Improvement of the Emergency service of an Ecuadorian children's hospital through Lean Six Sigma

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Abstract

During the last decade, Lean Six Sigma (LSS) in healthcare organizations has increased; however, most cases are registered in developing countries. We aim to show a detailed implementation of Lean Six Sigma in the Emergency Department of an Ecuadorian Children's Hospital to evaluate the applicability of LSS in a South American country and identify barriers, success factors, and tools applied. Following the Define-Measure-Analyze-Improve-Control (DMAIC) methodology, the waiting time in front of the register and treatment section decreased by 79.5% and 53.2%. The total service time was reduced by 55.6%, and the total waiting time decreased by 57%. An external team of experts led the implementation, which resulted in one of the critical success factors. Together with the leadership of the Hospital Director, it helped to reduce the most common barriers found in developing countries, such as lack of training, resistance among the staff, and lack of available data.

Keywords
Lean, Six Sigma, Emergency Department, Healthcare, South America

1. Introduction

Applying Lean or Six Sigma methodologies is traditionally associated with manufacturing environments. Since the beginning of Six Sigma in Motorola in 1987, the methodology has been used in organizations of manufacturing industries like General Electric, 3M, DuPont, and Ford. Similarly, Lean originated in an automotive company, a relevant manufacturing sector. The term Lean initially used by Krafcik (1988) in an academic publication, is based on the Toyota Production System (TPS) developed in the mid-fifties in Japan (Monden, 2011).

During the first years of the new millennium, some companies merged Lean and Six Sigma into a unique methodology. Lean Six Sigma (LSS) combines the strengths and compensates for each methodology's weakness when applied independently. For instance, LSS benefits from the Lean methodology's focus on improving the flow and reducing lead time by removing all types of waste from the process (Assarlind et al., 2013). Another advantage of combining both methods is taking the Six Sigma well-established approach composed of powerful statistical tools to reduce variation (Costa et al., 2018) (Henrique and Godinho Filho, 2020).

Despite the origin of both methodologies in manufacturing, most of the articles of LSS are from non-manufacturing applications. According to Singh and Rathi (2021), in a literature review of LSS in service applications developed between 2005 and 2021, 60% of publications aim at service organizations within the financial, education, or healthcare sectors (Lu et al., 2017) (Pazeti and Calache,2017) (Vashishth et al., 2019) (Cudney et al., 2020) (Madhani, 2021). In the case of the healthcare sector, the LSS articles were scarce until 2004, when several publications showed the effectiveness of LSS in improving operational efficiency, minimizing defects, reducing cycle times, and increasing patient satisfaction (Mason et al.,2015) (Honda et al., 2018) (Godley and Jenkins, 2019) (Henrique and Godinho Filho, 2020) (Trakulsunti et al., 2020).

Like the Lean and Six Sigma methodologies applications, most of the initially published case studies of LSS in healthcare appear in developed countries. According to Rathi et al. (2021), since 2014, the aim of the articles presenting LSS healthcare applications has shifted to developing countries. These publications are focused on India,

representing 73% of LSS publications in developing countries, such as the work presented by Bhat et al. (2019), Bhat et al. (2022), or Swarnakar et al. (2022). The rest of the publications include other nations such as Brazil, Iran, and Thailand, with cases like the presented by Walter and Paladine (2019), Mosadeghrad et al. (2019), and Trakulsunti et al. (2022). There is a lack of publications in Latin American countries, except Brazil and Mexico, representing 9% of publications in developing countries until 2021. These results match those presented by Peimbert-Garcia et al. (2020), who prepared a literature review of LSS applications in healthcare until 2018. These authors report that 81% of LSS healthcare publications come from developed countries, and in Latin America, just Brazil and Colombia reported LSS-related papers.

According to our literature review, there is a lack of academic literature presenting LSS applications in Spanish-speaker countries in South America, particularly in the ones with the lowest overall health performance, according to the World Health Organization (WHO, 2000). This result gives an evident research opportunity to study the applicability of LSS in a country within this geographical location. This study aims to evaluate the relevance of LSS methodology in an Ecuadorian Pediatric hospital, part of the most important non-profit organization in the country. This article aims to assess if it is possible to implement LSS in a South American country by identifying the results, barriers, success factors, and tools applied during the LSS implementation in an Ecuadorian Pediatric Hospital. Although presenting one single case study is the main limitation of this research work since the results cannot be generalized, the results can be taken as a starting point to replicate the methodology in similar contexts.

2. Literature Review

According to De Koning et al. (2006), combining Lean and Six Sigma methodologies is suitable and beneficial for healthcare organizations. These authors consider that the intuition of both methodologies makes them easily adaptable to the healthcare staff. Additionally, the focus of Lean on eliminating every type of waste is under the hospitals' recurrent efforts to minimize waste sources (Henrique and Godinho Filho, 2020). Similarly, Mason et al. (2015) present 124 relevant studies showing benefits obtained in healthcare environments through applying Lean and Six Sigma methodologies.

Despite the positive results of applying Lean Six Sigma in healthcare environments in developing countries, the lack of publications on LSS applications in South America is evident. The few publications are focused on Brazil and Mexico. For instance, García-Porres et al. (2008) apply Lean Six Sigma tools to improve the quality of service in an imaging department of the National Institute of Respiratory Diseases in Mexico City. In Brazil, Hors et al. (2012) present the application of LSS methodology to improve the management of scientific research in a Brazilian general hospital. Silva et al. (2012) submitted the application of LSS methodology in a hospital located in Sao Paulo to improve the inventory process control of critical medical equipment. The implementations show a quality service metric passing from 62.6% to 99.4%. In another project in Brazil, Pazeti and Calache (2017) developed a project with the department of medicine dispensation in a public hospital in Sao Paulo through Lean and Six Sigma tools.

Similarly, in the National Rehabilitation Institute (INR) of a Mexican public hospital, Yañez-Brand, et al. (2020) apply LSS to analyze and identify the leading causes that produce failures in Medical Devices (MDs) during surgery. Finally, Peimbert-Garcia et al. (2021) present a Lean implementation in a Mexican public medical center to reduce the discharge time of patients from the Internal Medicine Department. Authors like Peimbert-Garcia et al. (2019) and Juliani and de Oliveira (2020) developed studies to evaluate the state of LSS applications in different hospitals in Mexico and Brazil, respectively.

The literature review presents that LSS has assisted healthcare organizations in adopting process improvement methods delivering superior results to unstructured process improvement projects even with scarce resources, as in developing countries. However, there is very little research carried out on the use of LSS in South American countries. To our knowledge, there has not been registered literature on LSS application cases in South American countries except Brazil. The present study aims to close this research gap by presenting the application of LSS methodology considering the contextual conditions of an Ecuadorian Pediatric Hospital.

3. Methods

Our study is based on Empirical Research, as described by Flynn et al. (1990). Following the guidelines by Yin (2009), we selected a Single Case Study as our research design since we want to respond to a "how" research

question, have little control over the events, and want to focus on the implementation of LSS in a real-life context which is a South-American Hospital.

We follow the DMAIC framework, allowing our case study a formal and explicit procedure. For the data collection, we use participant observation as Flynn et al. (1990) described. To have a solid evaluation of the impact, the team collected data before and after the implementation. Section 4 shows the detail of the implementation and data collection.

For the design and execution of the LSS implementation, we formed a team with people from outside the organization. One of the team members was a college professor and Master Black Belt certified. The other two members were senior students from an Industrial Engineering local program, with formal training on LSS, continuous improvement tools, and statistical analysis. Inside the organization, the general manager led the initiative. He was involved in the meetings and allowed to have the LSS training for the nurses and administrative staff during working hours. This policy showed the team that continuous improvement is part of their job. The project team within the organization was composed of the chief of the Emergency department (ED), two doctors, and three workers from administrative areas such as admission and the payment area. The two senior students were also part of the project team and were in charge of the implementation.

4. LSS implementation and Data Collection

The hospital under study is a private small Ecuadorian Children's Hospital with 160 beds, a member of one of the essential charitable foundations in the country. The hospital offers clinical specialties such as general medical, surgical, cardiology, and gastroenterology.

4.1 Define

The Define phase aims to establish the problem statement and the baseline of the response variable of the project. During this phase, we also defined the scope and the project team.

The emergency department at the Children's Hospital faced an increment in the number of patients with a high length of stay waiting for attention in the emergency room. Through surveys developed to the patients, the voice of the customer (VOC) showed that the patient lead time in the Emergency Department (ED) was considered excessive. This increment resulted in a significant diminution of patient satisfaction and increment in the cases of patients leaving the hospital without ED attention. The historical data collected during one month showed that the average patient lead time was 367 min. According to Figure 1, 84% of the patient lead time was linked to non-value-added activities and waiting time.

The project's scope comprised all the activities included in the patient lead time, from the Triage section until the release to the Treatment section. It also contained laboratory exams and image processing time in the Radiology area.

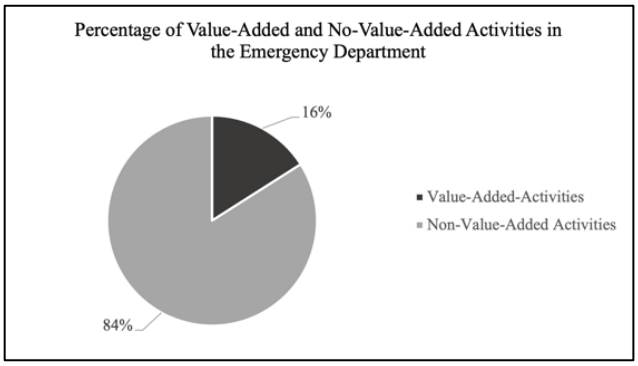

Figure 1. Percentage of value-added and non-value-added activities in the Emergency Department

4.2 Measure

The Measure phase aims to clarify the problem by collecting data to determine the primary issues. The data collection plan identifies the activities in the ED value stream that present the most critical obstacles in the flow of patients. With data collected during a month, the team developed a Value Stream Mapping (VSM) to identify the essential wastes and obstacles in the flow of patients. The VSM's current state presented in Figure 2 shows the highest queue times in the waiting zones of the register area and the treatment areas' waiting zones.

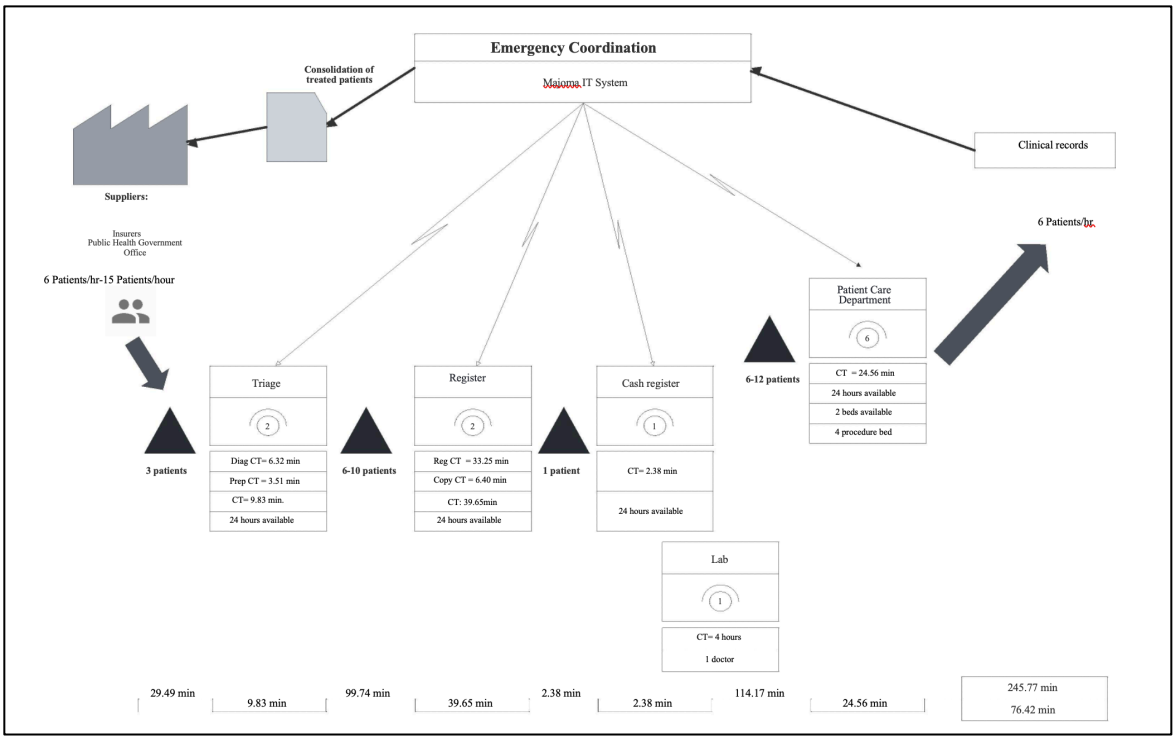

Figure 2. Value Stream Mapping Current State

The team members registered two or three people working the day shift at the Register area and one for the night shift. The average registration time was 39.65 min. The registration process includes several activities such as checking ID patient information, registering patients' entrances, and filling out forms required by the government agencies. Additionally, this area manages other activities such as hospitalization admissions, discharge processes, patient transferases between locations and other hospitals, and cancellations.

The treatment area is composed of two doctor offices and one common place for medical procedures with a capacity of four patients. In total, six patients can be treated simultaneously in the ED. The arrival rate of patients is between 6 and 15 patients per hour; the treatment areas offer an average service rate of 7 patients per hour. The difference between the arrival and attention rate explains the high patient waiting time in front of the treatment area during peak periods.

4.3 Analyze

The potential causes were identified, weighed, and evaluated by applying qualitative and quantitative tools to verify their significant association with the excessive waiting time in the Register and Treatment section. Figures 3 and 4 present two Ishikawa diagrams that identify potential causes (Xs) that, according to the project team, were associated with the excessive waiting time in the Register section and the Treatment section.

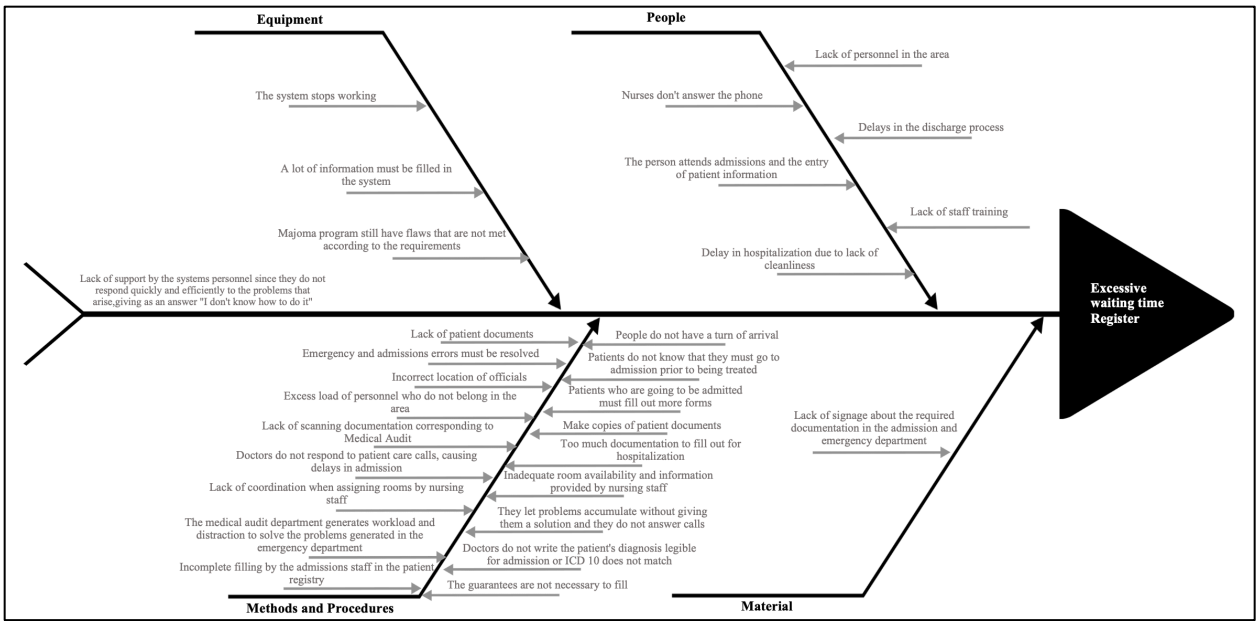

Figure 3. Ishikawa Diagram Register area

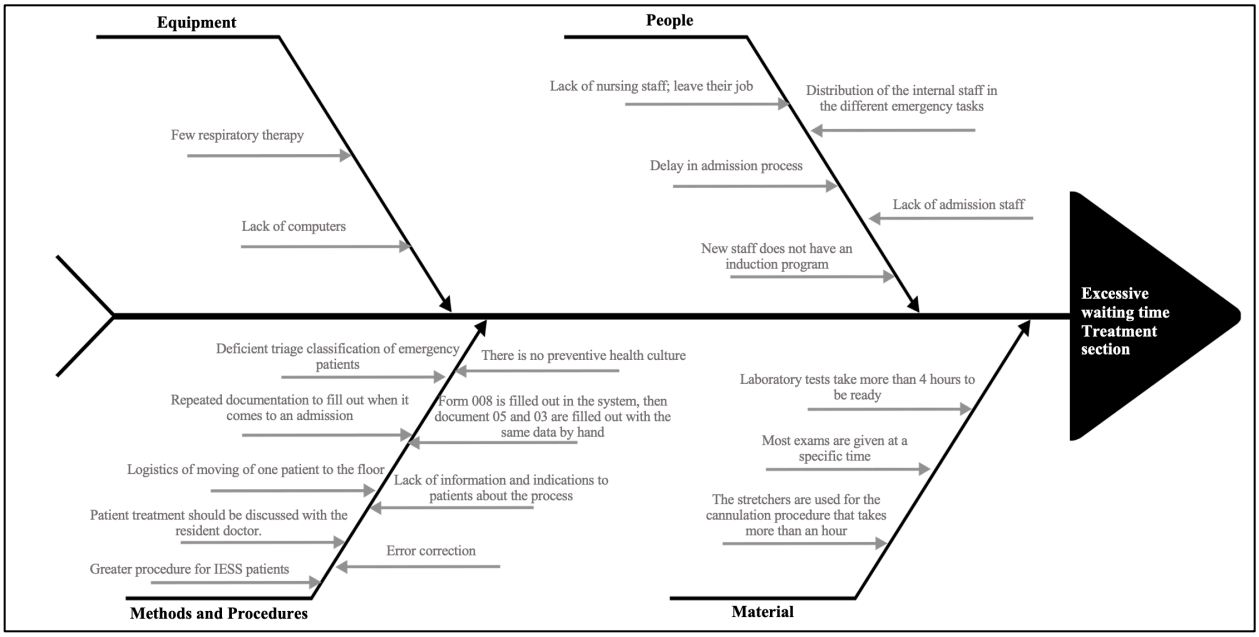

Figure 4. Ishikawa Diagram Treatment section

The potential causes are weighted using a cause-and-effect matrix. In this tool, three experts assigned a priority factor according to their assessment of the relation between the possible cause (Xs) and their waiting time. The experts were selected considering their years of experience in the ED. One doctor, one nurse, and one worker of the administrative staff completed the expert panel. The first column of Tables 1 and Table 2 appear the causes that obtained the highest expert evaluation in the cause-and-effect matrix. Before establishing improvement actions, it is necessary to verify the fundamental causes using data or Gemba observations. In this way, the improvement actions are related to facts and not just based on expert opinions. Table 1 and Table 2 present the verification plans for the two critical areas, including the method for their verification and the result of their application.

Table 1. Verification causes plan of the register area

Critical cause	Theory about the impact of the cause	Verification Process	Status
Bad layout organization.	The wrong arrangement of employees' work stations in the admission area affects people and information flows, incrementing service time.	Visits to the area and photographic records show the absence of a disposition that allows employees to determine the correct sequence of patients.	Significant
Lack of signs and visual information in the ED.	The lack of banners or signs results in confusion among the patients.	There is an evident lack of signs that help patients to find the different medical and administrative areas of the ED.	Significant
Poor training in the hospital IT system.	The lack of training in the Hospital IT system increments the service time.	Capacitation records throughout the year show that all the employees have the necessary skills to use the Hospital IT system.	Non-significant
High utilization of Admissions employees.	The high utilization of Admission employees increments the service time.	Following the Admissions employees' activities, the data collected during one month showed that their average utilization was 68%.	Non-significant
Excessive documentation requested	The policy of asking for a copy of the ID card and other additional documents increments the service time.	49% of patients join the admission queue without a copy of the ID card, affecting their time of attention.	Significant
There is an excessive number of forms required in the admission area.	The disproportionate number of forms increment the time of attention.	According to records, it takes 24.5 minutes to complete the necessary documents to get admission.	Significant
Lack of updated information about the available rooms for hospitalization.	The lack of correct information about the hospitalization room's state increments the time patients stay in the Emergency room.	During one month, it was possible to identify more than one error per shift regarding the current status of the hospitalization rooms.	Significant

Table 2. Verification causes plan of the Treatment section

Critical cause	Theory about the impact of the cause	Verification Process	Status
The nursing staff has a high amount of administrative tasks assigned.	The administrative tasks reduce the available nursing time dedicated to direct patient care.	According to the record of activities, nurses employ 31% of their time filling administrative forms.	Significant
Lack of order in documents and medical suppliers.	The conditions of order in the Emergency rooms provoke an increment in the attention time.	The ED shows the poor condition of the order. According to the record of activities, 26% of the time, the nurses are searching for materials or administrative papers. 11% of the time, the nurses moved out of the ED to collect materials.	Significant
In the attentions forms, the hospital asks for redundant information from the patients.	An essential part of the required forms presents redundant information incrementing the service	According to the record of activities, it takes 15 min. to complete each form manually. And more than 50% of the data is redundant among the required	Significant

	completing documents.	documents.	

4.4 Improve

According to the significant variables found in the Analysis phase, the project team proposed solutions to address their root cause. The proposed solutions for the admission and the attention area are presented in Tables 3 and 4, respectively. These tables include the root cause associated with each verified cause. The root causes resulted from the application of the 5 Whys strategy. According to the effort and impact evaluation, most proposed solutions are categorized as "quick wins" and applied immediately. Other solutions such as scanners or implementing a system to control the preparation of hospitalization rooms are considered "major projects" and appointed to the mid-term future.

Table 3. Proposed solutions in the register area

Verified cause	Root cause	Proposed Solutions	Priority implementation
Bad layout organization	The facility layout does not level the resource capacity to address the volume of work in the registration process of the ED.	Redistribution of the area considering the actual number of employees leveling the resource capacity.	Immediate implementation
		Application of 5S methodology.	Immediate implementation
Lack of signs and visual information in the ED.	No implementation plan to offer visual information in the ED.	Implement signs and banners to provide directions and information for ED registration.	Immediate implementation
Excessive documentation requested	Hospital procedures require an excessive and redundant information	Include scanners as standard equipment in the admission area.	Mid-term future
An excessive number of forms are necessary for the admission area.	Hospital procedures require an excessive and redundant information	Simplification of forms.	Immediate implementation
		Digitalization of admission forms.	Immediate implementation
Lack of updated information about the available rooms for hospitalization.	There is no system to monitor the actual status of the hospitalization rooms.	Implement a system to control the activities and the time to prepare a room after a discharge.	Mid-term future
		Link the information about the status of the hospitalization rooms using a mobile app.	Mid-term future

Table 4. Proposed solution in the Treatment section

PROPOSED SOLUTIONS IN THE TREATMENT AREA			
Verified cause	Root cause	Proposed Solutions	Priority implementation
The nursing staff has a high amount of administrative tasks assigned.	Hospital procedures require an excessive and redundant information	Forms simplification.	Immediate implementation
		Digitalization of attention forms.	Immediate implementation
Lack of order in documents and medical suppliers.	There is no standard for storing suppliers and documents in the ED.	Apply 5S methodology.	Immediate implementation

In the attentions forms, the hospital asks for redundant information from the patients.	Hospital procedures require an excessive and redundant information	Simplification of forms.	Immediate implementation
		Digitalization of attention forms.	Immediate implementation

The following section presents a brief explanation of each implemented solution.

4.4.1 5S Install signs and banners to provide directions

Previous to the redistribution of the area, it was necessary applicate the 5S methodology. The application of this methodology reduced space requirements by eliminating a significant number of materials or archives. Additionally, the team prepares a plan to include signs and banners alongside the emergency value stream.

4.4.2 Redistribution of the register area

The layout of the register area shows how this area shares the same working space with the social work and insurance control areas. Table 5 presents the significant disproportion of the admission area compared to the social work and Insurance revision area. According to the "From to Chart" and "Flow Between Chart," those areas attend a significantly smaller number of patients per day. Additionally, the two registration employees' high utilization level shows the system's unevenness in addressing the high volume of work in the Emergency Department.

Table 5. Patient Flow, space requirements, and utilization in the Register area previous improvements

Register area position	Number of patient flows per day	Servers per sub-area	Average queue length	Minimal required space (m^2)	Actual space (m2)	Sub-area utilization
Register	393	2-3	Six patients	16	12	133%
Social work	20	2	One patient	6	32	19%
Insurance revision area	80	1	One patient	8	12	67%

Considering the results of Table 5, the project team proposed a new distribution of employees. The new layout brings more space to the admission section, dividing the admission activities into two sub-sections. One sub-section is dedicated exclusively to the admissions to the Emergency Department, and the other is in charge of hospitalization admissions. Dividing the register activities into two sub-departments significantly reduces the employees' utilization and balances the resource capacity with the volume of work of the ED. Table 6 shows the results of modifying the layout and redistributing the activities.

Table 6. Patient Flow, space requirements, and utilization in the register area after improvements

Subareas	Number of flows per day	Servers per sub-area	Average queue length	Minimal required space (m^2)	Actual space (m2)	Sub-area utilization
Admission to ED	282	2	Five patients	14	32	50%
Admission to Hospitalization	111	1	One patient	4	6	70%
Social work	20	2	One patient	6	12	50%
Insurance revision area	80	1	One patient	4	6	70%

4.4.3 Forms Simplification and digitalization

Digitalizing the admission and attention forms reduced the time to fill out these documents. The time reduction resulted from using a computer instead of completing them manually and reducing an essential volume of redundant information (approximately 50%) imported directly between different forms. Hypothesis testing using the Wilcoxon test evaluates the difference in the median time for filling one of these forms manually compared to the new digital

format. With a p-value of 0, according to Figure 5, it is possible to conclude the significant reduction in the time required to complete this form.

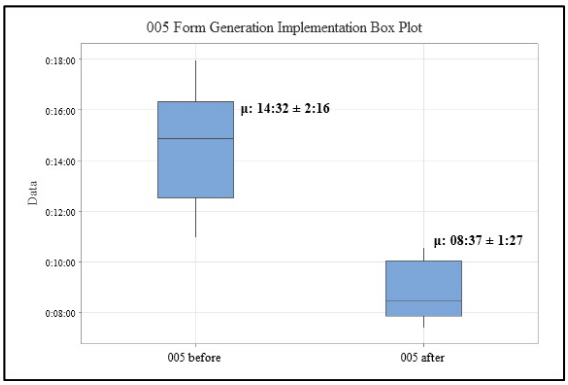

Figure 5. Filling form time before and after form digitalization

5. Control

The Control phase presents the results of admission and attention area improvement results. A new future state VSM is developed and shown in Figure 6. The waiting time in front of the Register and Treatment section resulted in a reduced patient lead time, from 322.19 to 139.51 min.

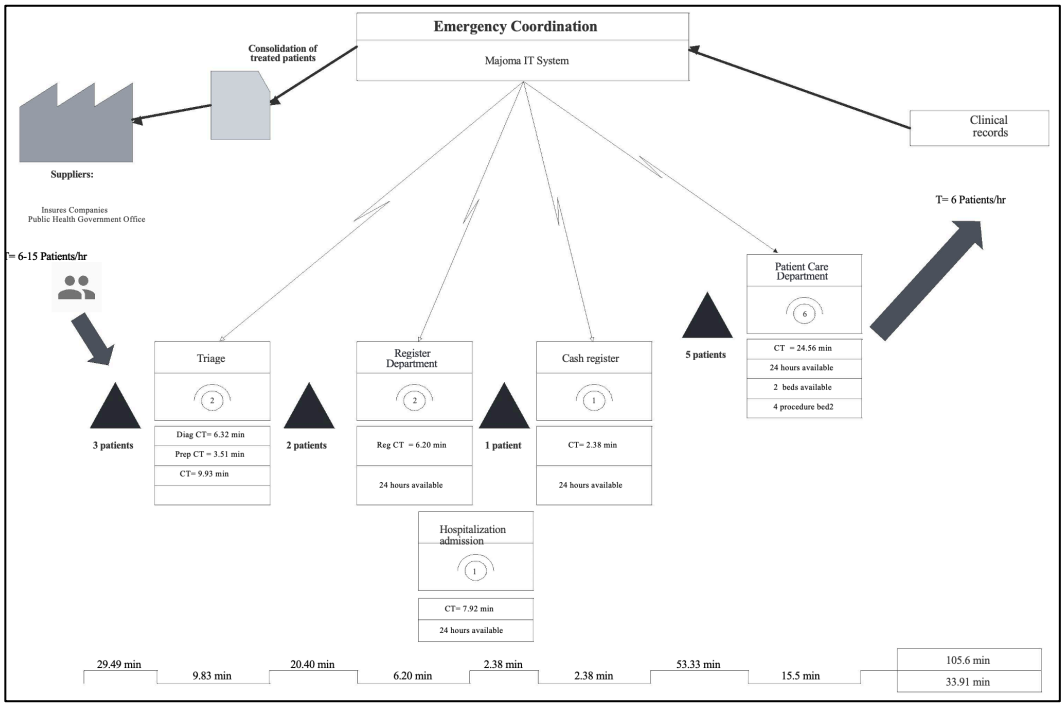

Figure 6. Future State Mapping

According to the future state mapping, a reduction in waiting and process time is evident. The total waiting time went from 245,77 min. to 105,6 min representing a reduction of 57%. The attention time went from 76.42 min. to 33.91 min. The standardization and the order in the areas reduced nurses' time looking for materials or documents.

Additionally, the new layout allows a better sequencing of patients improving the flow and reducing the waiting in the area. The reduction in the waiting time incremented the indicator of patient satisfaction in the surveys. A cost-benefit analysis of the LSS project shows a benefit-cost ratio (BCR) of five, suggesting the project offers a positive net present value for the hospital managers. Among other non-financial results of LSS implementations, we have a better workplace organization that facilitates the searching time of things and a team of people engaged in developing future continuous improvement projects.

6. Results and Discussion

As a result of the LSS implementation in the Emergency Department, the service and waiting times were significantly reduced. Table 7 summarizes the results after the implementation of the improvement actions.

Table 7. Waiting and service times at the Emergency Department

Areas	Before LSS implementation (min)	After LSS implementation (min)	Percentage of reduction
Waiting time in front of the register area	99.74 min.	20.4 min.	79.5%
Waiting time in front of the treatment section	114.17 min.	53.33 min.	53.2%
Register service time	39,65 min.	6.2 min.	84.3%

Henrique (2020) cites the lack of team effort and participation of the hospital board as common barriers to LSS success. In our case, this was handled from the beginning of the project. The Hospital Director, who has proven outstanding leadership for more than five years, was actively involved in the project and allowed to use the regular working hours for training and project execution. As a result, it was possible to create a team effort culture. Also, the staff was involved in the data analysis and improvement proposals, reducing any possible rejection. These results also go accordingly to the finding of Rodrigo E. Peimbert-García (2020)

Among other tools, for the problem definition and analysis of root causes, we proposed using 5 Whys, Gemba walk, and cause-and-effect matrix. And for the proposed solutions, we employed layout re-design and 5S. Henrique (2020) says these elements are the least cited in LSS application cases. Therefore, we use these tools to provide the current literature with a successful case study.

According to the team member interviews, the most important tool was the Value Stream Mapping (VSM), which allowed identifying the waiting time and process delays of each medical and administrative activity during the attention in the Emergency Department. The intuition of this tool facilitates their application even in a medical environment where Lean concepts are not applied. Presenting in a visual record each ED's activity and their elapsed was crucial during the team sessions for proposing potential causes for the excessive waiting times in the value stream.
As a process improvement methodology, we used DMAIC, which is distinctive of Six Sigma. The team members also identified DMAIC as one of the critical success factors for the LSS. The reason is that the structure framework, which is simple and rigorous, is based on the scientific method. Formulating hypotheses and making decisions based on data allow a good understanding of the cause-and-effect relationship.

The work standardization was identified by Henrique (2020) as one of the elements that generate more resistance among the personnel. For our case study, we not only standardized them but also worked on their simplification and digitalization. Therefore, the benefit for the staff was evident, and they were willing to accept the change.

Another relevant factor for success was the external team of experts guiding the implementation, consistent with the results from the literature review by Rodrigo E. Peimbert-García (2020). The LSS methodology requires knowledge of statistical tools and a deep understanding of the DMAIC methodology. Having a Black Belt expert guiding the project and two senior students from an Engineering program was vital for the success of the improvements projects.

One of the common barriers to LSS success is the lack of training Rodrigo E. Peimbert-García (2020). However, for our case study, two factors helped prevent their negative effect: top management being deeply involved in the

continuous improvement culture and having an external team of experts supporting the implementation. The Hospital Director scheduled the training sessions during the working hours, and the experts executed the training program. The staff was trained and learned the basic concepts for LSS and was able to participate in the problem analysis and solution proposal. These two factors strategically introduced the Continuous Improvement culture in the hospital. The success of this first LSS project opened the door for further projects and the creation of a Continuous Improvement Department.

One of the barriers to the LSS implementation was the lack of available data. The two senior Engineering students had to collect the necessary data from overcoming that problem. For the authors, it is evident that external support was critical to the project's success. Given that most South American Hospitals will not have trained personnel to develop an LSS implementation, it is necessary to collaborate with an Academic Institution to have the necessary support.

7. Conclusion

The Lean Six Sigma (LSS) methodology combines the waste reduction focus and intuitive tools from Lean and the structured and data-driven methods, focusing on variation reduction from Six Sigma. Although several study cases show the successful implementation of LSS in healthcare institutions, most are focused on developed countries (Pepper and Spedding, 2010). Therefore, the results cannot be transferred to developing countries where the quality and quantity of the available resources are different.

Our goal is to present the implementation of LSS in the Emergency Department of an Ecuadorian Children's Hospital to identify the barriers, success factors, and tools applied. Although we cannot generalize the results from a single case study, the findings can be used to replicate the methodology in similar contexts.

Using the DMAIC methodology, we identified that the excessive waiting time was the central issue in the department, resulting in a low satisfaction level among the patients. Based on historical data, the average waiting time was 367 min. After implementing the improvement actions, the waiting time before the register and treatment area was reduced by 79.5% and 53.2%. The attention time in the register area was decreased by 84.3%, and the treatment's service time was reduced by 36.9%.

The successful deployment of LSS in a hospital with personal, technological, and financial restrictions provides substantial evidence of its suitability in the context of South American countries. The result of this research presents an excellent opportunity for hospital managers to adopt the LSS methodology in other healthcare units where the excessive waiting time is a recurrent problem affecting the service level of patients. Other opportunities in Ecuadorian hospitals are problems related to excessive hospital discharge time, inefficient cleaning of hospital rooms, or excessive nursing workload resulting from non-appropriate methods for the nurse-patient assignment processes. In any case, this research demonstrates to hospital managers that adopting the LSS methodology can offer value to their organization by improving their operations relatively quickly. We hope that the results of this research allow the involvement and commitment of the stakeholders associated with the improvement process of other South American hospitals.

Commonly found barriers like lack of training, resistance among the staff, and lack of available data were handled by an external team. The external experts led the implementation and involved the hospital staff during each phase. Another critical success factor was the leadership shown by the Hospital Director, who demonstrated his commitment by allowing the working hours for training and discussion sessions.

The team identified two critical tools that should be considered during any implementation. First, the DMAIC methodology provides a structured road map to identify the problems and their root causes. A crucial characteristic of DMAIC is the use of data and statistical analysis to prove the effect of any potential root cause. The second is the Value Stream Mapping, which allows for visually identifying wastes or obstacles in the flow of patients.

As in most LSS implementation cases, the improvement continuity could be the implementation's weakest point. Given that an external team of experts led the implementation, the maintenance of the program can be in danger. However, this was the first improvement project of a more extensive Hospital Excellence Program. Instead of seeing

the external intervention as a weak point, it can be seen as a strategy to demonstrate the positive impact of creating a Continuous Improvement Culture and encourage a Continuous Improvement Department inside the hospital.

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