved by health care organizations around the world by implementing quality improvement projects using this methodology. Since there are many deficiencies in the level of health services provided by Libyan healthcare organizations, and this is clearly seen in the dissatisfaction of patients with the level of health services provided, the researchers decided to explore and clarify the extent to which Libyan health institutions apply initiatives and methodologies to improve the quality of health services in general, and Lean Six-Sigma specifically, and to conduct a survey that includes samples of Libyan health facilities to determine the extent of the use of the Lean Six Sigma methodology or any other methodologies to improve the quality of health services in Libyan health care facilities. To our knowledge, no national survey has been conducted on the use of Lean Six Sigma methodology or other methodologies to improve health care systems in Libya so far.

3.1 Research objectives

1. To study and evaluate the application of LSS concepts and methodology in the health sector in Libya.
2. To identify the main reasons for the necessity to implement the LSS approach in the health sectors in Libya.
3. To know the extent to which the health sectors in Libya apply any other methodologies to improve the quality of their health services.
4. To find out whether there are any plans to apply LSS or any other methodology for improving quality in the future.

5. Identify the barriers faced by health institutions in Libya, that prevent them from applying quality improvement methodologies in the health sectors in Libya.
6. Evaluating the extent of leadership support in the health sectors in Libya to improve the quality of their services.
7. Determine the Critical Success Factors needed to ensure the success of improvement projects using Lean Six-Sigma methodology.

4. Literature survey

In 1995, the Six Sigma methodology was implemented at General Electric (GE). where a five-phase Six Sigma implementation plan, known as Define - Measure - Analyze - Improve - Control (DMAIC), was created.

GE's Six Sigma program took a quality improvement approach that included training employees in Six Sigma tools and techniques, providing project management support, and creating a culture of continuous improvement. The company was able to significantly reduce the number of errors in its products and services, resulting in increased sales and profits. (11)

The first health organization to adopt the SS approach and apply it in health care was Commonwealth Health Corporation (CHC) in March 1998, an American organization in partnership with General Electric, and it became a leader in the health care industry. Then some health centers started this approach in the radiology department by improving the throughput of CT scans and reducing the time needed, and since then this approach has been slowly but successfully implemented by healthcare institutions around the world (8). Combining the two approaches, lean and SS, had the ability to achieve better results than either method could have achieved alone, and there are a number of research studies that empirically document how they can achieve high-level results (16). The need to expand the application of Lean Six-Sigma in healthcare has been necessary and important for several reasons, including increasing healthcare complexity (17), increasing costs (18), and increasing competition (19). (Feng et al. 2008, (8) study confirms that LSS can be applied in many areas of health service delivery within a single health organization and the experiences and lessons learned from past projects can be integrated and shared in future projects of a similar nature.

In 2006, a national survey was conducted in the United States to evaluate the use of Lean Six Sigma (LSS) methodology in healthcare organizations. The survey included 56 hospitals, and the projects implemented in hospitals adopting LSS focused on three main types of improvements: Reducing peak time, improving process flow, and reducing medical errors (8).

In Malaysia, many healthcare providers have implemented LSS methodology with a high return besides reducing medical errors in healthcare and LSS implementation has had a positive impact in improving time, speed, cost, efficiency, and increasing customer satisfaction (18,20).

At an Indian medical institute, a reduction in patient cycle time was observed after adopting the LSS approach and resulted in a significant reduction in average time and length of waiting (10).

At Harley Street Hospital in the UK, Six Sigma was used to optimize the inventory management process. This reduced costs by 20%, and increased productivity by 15% (21).

In a study at a hospital in Saudi Arabia, Lean Six Sigma was used to improve the process of reducing waiting time in patient clinics. This resulted in a 50% reduction in waiting time and a 20% increase in patient satisfaction (10).

At the Cleveland Clinic in the United States, Lean Six Sigma was used to improve the breast cancer diagnosis process. This reduced medical error rates by 25%, and increased the detection rate of malignant tumors at an early stage by 15% (22).

5. Data Collection, Analysis and Results

Within the framework of achieving the objectives set for this research and to answer the main question of this research, which is the extent of the application of the LSS methodology in Libyan health institutions and how to adopt it as a methodology for continuous improvement and start using it, a questionnaire was designed that includes several questions to capture the various aspects of the issue and try to investigate the reasons for not applying the methodology in Libyan health institutions as well as ranking the importance of critical success factors that contribute to the success of development project initiatives using the LSS methodology, and other questions related to the extent of applying any other initiatives other than LSS as methodologies for continuous improvement in Libyan health institutions.

The questionnaires were officially distributed to seventeen hospitals and health complexes from public hospitals in Greater Tripoli as they represent a sample of public hospitals and health complexes.

6. Survey methodology and sampling

The study and the distribution of questionnaires began in October 2023, and finished in February 2024, and the targeted individuals (administrators, doctors, department managers, and quality managers in those institutions) were reached in this study through field visits where the distribution of questionnaires is accompanied by personal interviews for individuals targeted by four questionnaires for each health sector in a total of sixty eight individuals targeted in these hospitals and health complexes.

7. Survey design

The questionnaire interface was a definition of the Lean Six Sigma approach so that those who were not familiar with this approach could be recognized, and the questions were varied between optional and voting questions, and the longest questions were asked near the end of the questionnaire. The survey ended by a table of critical success factors needed to be ranked and prioritized for importance. The questionnaire questions were divided into several sections:

Section I: The questionnaire started with simple questions such as the name of your organization, the number of its employees, and how to describe your role within the organization, and the extent of your knowledge of the LSS methodology, where the importance of these questions is that it gives an idea about the surveyed person and the extent of the degree of reliability of the answers issued by him, as several answers were excluded.

Section II: Organizations were asked whether the LSS approach has been adopted and implemented (this is very unlikely by the researchers). If yes, the respondents answered some detailed questions about how LSS programs are implemented in the organization, and if not (this is likely), they were asked whether any other quality initiatives other than LSS are used, whether the organization plans to implement LSS programs in the future, and in case your organization wants to implement LSS, what are the main challenges and barriers that prevent this approach from being implemented, and how

much support your top management has for health service improvement programs in your organization.

Section III: If the organization has implemented the LSS approach (which is unlikely), they were asked how long has it been since the LSS approach was implemented, what were the main reasons for implementing it, what are the LSS tools and techniques used in your organization, how often do you conduct LSS projects, did you notice improvements when implementing the approach, and how satisfied you are with the results?

Section IV: Its questions focused on the most important Critical Success Factors (CSFs) that the respondents consider important for the success of the LSS program if it is or will be implemented in their organizations. To facilitate answers for respondents, a table was designed that contains several elements of the critical success factors within the questionnaire. Respondents are required to indicate the importance of each of these factors using a Likert system, as this system contains five grades that show the importance of each scale as follows: 1: Not Important, 2: moderate importance, 3: important, 4: very important, 5: extremely important.

7.1 Data collection, analysis and results

All questionnaires were hand-delivered to various hospitals and health complexes located within the Greater Tripoli area, and 68 respondents answered the questionnaire with four questionnaires for each health institution. The following table (table1) shows the roles and tasks of the respondents within their health institutions as follows:

Table (1) Roles of Respondents

Respondents	Number
Managers (Executive - Leader)	18
Quality officials (specialists to improve operations improvements)	12
Physicians (General - Specialist - Consultant)	22
Other administrative jobs	16

7.2 Based on the survey results

All health care institutions targeted, seventeen out of seventeen, do not use the LSS approach in their organizations, i.e. 100% of the organizations do not use the LSS approach, which is not surprising given the relatively short history of LSS in healthcare quality improvement in the world, and the lack of a culture of continuous improvement and knowledge of quality improvement methodologies including LSS to improve health services in Libya.

The results of the questionnaire showed that more than 88% of the respondents do not have sufficient knowledge of the LSS methodology, meaning that this methodology is unfamiliar to them. This may be due to the lack of training programs at the leadership level regarding the best methodologies for continuous improvement in health institutions and thus reflecting the extent of knowledge of health sector workers (doctors, nurses, and administrative leaders) about continuous improvement methodologies, whether LSS or other methodologies. Figure (1)

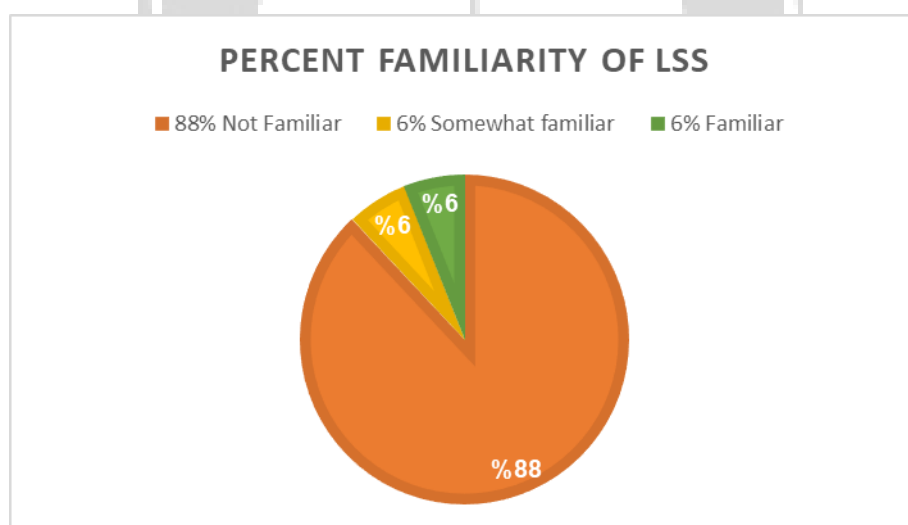


Fig 1. Familiarity with LSS methodology

As seen from questionnaire data, ten out of seventeen organizations are considering implementing the LSS approach in the future and 7 organizations are not planning to implement this approach in the future, although we have concerns about such answers because the respondents do not have full authority to decide whether or not to include the LSS methodology in their health organizations. Figure 2 shows the ratio of organizations that may plan to use the LSS methodology in their future

improvement and development programs to organizations that are not considering adopting this methodology in the foreseeable future.

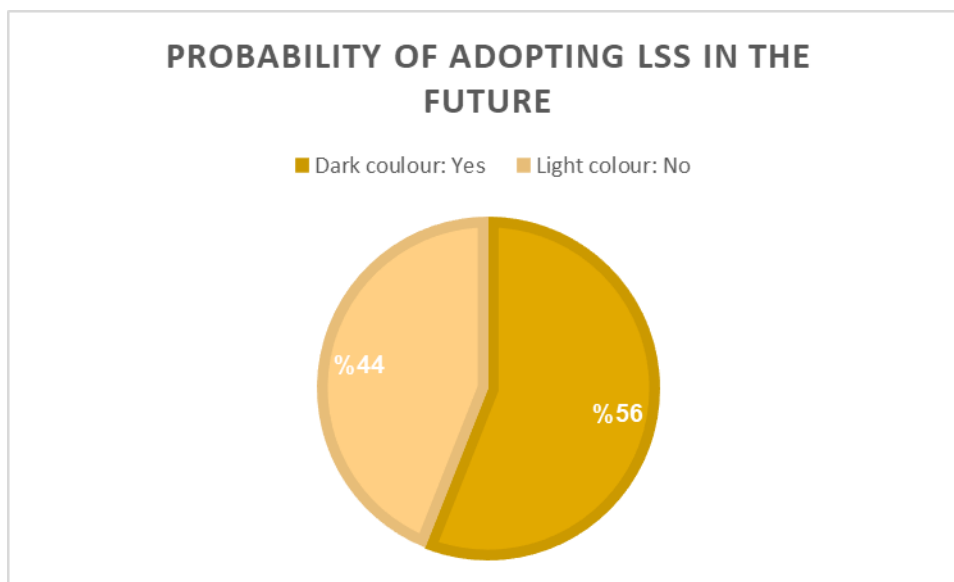


Figure 2: Percentage of organizations planning to adopt the LSS approach in the future

Considering that the LSS methodology is not applied in health institutions in Libya, the questions resulting from its application become meaningless or useless and useless. Also, considering that this methodology is not applied in these institutions, there are no leaders and implementers of the LSS methodology, those black and green belt holders (Master Black Belt(MBB), Black Belt(BB), and Green Belt(GB)) who act as the essential experts for leading improvement and development projects using the LSS methodology and implementing it in any sector, whether industrial or service.

As for the reasons and obstacles for not adopting the LSS methodology in Libyan health institutions, the most important reasons are captured for not adopting the LSS approach. The priorities of these reasons will be shown in the Pareto chart and the cause-and-effect diagram so that they can be recognized and addressed when applying the methodology.

The following Pareto chart (Figure 3) shows the importance of each of the reasons that hinder the application of the LSS methodology in health centers in Libya. It was found that the lack of training and knowledge of the methodology was the biggest reason for not applying the methodology. This is the role of leaders in the field of health care who are entrusted with improving the quality of health services, as they are supposed to raise awareness and introduce methodologies for developing and

improving the quality of health facilities and training to use them in a scientifically studied manner in their organizations. As it was revealed through the questionnaire as well as personal interviews that the majority of leaders have not heard of the LSS approach and do not have any information about this methodology.

The second main reason was the insufficient resources for training and implementation of the methodology, including trainers, training curricula, and leaders who supervise training and implementation of the methodology (MBB, BB, GB).

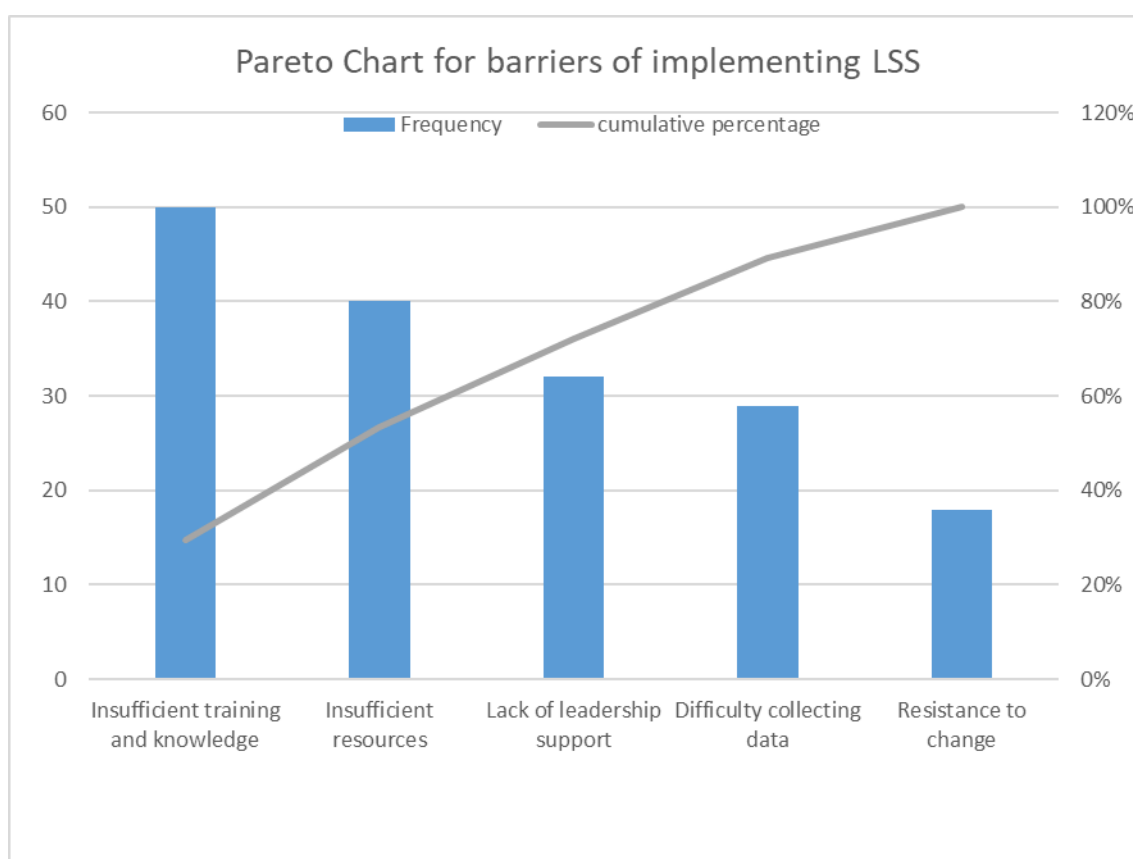


Fig. (3) Pareto chart for prioritizing reasons for not implementing LSS

The third reason was the lack of leadership support for continuous improvement efforts in healthcare fields. According to previous studies, the support of senior management for continuous improvement projects including the LSS methodology is extremely important and it plays a main reason for the successful implementation of improvement projects, because senior management support sends a clear message to all employees that quality improvement is a top priority for the organization, and

this helps build commitment to the initiative and ensure that there are sufficient resources to implement it successfully. Senior management can provide direction for the initiative, including setting goals and developing an implementation plan. Senior management can remove obstacles to the initiative, such as lack of resources or resistance from employees, helping to ensure that the initiative progresses smoothly and achieves its goals. Senior management support also includes providing financial and logistical support for the initiative, appointing an executive responsible for leading the initiative, and establishing a steering committee with representatives from all levels of the health organization to participate in improvement activities. What is needed to be mentioned here is that the results of the questionnaire and personal interviews with the leaders revealed that they often show their lack of ability to prioritize improvement projects and their lack of understanding of long-term systematic improvement methods and are stick with just some improvement campaigns here and there, which usually quickly lose their potential and stop working as a result of lack of control plans those maintain consistency.

The fourth reason for the failure to apply LSS in health institutions in Libya, is the difficulty of collecting data and information. Previous studies have shown that one of the manifestations of the lack of management success in health institutions is that there are no ready (centralized) databases, where data and information can be extracted easily and on time because the LSS methodology relies heavily on the availability of data and information (Data Driven Methodology). Databases play a crucial role in hospital management and effective health care delivery, as databases help organize the vast array of data collected in a hospital.

The fifth reason for the failure to apply LSS in Libyan health institutions is resistance to change. Resistance to change is a global phenomenon that exists in all countries. It means the unwillingness to change the existing system, no matter how negative it is, and resisting any change that could change the existing way of working in the organization. The reasons behind the resistance to change is believed to be due to the fear of failure, and the lack of guarantee of results even in terrible situations that require radical change.

7.3 Cause and Effect Diagram (Ishikawa Diagram)

Ishikawa's cause and effect diagram aims to analyze the causes of a particular issue based on data and evidence observed through brainstorming sessions by individuals related to this issue or outcome.

This diagram was created in coordination between the researchers and some individuals from some hospitals who attend sessions of brainstorming to identify the causes of the main issue of not adopting the LSS methodology in Libyan health institutions. Through these sessions, some of the reasons for this issue were identified and presented in the attached figure (Fig4).

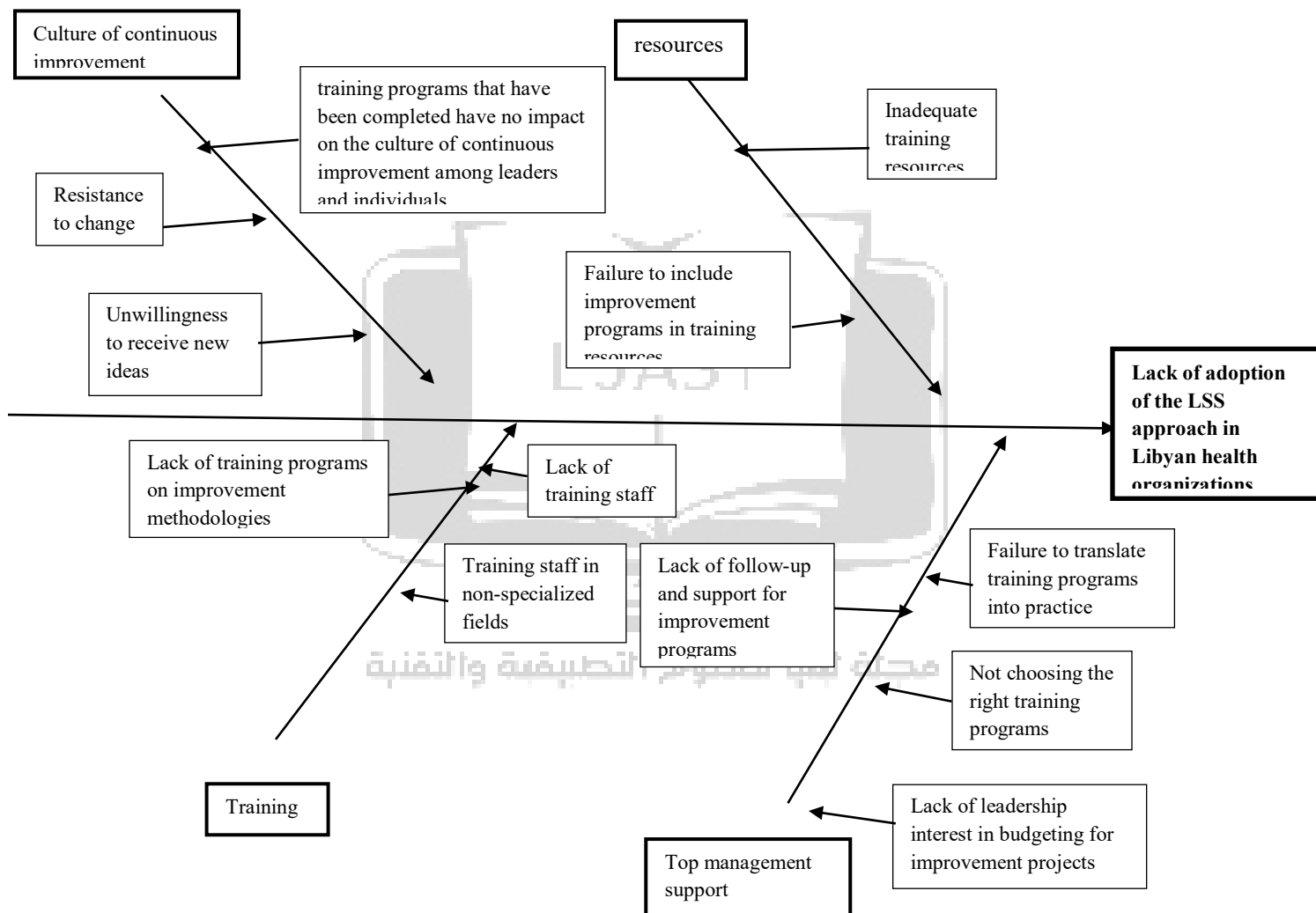


Fig. 4 The Cause and Effect Diagram for the research problem

The root causes were divided into four main sections: leadership support, resources, culture of continuous improvement, and training.

7.3.1 Leadership support: The following sub-causes were highlighted:

I. Failure to convert training programs into a practical reality. The training programs remain merely training plans that are often not implemented, as the leadership does not prepare post-training programs that incorporate the contents of the training material into the tasks and work of the individuals who were targeted by the training courses.

II. Lack of leadership interest in spending budgets for improvement projects that aim to raise the level of service provided to patients, as these leaders do not see great importance of such projects.

III. Failure to choose appropriate training programs, as the brainstorming committee members stated that many training programs have no significant benefits, and even if they could be used, there are no plans by senior management to activate what has been achieved in the work programs in health centers.

7.3.2 Resources: It includes two sub-causes:

I. Lack of adequate training resources due to limited budgets and the failure to distribute these budgets in a proportionate way with the needs of health facilities to develop improvement programs for these institutions. Also, poor selection of qualified individuals for improvement and development programs in terms of specialties and competencies.

II. Failure to include quality improvement programs inside the training resources, due to the ignorance of quality improvement programs in the lists of training programs. We noticed that hospitals and health centers inspected did not have anyone who was certified with MBB, BB, GB certificates, which are necessary to lead improvement programs in any industrial or service organization.

7.3.3 Training: It includes three sub-causes:

I. Lack of training staff in continuous improvement methodologies, including the LSS methodology, as, to our knowledge, there are no trainers with BB or MBB certificates who can qualify trainers, implementers and supervisors of continuous improvement projects using LSS.

II. Lack of training programs on continuous improvement programs. As mentioned above, the recognition of the importance of including training programs on continuous improvement is still limited, so it is usually not included in training programs, and even if it is included, it does not take sufficient care in terms of selecting curricula and qualified trainers.

III. Training individuals in other than their specialties, such as training doctors on some programs in which they do not have any scientific background, or nominating completely unqualified individuals to attend training or qualification courses in specialties that are completely different from their career path, and thus they will not get benefit from these programs and will not benefit their institutions with any new knowledge.

7.3.4 Culture of continuous improvement that includes three sub-causes:

I. Resistance to change by some leaders and even staff due to their fear of the consequences of the changes that may occur as a result of the introduction of improvement programs, in addition to their feeling of security by remaining in their current status, no matter how bad it may be.

II. Unwillingness to receive new ideas for change. Through brainstorming, it was found that most individuals tend to love routine work and remain in their current status because change requires efforts to identify and get used to new change programs and improvements that they do not need to make efforts to keep up with them.

III. Lack of impact of training programs on the culture of continuous improvement among leaders and individuals. In general, training programs are seen as a place to take a break from the daily work routine and not to learn a new approach or new ideas that may contribute to improving work conditions, increasing productivity, and reaching the best state of patient satisfaction.

7.4 Critical Success Factors for the success of Lean Six Sigma initiatives: (CSFs):

Critical Success Factors (CSFs) are the foundations for the successful implementation of LSS methodologies in health organizations. The factors mentioned in the following table (Table 2) have been collected and summarized through previous studies and through discussions with health sector workers as the most important success factors for LSS initiatives if implemented in Libyan health institutions. The respondents were asked to rank the critical success factors from 1 to 5 to indicate their importance (1 least important, 2 moderate importance, 3 important, 4 very important, 5 extremely important), so that these factors will be considered when designing development programs through the LSS methodology.

Table (2) Critical Success Factors for a successful implementation of LSS program

Critical Success Factors (CSFs)	Importance of factors
Focus on patient needs	4.96
Top management commitment and support	4.91
Strong leadership for continuous improvement processes and assigning a LSS leader	4.86
Measurement and feedback	4.58
Embedding a culture of continuous improvement	4.51
Focus on critical processes	4.33

Communication with employees	2.86
Infrastructure and resources	3.60
Risk tolerance	3.44
LSS training and tools	4.90
Linking LSS to business strategies and organizational goals	3.14

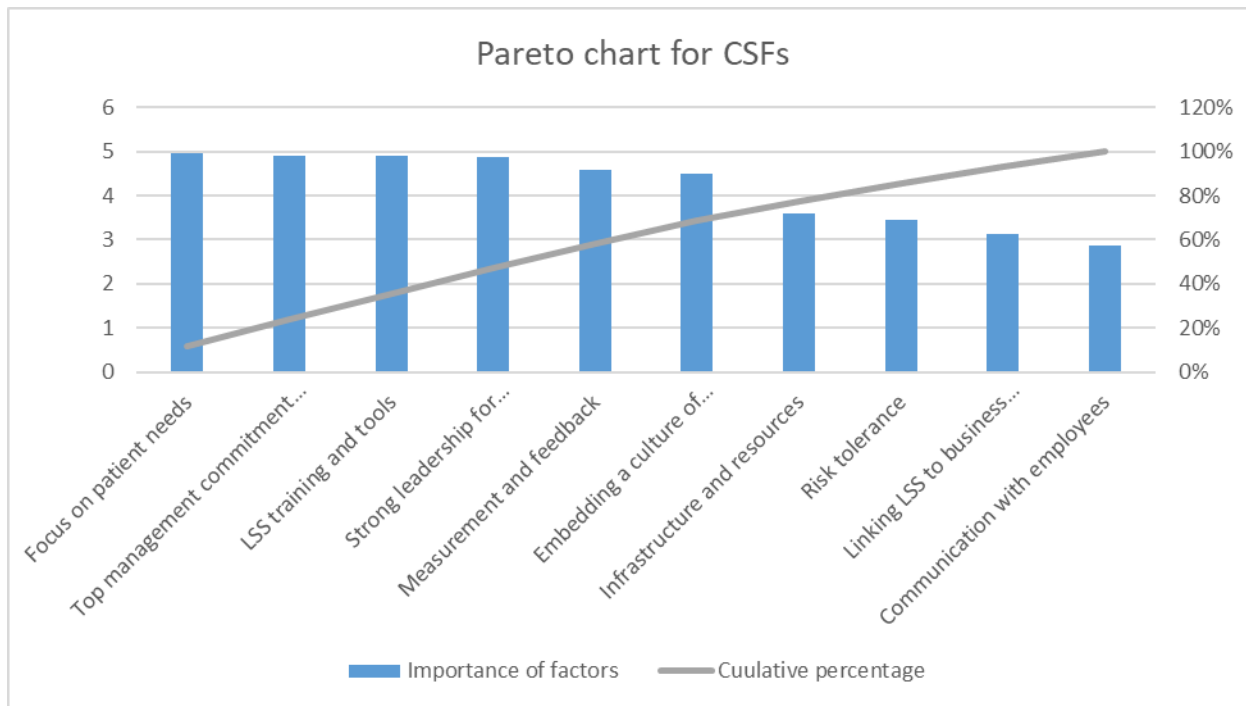


Fig (5) Pareto chart for prioritizing critical success factors

Through the attached Pareto chart (Fig.5), which prioritizes the critical success factors for implementing the LSS methodology in Libyan health centers, it was found that the following factors received the most attention from the participants, in order from the most important to the least important:

1. Focus on patient needs: It is natural that all respondents agree on the importance of this factor because the main goal of providing health services is to provide patients' comfort and satisfaction with the level of services provided to them, and all resources and capabilities must be used in the best way to achieve this goal. Patient needs can be defined as responding to the

reasons why patients come to the hospital or health center and providing all possible services in the best way and in the shortest time in a manner that achieves the purpose of his coming to this facility.

2. Commitment and support of senior management: There is no doubt that any improvement initiative, whether using the LSS methodology or any other methodology, will not be successful unless it is accompanied by the support of senior leadership, overcoming all obstacles in front of it, and providing all capabilities to make it successful. As has been mentioned in many studies, the lack of support and interest of senior leadership for quality improvement initiatives was a major reason for the failure of many improvement projects that were undertaken.
3. Strong leadership for continuous improvement processes and appointing a leader for the LSS initiative: Continuous improvement processes are supervised by appointing a leadership committee for improvement processes, which is usually led by supervisory leadership and technical leadership who have practical experience and great knowledge in improvement areas using improvement methodologies, including the LSS methodology. The technical leadership is usually someone who holds the Master Black Belt (MBB) or at least the Black Belt (BB) or is at his level in terms of technical expertise in defining improvement goals, using the appropriate tools for improvement processes, and leading the improvement team to reach the desired goals.
4. Measurement and feedback: This means measuring the extent of achievement that has been achieved in the improvement processes and comparing it with the goals that were initially set in the stage of control process, which is one of the stages of the improvement process using the LSS methodology.
5. Establishing a culture of continuous improvement: Implanting a culture of continuous improvement is considered one of the pillars of change in organizations, as it prepares people to accept and adopt the ideas of change and not resist them, which enhances the chances of success of improvement and development processes. This culture is cultivated through continuous awareness-raising and training on the use of new methods to complete processes, whether industrial or service. The adoption of a culture of continuous improvement by senior

leaders is considered as a driving force for the success of improvement projects in the organization.

6. Focus on critical success processes: Identifying the most important critical success factors is one of the priorities of the process of directing the use of the organization's resources in improvement processes, as it requires looking at the most important factors that affect the success or failure of processes to focus on them in prioritizing improvements in light of the limited resources.

8. Conclusion and Recommendations:

Through this survey, this work is the first study to investigate the state of adoption and implementation of Lean Six Sigma methodology in healthcare systems in Libya. The study found several findings, which we summarize in the following points:

- 1- The study proved, as expected, that the Lean Six Sigma methodology is almost unknown in the medical community, and at best, what is known about it is very superficial and does not rise to the point of identifying its capabilities.
- 2- The study demonstrated the lack of use of any well-known methodology in improving health services, and the improvement attempts that occur from time to time are individual efforts that do not guarantee continuity in their application and are not based on known principles and rules, and this is called in the language of Six Sigma (The Saw Teeth), as after any improvement campaign and obtaining temporary improvements, the situation returns to what it was before the improvement.
- 3- The main reasons for not adopting Lean Six Sigma were summarized as follows:
 - I. Lack of knowledge of the methodology, lack of training on the methodology, and lack of resources.
 - II. The second most important reason was the lack of resources for training and qualification to implement improvement programs in general and the use of Lean Six Sigma in particular.
 - III. The third most important reason was the lack of support from leadership and senior management for programs to spread the culture of change and improvement, may be

due to a lack of full knowledge of the benefits of systematic, and sustainable improvement programs

- IV. Lack of data is a major obstacle in the way of improvement because the application of Lean Six Sigma methodology depends mainly on data (Data driven methodology), as the availability and accessibility of data is a prerequisite for starting any improvement project using Six Sigma methodology.
- V. The lack of leadership support for continuous improvement, along with resistance to change from various administrative levels in the organization, is one of the most important factors in discouraging, failing, and planting the idea of failure even before the improvement projects start because they are afraid of the consequences of change.

4- The analysis of the most critical factors for the success of Lean Six Sigma programs in health institutions showed that the most important success factors are: focus on patient's needs, commitment of senior management to support continuous improvement projects, training in using the Lean Six Sigma methodology and its tools, appointing strong and trained leaders to lead Lean Six Sigma projects (Master Black Belt, Black Belt), establishing a culture of continuous improvement, and focusing on critical processes.

9. Recommendations

- 1- The necessity of adopting the Lean Six Sigma approach as a strategic methodology for continuous improvement in Libyan health institutions after this methodology has proven remarkable global successes.
- 2- The need to pay attention to training cadres to lead development and continuous improvement projects that have a good background in the field of quality improvement, in addition to cooperation, participation and get benefit from the experiences of those who preceded us in this field.
- 3- The need to allocate resources for training and improving the level of services provided to patients, as there is no success for development and improvement projects without resources.
- 4- Start improvements by choosing easy projects that are guaranteed success (Quick wins) so that they will be an incentive to continue choosing larger and more difficult projects.

- 5- Initiating awareness campaigns to spread the culture of change and non-resistance to development and improvement ideas and projects, and involve enthusiastic young leaders to lead development projects.
- 6- Paying attention to providing a unified database that is easily accessible to researchers and leaders of improvement and development projects.
- 7- Motivating workers in the areas of providing health services financially, morally and in training.

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