IMPROVING REGISTRATION PROCESS AND SERVICE QUALITY IN DENTAL CARE DEPARTMENT IN A UAE HOSPITAL USING LEAN SIX SIGMA METHODOLOGY

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ABSTRACT

The health care industry is considered one of the fastest-growing industries in the world. It raises the competition between health organizations to deliver the highest quality service. On the other hand, a balance between medical care and the financial aspect needs to be considered. One of the most frequent complaints in the healthcare sector is the waiting time of the patient until the medical service is delivered by the physician, which is strongly affecting the satisfaction rate which is why improving the waiting time of the patient is a must in healthcare organization's attempt to deliver exceptional services. Several quality management practices, including, are adopted by hospitals to overcome the shortcomings relevant to service quality. The purpose of this paper is to study the efficiency of using Lean Six Sigma methodology in improving the issue of quality in the healthcare sector. The research of this paper is based on the use of the LSS DMAIC approach and its ability to improve the registration process of a new patient in the dental department of a hospital in the UAE. The study illustrates the improvement in the dental department registration process with the power of LSS. The time for registering new patients in the dental department reduced from 15 minutes to 5 minutes. Also, it allowed the dental department to accommodate more patients and increase the overall hospital revenue. The hospital utilized the LSS methodology to improve the dental care department registration process and overall service quality.

KEYWORDS: Registration time, Dental clinic, Lean, Six Sigma, Waiting time, LSS & Hospital Industry

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INTRODUCTION

Total Quality Management, Kaizen, Lean, Six Sigma, and Lean Six Sigma have been used to improve service quality in the health care sector. From all the quality management practices, Lean Six Sigma has been used and has extensive scope for further application. This methodology covers all the discrepancies of Lean and Six Sigma. E.g., Lean cannot get the process in statistical control, and Six Sigma cannot decrease process speed and lessen investment (Vijaya et al. 2019).

Without any shortcomings in the procedure, Lean Six Sigma seems to be the best option in the dental care sector. Lean Six Sigma effectively blends improvement of quality and cost reduction, which helps to resolve financial complications and to improve service quality (Heuvel et al. 2005). There are high chances to get process improvement and related cost savings in the dental care sector (Honda et al. 2018). Lean Six Sigma emphasizes on calculating and removing inaccuracies (by variance reduction) and upgrading workflow. Therefore, it is effective and enhanced (through the erasure of waste) in the phase of consistent development (Lin et al. 2013; Omar and Tariq, 2020). When design thinking unites with Lean Six Sigma tools, it helps to develop a system that provides service efficiency and leads to customer satisfaction. Roadmap for Lean Six Sigma DMAIC (Define, Measure,

Analyze, Improve, Control) leads to the improvement of service quality. This process is distinctive due to its determinants as it focuses on providing the best quality to the customers at every phase (Gitlow, 2006). According to a technical perspective, an adaptable approach is required while implementing Lean Six Sigma to the public health or dental care sector. Various factors of the DMAIC model can be used according to the features of the dental care process. Lean Six Sigma provides health and dental care sector with a workable approach which reduces the cost and improves the quality (Chiarini & Bracci, 2013). Lean Six Sigma has ascertained its worth in both industrial and service quality. Although LSS has been popular among the services, in general, its application in healthcare has been dominant. Health and dental care sectors have observed various intrusions of Lean Six Sigma tools (Vijaya et al. 2019; Khazna and Tariq, 2020).

Applying Lean Six Sigma in healthcare organizations helps in improving the quality of service and increase the satisfaction rate by addressing the problems related to the process. The lean approach helps to speed up the process by eliminating the wastes while the Six Sigma tools reduce the variation, which ensures improvement in performance. In this study, Lean Six Sigma techniques are used to address quality issues in the dental department of the hospital.

The research paper is structured as follows: A literature review of relevant research works of applying Lean Six Sigma methodology in health care sectors is discussed in section 2. The Research Methodology overview in section 3. Data analysis and results are discussed in section 4. A discussion of the results is displayed in section 5. Finally, the conclusion of the study is illustrated in section 6.

LITERATURE REVIEW

Lean Six Sigma Process in Health Care Sector

LSS is considered one of the most effective methodologies in establishing improvement and innovation efforts in the healthcare sector. LSS helps to improve the process by eliminating the root causes of the problem, which reduces wastes and stabilizes the process (Bhat et al. 2014). It has tools, methods, and concept which provide a more structured manner in the process changing, and if used effectively, it could reduce effort, time, and resources required for improvement. Lean six sigma projects improve the way of doing work, which enhances operational and process quality (Laureani et al. 2013). Besides, the application of these techniques in the healthcare organization helps in improving the quality of service (Nayar et al. 2016). Also, the LSS approach has a direct impact on the quality of performance in hospitals (Selim et al. 2018). Also, this approach helps to increase the profitability of the hospital in the long run (Kumar & Steinebach, 2008). Combining lean and six Sigma greatly benefits the hospital if applied appropriately (Honda et al. 2018). On the other hand, continuous monitoring must be conducted, following the application of the LSS framework, in order to maintain the positive results achieved in enhancing patient services (Al-Zain et al. 2019). Seeking zero defects in the health care industry is essential, and by implementing lean six Sigma in health care, it helps in reducing variation and defects in the process and standardizes it by eliminating non-value-added steps (Alsulami et al. 2012). A study done by (Walters & Barneva, 2017), showed that improvement gained from using LSS influences the dental practice to have data-driven solution of the process in the future instead of focusing on the behavior of the staff. The structured problem-solving approach taken from Six Sigma and the efficiency and speed of lean combine to help in having open communication with all employees involved in the process and enables them to work as a team towards a common goal (Jackson & Woeste, 2008). Another study (Selim et al. 2018) revealed that lean six sigma methodology links the operational level in health care sectors with the strategic level, in addition to binding all operational activities together. The result of an inefficient healthcare system is either decrease in quality of care or an increase in cost (Bhat et al. 2016). (Gijo et al. 2013) found that only simple solutions needed to be implemented

in order to achieve the results, without the need for any cost or investment from the company. Lean Six Sigma tools and techniques are used to eliminate wastes (William et al. 2019). LSS methodology helps in eliminating the problem by identifying the root causes of it (Gavriloff et al. 2017). A study done by (Miller & Chalapati, 2015) indicates that the results obtained after conducting the LSS process are not temporary and are maintained over a period.

Customer satisfaction is considered as a critical factor in the development of any institute. Excellent quality of services and understanding needs of customers are the essential factors to sustain in this competitive era. Lean Six Sigma process helps to achieve this goal. As Lean emphasizes to speed up the process and exclude the waste, however, Six Sigma helps to clear out the flaws and statistical control. The development of the dental sector also depends on various aspects, including service quality, so Lean Six Sigma helps to attain success. The success or failure of the Lean Six Sigma process depends on how it is being used. To effectively use this process, it is imperative to understand the factors that are involved in quality improvement, for example, the working environment, organizational guidelines, and work methods. Staff training, Management dedication, and making resources available makes the smooth implementation of the Lean Six Sigma process (Raval et al. 2018).

Lean Six Sigma acts as a business improvement plan and becomes a process that improves the performance of employees, which results in excellent service quality and customer satisfaction. LSS eliminates overtime, improves efficiency, increases organizational flexibility, and subsequently decreases waste and service time. The application of Lean Six Sigma methodology lessened the cost of procedures and the time required to provide the services by 52%. The combination of Lean and Six Sigma process permits the staff to have better control in the working process and ends up in the constant enhancement in the service quality (Drohomeretski et al. 2013).

Lean Six Sigma utilizes process from both methods, i.e., Lean and Six Sigma, to secure the best results from both procedures, which increases speed as well as exactitude (Laureani & Antony, 2015). As stated above, Lean and Six Sigma have a corresponding association with one another to improve service quality and lowering costs and waste. The lean process utilizes a management framework in compliance with the Six Sigma procedure. Six Sigma process delivers an operative entrenching outline according to the application of Lean principles. However, the Lean process does not evaluate financial pointers. Instead, it removes the excess cost factors of the organization, whereas the DMAIC model of Six Sigma helps to examine and inspect the performance of the organization. Therefore, Lean and Six Sigma are used together as Lean Six Sigma to improve the performance and service quality continuously (Ahmed et al. 2013; Tariq, 2013).

The healthcare sector, including the dental care sector, has faced many challenges, including patient care and providing excellent service quality to patients as well as to their attendants. This industry has been criticized for not delivering quality service and care to the patients. When effectiveness and service quality is questioned, there is an essential requirement of change. The authorities have now enforced the staff and management to implement innovative ways to combat this inefficiency. The revolution of compensations for the services provided by hospitals has enforced the healthcare sector to adopt advanced ways to improve service quality with cost reduction (Langabeer et al. 2009).

Lean Six Sigma focuses on competence results; for example, it has been used to boost the effectiveness of treatment provided to the patients, lessen the waiting time for patients, decrease time during the registration process, to develop efficient ways to keep clinical records updated, lower the costs associated and to increase patient's satisfaction. The appropriate distribution of resources, together with waste lessening, is vital in the dental sector. The deficiency of resources to fulfill dental care needs, including the requirement for brilliant performance and excellent dental care, are causes for adopting Lean

and Six Sigma methodology (Improta et al. 2017).

In the dental care sector quality is dependent on the following aspects:

- **Safety:** Patients should not be distressed by the treatment that is planned to cure them.
- **Timeliness:** Pointless delaying and waiting time in the registration process and treatment should be reduced.
- **Effectiveness:** Treatment should be effective and based on proper medical information,
- **Efficient:** Treatment should be effectual
- **Equitable:** Treatment should not differ. even patients may have different characteristics
- **Patient-Centered:** Treatment should be according to the requirements of the patients (Kuo et al. 2011).

Importance of Good Service Quality in the Dental Care Sector

Service Quality is an important topic when it comes to the dental care sector compared to its relationship with the cost. It also plays a vital role in the economic and marketing performance. Patient satisfaction also depends on service quality. It is considered that it is imperative to retain the patient's confidence in getting the treatment done by an easy registration process and by providing the best service quality (Sadiq, 2003).

In dental clinics and hospitals, various services can be utilized advantageously in the competitive environment (Lim & Tang, 2000). Endorsing quality will improve a patient's satisfaction and trustworthiness. Besides, excellent service quality plays a vital role in the patient's future appointments. Previously, service features were described as quality measurements. However, in this competitive era, service quality is defined as the patient's needs and wishes (West, 2001). Currently, quality measurement, according to the patient's requirements, is recognized in the dental care sector. The statistics gathered by patients' viewpoints is an effective process for the assessment and improvement of service quality. In the dental care sector, various strategies are developed to upgrade service quality.

Patient observations, viewpoints, and satisfaction with dental care service quality are distinguished as essential aspects. Providing excellent dental care, easy registration, and service quality to patients may increase patient satisfaction and can lessen tension and discomfort throughout the dental procedures. Patients willingly come for future treatments. Improved service quality lessens costs and attracts more patients by patient's satisfaction. Various aspects, including proper treatment, ethical behavior, morality, easy registration process, create patient's satisfaction. Various patients need dental care daily, so recognizing, determining, and developing aspects involving dental care and service quality can block wasting resources. Good service quality involves managers, supervisors, and dentists to know patients' realistic requirements and to resolve their complications. Dental clinics should deliver prospects for staff to provide services according to the patient's requirements. It is crucial to improve service quality during dental care by paying attention and providing treatment according to the patient's demands and needs (Bahadori et al. 2015). The case study is based on the implementation of LSS methodology in a dental clinic of a hospital in UAE, and the research questions are as follows:

- Will LSS implementation help to reduce the patient registration time in the dental clinic? And,
- What are the right tools for each phase of LSS implementation for improvement of the registration process?

Case Study Hayat Hospital

The case study organization is Hayat hospital that specializes in several healthcare services within various departments, including dental, surgery, emergency, outpatient, inpatient, and general medicine. The organization must provide the best services to the patients that require monitoring of all processes with no errors. The current registration process has delays that are causing issues with the patients as they are not happy. Several approaches were implemented to improve the registration time from 15 minutes to 5 minutes. The delay in the registration process must be improved to maintain reputation in the market. The quality team suggested using the LSS approach to find the root cause of the delay in the registration process.

Lean Six Sigma Implementation

To reduce the registration process time of new patients in the dental department, the DMAIC process of Six Sigma and lean tools and approaches used. The detailed explanation of each phase tools used mentioned below:

Define Phase

Problem Statement	Business Case & Benefits																																
The registration time of new patient in dental clinic usually high and not meeting patient expectations which affect the satisfaction rate and cause reduction in the patient number and hospital revenue	This project adopts the quality goal of the hospital by increase patient satisfaction, and decreases complain by decreasing waiting time in the registration process. Also, it aims to increase hospital profit by increasing patient number in less time																																
Goal Statement	Timeline																																
The goal is to reduce the registration time of new patient in the dental department of XYZ hospital from 15 mints to 5 mints	<table><tr><th>Phase</th><th>Planned Completion Date</th><th>Actual</th></tr><tr><td>Define:</td><td>January/24th</td><td>January/31th</td></tr><tr><td>Measure:</td><td>February/14th</td><td>February/21th</td></tr><tr><td>Analyze:</td><td>March/6th</td><td>March/13th</td></tr><tr><td>Improve:</td><td>March/27th</td><td>April/17th</td></tr><tr><td>Control:</td><td>April/24th</td><td>May/8th</td></tr></table>	Phase	Planned Completion Date	Actual	Define:	January/24th	January/31th	Measure:	February/14th	February/21th	Analyze:	March/6th	March/13th	Improve:	March/27th	April/17th	Control:	April/24th	May/8th														
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Scope - First/Last and In/Out	Team Members																																
<table><tr><td><u>1st Process Step</u></td><td>Patient arrived at the clinic</td></tr><tr><td><u>Last Process Step</u></td><td>Patient checked-in</td></tr></table>	<u>1st Process Step</u>	Patient arrived at the clinic	<u>Last Process Step</u>	Patient checked-in	<table><tr><th>Position</th><th>Person</th><th>Title</th><th>% of Time</th></tr><tr><td>Team Lead</td><td>Shaima</td><td>Black belt candidate</td><td>30%</td></tr><tr><td>Sponsor</td><td>Mariam</td><td>Medical Director</td><td>20%</td></tr><tr><td>Team Member</td><td>Aisha</td><td>Staff manager</td><td>15%</td></tr><tr><td>Team Member</td><td>Rashed</td><td>Staff supervisor</td><td>15%</td></tr><tr><td>Team Member</td><td>Fatima</td><td>Receptionist</td><td>10%</td></tr><tr><td>Team Member</td><td>Nouf</td><td>Receptionist</td><td>10%</td></tr></table>	Position	Person	Title	% of Time	Team Lead	Shaima	Black belt candidate	30%	Sponsor	Mariam	Medical Director	20%	Team Member	Aisha	Staff manager	15%	Team Member	Rashed	Staff supervisor	15%	Team Member	Fatima	Receptionist	10%	Team Member	Nouf	Receptionist	10%
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<p><u>In Scope:</u> Staff competency,registration process, allocation of staff staff resources</p> <p><u>Out of Scope:</u> Additional hiring, system update</p>																																	

Table 1: Project Charter

In this phase, the problem is identified, and the customer requirement addressed with the primary goal required to be achieved by using the project charter (Table 1). Besides, the benefits of having this improvement addressed with the timeline and team members needed. Understanding the process is highly crucial in order to have any improvement activity or process management. SIPOC (Supplier-Input-Process-Output-Customer) helps in understanding the process in a structured way (Table 2).

Measure Phase

and some patients are not recommending this hospital to others (Figure 3). Furthermore, the registration process defined, and a flowchart developed that helps to understand the steps they experience since the patient arrived until registration (Figure 4). The value-added steps in the process are patient arrived and registration of the patient. While the value-enabled steps which are done for the value added to complete and is four steps: provide original EID, patient fill consent form, send a copy of EID and check insurance.

On the other hand, the non-value-added steps determined: print copy of EID, GSO fill consent form, fill patient file manually, and scan EID and consent form. A value cycle time analysis of the registration process flowchart constructed in order to measure the time spent in each step. It shows that the value-added time takes 1 minute, while the value-enabled take 7 minutes, and the non-value-added takes 7 minutes also, which leads to 15 minutes of total registration process time (Table 3).

Figure 2: Patient Insurance

Figure 3: Appointment taken, the Patient Came to the Appointment in, the Patient Recommendation of the Hospital and Patient Usually Come

Figure 4: Registration Process Flow Chart

Analyze phase

Fishbone diagram constructed with the lengthy registration process as the fish head. Five primary causes determined: man, machine, material, method, environment. Under the primary causes, several secondary causes determined. The controllable causes then separated from un-controllable causes in order to understand what can be improved. Fifteen secondary causes determined, eight of them related directly to the process, and they are:

- Checking insurance eligibility in same appointment time
- Manually filling information by GSO
- Scanning consent and EID
- Improper distribution of scanner
- Improper consent forms location

- Lack of training
- Non-availability of the consent form
- Incomplete information in the consent form

Moreover, three of them indirectly related to the process, which are:

- Scanner defect
- PC shut down
- EID reader not working

The other four are uncontrollable and occurred by chance:

- Crowding of patient
- Patient coming late
- Lack of positive attitude
- Non- availability of EID with patient

Figure 5 displays the findings using the Ishikawa diagram. The root causes with the highest contributions to the problem are circled with red.

Two Pareto charts constructed, the first one with the controllable causes to identify the root causes of the lengthy registration process (Figure 6). The historical data provided by the managers and observations of the process helped determined the frequency of occurrence of each cause. The main issues contributing to the problem were five, and they are as follow:

- Checking insurance eligibility in same appointment time
- Manually filling information by GSO
- Improper consent forms location
- Incomplete information in the consent form
- Non-availability of a consent form

The second Pareto chart constructed to determine the most frequently information the patient missed in the consent form. Actual observation of the consent form information missed determined the most frequently missed information, which was the patient's signature and the address (Figure 7).

VALUE	Process Step	1	2	3	4	5	6	7	8	9	10	Total	% Total
	Value - Added	Patient Arrived									Register patient	2	20%
	Value - Enabled		Provide original EID	Patient fill consent form	Send copy of EID			Check insurance				4	40%
	Non-Value Added					Print copy of EID	GSO fill consent form		Fill patient file manually	Scan EID and consent		4	40%
	Total											10	

TIME	Process Step	1	2	3	4	5	6	7	8	9	10	Total	% Total
	Work Time	0	1	3								4	27%
	Wait Time				1	2	1	2	2	2	1	11	73%
	Total Time	0	1	3	1	2	1	2	2	2	1	15	

Table 3: Value Cycle Time Analysis of Registration Process Flowchart

Figure 5: Fishbone Diagram

Figure 6: Pareto chart of Controllable Causes.

Figure 7: Pareto chart of Most Missed Information in the Consent Form

Improve phase

A risk assessment matrix constructed in order to identify the probability of the issue happened and the severity level of each of them, which helps in deciding the most important areas for improvement. Table 4 explained in detail the likelihood and severity of the occurrence of each issue. Also, the 5s lean approach used to improve the improper location of the consent form to reduce the waste of motion of staff during the registration process (Figure 8). Other lean approaches used to improve some issues as Kanban system, TPM, Poka-yoke, standardization, and elimination of wastes. The solutions explained in detail in table 5 below.

Table 4: Risk Assessment Matrix

	SEVERITY			
	ACCEPTABLE LITTLE TO NO EFFECT ON EVENT	TOLERABLE EFFECTS ARE FELT, BUT NOT CRITICAL TO OUTCOME	UNDESIRABLE SERIOUS IMPACT TO THE COURSE OF ACTION AND OUTCOME	INTOLERABLE COULD RESULT IN DISASTER
LIKELIHOOD				
IMPROBABLE RISK IS UNLIKELY TO OCCUR	LOW Scanner defect	MEDIUM Improper distribution of scanner	MEDIUM Lack of training	HIGH Non-availability of EID with patient
POSSIBLE RISK WILL LIKELY OCCUR	LOW Pc shut down	MEDIUM Patient coming late	HIGH Incomplete information in consent form	EXTREME Manually filling information by GSO
PROBABLE RISK WILL OCCUR	MEDIUM Scan EID and consent form	HIGH Non-availability of consent form	HIGH Improper consent forms location	EXTREME Checking insurance eligibility in same appointment time

1. Sort

Separate needed papers in the disk from unneeded and removed the unneeded

2. Set in order

Keep required papers and consent form in a defined place for each paper needed beside each reception disk

3. Shine

Clean the reception disk from any dust

4. Standardize

Ensure all staff train on paper places, use visual management and labels to determine consent places

5. Sustain

Measure and monitor progress, and train new staff on it

Figure 8: 5s Approach**Table 5: Identified Problems and Solution**

Problem	Suggested solution
Checking insurance in the same appointment time	Checking insurance eligibility done one day before the appointment in the same confirmation phone call of the patient. To eliminate the step of checking insurance in the same appointment time, so the error is proofed (poka-yoke).
Filling information manually during registration process	In the same confirmation call, the new file opened, and the information filled manually and eliminated the waste of waiting.
Run out of consent forms	Kanban system used by having unique consent forms trays that allow visual observation of the amount remaining and standardize the loading of the consent forms once they reach a

	certain amount to avoid a sudden run out of it.
Consent information not complete	Rearrange the information required to be filled in the consent form so that the signature and address area are placed near the other information and well defined (mistake-proof).
Lack of training	A training workshop for new staff provided for three days, which simulates the registration process with the same program in the PC and EID reader and time measuring of registration process steps until the target time of registration process reached by the staff before assigning them in the reception area.
GSO fill information and sign consent form/Scan EID and Consent form	Eliminate the waste of over processing by informing GSOs to postpone these two steps in the registration process after registering the patient and reduce the waiting time of patient and waste of over-processing.

Control Phase

The new registration process flowchart showed in figure 9. The process steps reduced by removing the steps required to reduce the registration time. Also, a monitoring plan map constructed (Table 6) to measure and control the process steps by measuring the time taken in three essential process steps and the total registration time, which should be five minutes only. Taking the EID or sending a copy of it takes one minute, two minutes in filling the consent form, one minute to insert the EID or printing copy of it, and one minute to register the patient. This monitoring will help to measure and control the improvement achieved by using lean six sigma tools and approaches.

Figure 9: Improved Registration Process Flow

Table 6: Monitoring Plan for Registration Process

DISCUSSIONS

The research outcomes indicate that Lean and Six Sigma approach has significance and direct influence in the service quality of the dental department. This improvement of the registration process of the new patient in the dental department decreased the waiting time of the patient and enhanced the satisfaction rate. Also, it helps in fully utilizing the dentist by seeing the patients in their exact appointment time, which on the other hand, will increase the number of patients seeing and the hospital profit in the long run. (Kumar & Steinebach, 2008). Besides, applying LSS in the hospital help improving the service quality, which is agreed by (Nayar et al. 2016). Also, the overall performance quality of the hospital improved by using this approach, which founded in the research done by (Selim et al. 2018). The define phase of DMAIC help identifies the problem, which is a long registration time of new patient compared to follow-up patient who has files on the system. The registration time of the follow-up patient required 2 minutes, while the registration of new patient required 15 mints which indicate a considerable difference. The result of the survey showed that most of the patients are coming on their exact appointment time, and with this long registration process, the patient will not see the doctor in the same appointment time, and that will affect his treatment options. It may cause a delay in seeing the next patient appointment. On the other hand, the survey revealed that some of the patients are coming as a walk-in. Moreover, with the lengthy registration process, the clinic would not be able to treat them all, which affects the satisfaction rate and the overall profit of the hospital. The goal was to reduce the time of registration from 15 mints to 5 mints after taking the patient opinion of the acceptable waiting time by the survey done. 31.4% of patients wait for more than ten mints to be registered, and 45.7% of the patient accept to have 5-10 mint waiting time for registration. With the measure phase, the registration process identified first to check each step the patient must go through during the registration. The value-added and non-value-added steps identified, and the time taken in each of them measured. Also, the non-value-added steps eliminated, which removed the wastes of the process and helped in standardizing the process. A study done by (Alsulami et al. 2012) indicates the same result. One of the most crucial non-value-added steps in the process is checking the insurance eligibility of the patient in the same appointment visit, which causes a massive waste

of waiting if there are some issues in the insurance of the patient. Given that all patients coming to this dental department are covered by insurance, this step should be improved. The Ishikawa diagram used to identify the root causes of the lengthy registration process in order to eliminate them. (Gavriloff et al. 2017) had that finding also. The controllable causes that happened in the process identified, which then analyzed in the Pareto chart to give the most frequently happened, and by eliminating them, 80% of the problem improved. Actual observation of the controllable causes and the patient consent form helps in identifying the frequency of occurrence. In this way, we use the data to improve the registration process, as seen in (Walters & Barneva, 2017). In this study, the combination of Six Sigma tools and lean approach showed significant improvement in the registration process, as shown in (Honda et al. 2018). The risk assessment matrix help determine the most likely occur issues and their effects on the registration process. From that assessment, the improvement focused on the issues that are extremely harming the hospital and affecting its strategy. So that the operational level of the hospital linked to the strategic level which founded in (Selim et al. 2018) research results. A simple solution used by applying the 5S approach to improve the improper location of the consent forms due to un-necessary papers on the reception disk and non-standardized location of the consent form, which approved the finding of the study done by (Gijo et al. 2013). Using this lean approach also eliminates waste of motion of the receptionist to find the consent form. Other lean approaches and Six Sigma tools used to improve the remaining issues by eliminating the wastes and the root causes and stabilize the process with less effort and resources from the hospital to gain improvement. A study (Bhat et al. 2014) confirmed that. The errors in checking the insurance in the same appointment time and the missed information in the consent form improved by used the poka-yoke approach. Also, the Kanban system used as visual management for the run out of the consent forms. Besides, to eliminate the waste of over processing in opening a new file and filing the information manually during registration process standardization of the process done to avoid it by opening the file before the appointment time. Furthermore, according to the risk assessment, the lack of training causing an undesirable effect in the registration process if it happened and to improve it poka-yoke approach applied by conducting training for all employees before assigning them in the registration disk. Filling the consent form and sign it by GSO and scanning the EID and the consent done after registering the patient to eliminate the waste. This step is essential as the patients are usually having their appointment in the afternoon, as found from the survey, which leads to crowding of the registration area. LSS methodology helped the receptionist improve their work by showing them the best way to do it, as shown in (Laureani et al. 2013) study. After reducing the registration process time to 5 mints and standardize it, The process is maintained and measured continuously in order to sustain the improvement. (Al-Zain et al. 2019). The process is measured in three crucial steps of the registration and the full registration time recorded. Moreover, that will improve the result founded from the survey of having some patients not recommend this hospital to others. The improvement developed by using LSS methodology will continue in the hospital by maintaining them continually as in (Miller & Chalapati, 2015) results.

CONCLUSIONS

This research aims to address the long registration time of new patients in the dental department comparing to the registration time of follow up patient, using Lean Six Sigma methodology. A review of literature related to that issue discussed, and the DMAIC process used to improve the process. A survey conducted to collect the data required and observation of the registration process, and the consent forms recorded the other data. The result o the survey showed that more than 30% of the patient waited more than ten mints to be registered. Furthermore, more than 40% indicated that adequate registration time is 5-10 mints. Statistical tools and lean approaches used to define the problem, measure, analyze, improve, and control the process. Besides, the results discussed and related to the literature review. As a result of this study, the registration time was

15 mints, and after the improvement, it reduced to 5 mints. The application of the Six Sigma tools help to reduce the variation of the process, and the Lean approach removed the waste. DMAIC and LSS methodology promotes a systematic approach toward solving problems. This result encouraged the management to implement LSS for all quality improvement projects in the organization.

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