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ORIGINAL ARTICLE

THE LEAN METHODOLOGY IMPACT ON THE PATIENTS PERMANENCE IN AN EMERGENCY CARE

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ABSTRACT
Objective: To identify the average length of patients' stay before and after the Lean methodology application in a Teaching Hospital's Emergency Room. Method: cross-sectional, retrospective, documentary, quantitative study. The data was collected in December 2019 via the TASY system. The list of patients admitted to the emergency room, from November 2018 to November 2019, in Western Paraná – Brazil, was obtained. A descriptive statistical analysis was carried out, and the Statistica 7.0 program was used, with Levene and Scheff tests. Results: there was an increase of 61% in the number of hospitalizations, a 30% reduction in the stay, and 26% of the maximum stay recorded. However, there was no significant difference in the period before and after Lean in the stay length. Conclusion: it was evident that Lean can potentially collaborate in improving the patients' flow, increasing the visits, and reducing the stay period in the unit.

DESCRIPTORS: Health Management; Health services; Beds; Hospitalization time; Emergency Assistance.

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INTRODUCTION

Health care providers, particularly hospitals, have a disproportionately high cost of services offered, disproportionately compared to other products and services, with ongoing changes to improve care, reduce waiting for time, costs, and errors [1].

In health services, the aspects valued by patients are safe, fast, qualified, and resolute care, according to their needs, and with full recovery of their well-being. The improvement of care provided in healthcare environments has been taking place since the beginning of medical-hospital care to improve the effectiveness of actions and offer quality support to users of these services [2]. Due to the need for more effective management of resources, some methods and tools commonly adopted in manufacturing were adapted for the healthcare system, including Lean production (PE), which is recognized by the term Lean Healthcare [3], with the first publications in 2002 [1].

The Lean methodology is derived from the Toyota Production System to identify waste relevant to production and disposal, enabling a reduction in Lead Time (processing time) and flexibility to meet market volatility [4]. Although the origin of Lean thinking is the industrial context, its principles are used in various scenarios. This universal applicability is due to the similarity of the production processes of organizations that seek to plan and execute a set of actions in the right sequence and time to create value for a customer [2].

From this perspective, Lean is constantly growing within health institutions, as intrinsic aspects such as the empowerment of the team and the concept of continuous improvement provide better adaptation for the health area [1]. The method, characterized by the continuous improvement concept, aims to eliminate waste through the involvement and participation of professionals, achieving quality and safety, reducing costs and time for processes such as patient triage, case analysis, and referrals [4].

The Lean production concepts application in health services is more representative in the urgency and emergency sectors, considered inefficient, which need to solve problems such as overcrowding, delays, low quality of care, among others [3]. The overload involving the emergency services is a reality worldwide, represented by the total occupation of beds, patients accommodated in inappropriate places, long time for care. These items suggest the inefficiency of the system, leading to low quality of service [5].

Another factor that influences the burden of urgent and emergency services is the population's view. For them, this service is the alternative to solve many health problems. This mistaken idea can lead to overcrowding, difficulties in care, including a significant burden on the financing of health services [6].

A study carried out in an Australian hospital report that the Lean process application initiated in the emergency service increased in patients who remain in the emergency department for just one day, from 40% to 80%, an increase in emergency room visits and a reduction in dropouts due to delays [3]. Another study, which evaluated the Lean implementation concepts in five sectors of two Brazilian hospitals, observed improvements in financial aspects, productivity, sector capacity, and a reduction in Lead Time [1].

Therefore, in health institutions, there is an awareness of the importance of using performance indicators, which will measure the efficiency and effectiveness of management, the allocation of resources, improving their internal processes [7]. The indicator is characterized as a quantitative measure, a reference for monitoring and evaluating the quality of care provided to the end-user, including the activities carried out by the services[8]. For the measurement of productivity in bed management, it is an international reality. Among those used, the average length of stay is included, influencing the productivity of services[9].

According to the activities developed in the Residency Program in Nursing

Management in Medical and Surgical Clinic in the Emergency Room, it was observed that the nurse and the nursing resident have a primordial role in the management of beds, coordinating the flow of patients from admission to the time of transfer to unit. While patients remained in the Emergency Room, the long period of stay contributed to overcrowding. Thus, after the Lean methodology implementation, the question was: what was the impact on the patient's stay length in the Emergency Room? Therefore, this study aims to identify the average length of stay of patients before and after the Lean methodology application in an Emergency Room of a Teaching Hospital.

METHOD

This is a cross-sectional, retrospective, documentary study with a quantitative approach.

The hospital understudy has 238 beds for the care of patients in the Unified Health System (SUS), being recognized as a reference for 25 municipalities belonging to the 10th Regional Health Center and four other Health Regions Centre in the Paraná state. It is intended for high-complexity care in trauma-orthopedics, vascular surgery and procedures in interventional cardiology, vascular surgery, high-complexity cardiovascular, and high-complexity in neurology/neurosurgery [10].

The Emergency Room currently has five rooms, one exclusively pediatric, used as a male or female room, a room for procedures, and a capacity for 18 patients. There are three offices (Orthopedics, Pediatrics, and General Practice) for the first appointments. It includes the five-bed emergency room designed for critically ill patients in need of semi-critical and/or intensive care.

The Lean methodology implementation in the hospital took place through the Project "Lean in Emergencies: reduction of hospital overcrowding," via the Ministry of Health, developed through the SUS Institutional Development Support Program – Proadi-SUS, executed in partnership with the Sírio-Libanês Hospital [11].

In November 2018, training was started with servers at the Teaching Hospital on the Lean methodology and tools that would be used, such as Value stream map; Spaghetti Diagram; Ishikawa diagram; 5S; among others [10]. Then, between January and February 2019, the Lean implementation began, with the guidance of two consultants from Sírio-Libanês Hospital, who carried out monthly visits in the first stage of the project.

With the growing need to improve the flow of patients internally, senior hospital management, with the help of the Lean Project in Emergencies, opted for the creation of the Internal Regulation Nucleus (IRN) in February 2019, whose initial structure was composed of a nurse, a doctor, and two administrative techniques.

It is worth highlighting the National Policy on Hospital Care (PNHOSP), established by Ordinance No. 2, of September 28, 2017, which defines and recommends the IRN creation. This body monitors the patient from his/her entry into the institution, during the hospitalization process, and during his/her internal and external movement until the moment of hospital discharge. The composition should be carried out according to the complexity and size of the installed capacity, adapting to the reality of each institution [12].

At the Teaching Hospital, the Lean methodology initially sought to manage the flow of patients in the Emergency Room ward. The interventions were aimed at patients who were referred to the Medical and Surgical Clinic (F2), Neurology and Orthopedics (G3), and Emergency Orthopedics (G2) units, representing a greater number of patients who remained in the Emergency Room.

The data for the study were acquired in December 2019 from the IRN, which provided a report via the TASY system (hospital management software) containing patients who remained hospitalized, from November 2018 to November 2019, in the Emergency Room. Next, the following inclusion criteria for the study were listed: admissions exclusively to the Emergency Room ward. And as an exclusion criterion: admissions that did not go through the Emergency Room ward, including those in the emergency room.

Attempting to reduce the chance of bias in using the TASY system, a manual search was carried out for the transfer time of patients through the evolution of health professionals registered in the TASY. These evolutions collaborate with care statistics and provide legal support for the professional regarding the activities carried out on behalf of the patient. To check the stay length, the LOS (length of stay) indicator was used, defined in the literature as the average time in minutes between check-in and the patient's departure from the Emergency Room [13].

The data analysis was quantitative, using descriptive statistics, with the presentation of whole numbers and percentages, calculating the relative and absolute frequency, standard deviation, and confidence interval. Data were organized with Excel and analyzed with the Statistica 7.0 program, using two tests, namely: Levene's test to assess the homogeneity of the groups, hence, the presentation of the p-value; and the Scheff test to compare the means of each treatment or group.

This study is part of a broader research project, which involves the Construction of Care and Management Indicators of the Nursing Service at the University Hospital of the West of Paraná - HUOP, approved by the Ethics Committee for Research Involving Human Beings, as per opinion number 3,323,244/2019, respecting the guidelines of Resolution 466 of 2012 [14].

RESULTS

The processed values totaled 3765 admissions during the study period, and after applying the exclusion criteria, 255 admissions were disqualified, resulting in 3510 eligible admissions. A p-value of 0.000291 was presented for this study, indicating significance. The other variables are shown in Table 1.

Table 1 - Distribution of stay length of patients admitted to the Emergency Room of a Teaching Hospital, from November 2018 to November 2019. Cascavel, PR, Brazil, 2019 (continues)

Month/ year	Admissions (n=3510)	LOS* - minutes (Average)	Standard deviation	Confidence interval +95%	Confidence interval -95%	Maximum permanence - minutes
Nov/18	187	1158,802**	1523,646	938,993	1378,612	8876***
Dec/18	267	922,060	1503,686	740,872	1103,248	12078
Jan/19	266	989,613	1203,933	844,269	1134,957	7244
Feb/19	269	988,097	1294,922	832,650	1143,543	14503
Mar/19	286	783,280	980,334	669,179	897,380	5970
Apr/19	277	1018,903	1157,237	882,023	1155,782	6853
May/19	260	902,962	1084,208	770,555	1035,368	5838

Jun/19	246	850,224	1138,532	707,243	993,204	8430
Jul/19	244	714,221	901,631	600,524	827,919	8005
Agu/19	283	865,251	1228,348	721,522	1008,980	8532
Sep/19	279	886,993	1117,009	755,350	1008,636	6287
Oct/19	345	883,867	982,688	779,807	987,927	6635
Nov/19	301	811,555**	1017,296	696,188	926,922	6548***
Total	3510	899,692	1167,296	861,062	938,322	

*LOS (length of stay). ** 30% reduction in LOS. *** 26% reduction in the maximum registered length of stay
Source: Authors (2019).

According to Table 1, comparing the month of November (2018), before the implementation of Lean actions, with November (2019), an increase in the number of patients hospitalized via the Emergency Room was identified, from 187 to 301 patients (61%). There was also a decrease in LOS from 1158,802 to 811,555 minutes (30%). The maximum length of stay reflected a decline from 8876 to 6548 (26%), showing a significant improvement in this indicator.

However, the comparison between the means (LOS) showed that there was no statistical difference before and after the Lean implementation in the study period, which may be related to the absence of variable that would complement the study, for example, the patient's age range, reason of admission to the emergency department, severity, etc.

Still, with the Lean implementation, there are improvements in flow, productivity, and efficiency in processes, such as patient care, exams, and communication between sectors that directly influence the patient's flow.

As for the maximum length of stay, there was a reduction in the highest value recorded, in December (2018) with 12078 minutes and in February (2019) with 14503 minutes, subsequently obtaining a gradual decrease and returning to record higher values in July (2019), with 8430 minutes, and August (2019), with 8532 minutes. It is observed that the prolonged hospitalizations that were registered in the Emergency Room may be associated with the occupation of beds in the inpatient units, representing a difficulty in absorbing the existing demand.

Regarding the data, in August (2019) compared to July (2019), a variation in the LOS from 714,221 to 865.251 minutes (21%) was identified, and an increase in the maximum length of stay recorded from 8005 to 8532 minutes (7%), in addition to the admissions numbers increase that went through the Emergency Room, from 244 to 283 patients (16%). The results can be justified in detriment to the turnover of professionals in the institution. There were terminations of employment contracts, a factor that can influence the indicators, considering the adaptation of professionals to the flow of inpatient units and the Emergency Room itself.

DISCUSSION

As an alternative to improve the patient's flow in the Teaching Hospital Emergency Room, Lean principles were adopted, and the flows and processes were rethought, seeking to improve the LOS through increased productivity, efficiency, and better use of

hospital beds, providing better access to care provided by the Emergency Room. Likewise, other experiences were found in the literature demonstrating the results with the Lean implementation.

At the Vale Oncology Institute (IOV) in São Paulo, the Lean implementation managed to reduce the total cycle time by 36%, as irrelevant processes (waiting for appointments, exam results delivery, bed) were reduced by 96%. Still, the period that the patient remained in the hospital had a reduction of 84%, with an increase in the capacity of patient care by 170% [15].

In comparison with the present study, it was found that both achieved a reduction of patient stay and an increase in a service capacity, with an improvement in lead time and a reduction in processes that do not add value. The patient stays reduction and the increase in service capacity were even greater in the IOV when compared to the study site, showing the potential of using Lean.

It also corroborates the study carried out at the Haaglanden Medical Center (HMC) Westeinde: with the application of multimodal interventions including the Lean program, the LOS reduced by 13 minutes, from 167 to 154 minutes [16]. Likewise, in VA Palo Alto Health Care System (VAPAHCS), the Lean method was used as an intervention in the emergency department, verifying that the LOS for the admitted soldiers decreased by 42.2 minutes, from 398.7 to 356.5 minutes after the intervention, compared to 1.8 minutes, from 346.9 to 345.1 minutes at the control sites [13].

The LOS represents a meaningful indicator for hospital management since, for institutions, the LOS reduction results in greater capacity and lower cost. A 600-bed hospital with total occupancy and an average LOS of 6 days would need only 500 beds for the same amount with a 1-day reduction in LOS [17]. In the user's view, the LOS reduction is directly associated with a better experience and satisfaction with the service. On the other hand, the long waiting time is evaluated as a significant factor for dissatisfaction [16,18].

In addition to those mentioned, a considerable number of studies demonstrate an evolution in the performance of emergency services when using Lean to deal with overcrowding and hospital admissions, obtaining an increase in the volume of patients, a decrease in the LOS, a reduction in costs and an increase in patient satisfaction. patient [19]. On the other hand, a study carried out in four emergency departments, intending to describe the Lean effects, observed that after the second and third year of its implementation, the level of continuous commitment of hospital management to Lean was a factor that affected considerably the results obtained [20].

Among the challenges found in the literature for the Lean implementation, the difficulties in maintaining the support of health professionals and hospital leaders and the lack of training of managers with a Lean vision are mentioned [2]. Some authors characterize the health services management, specifically in the hospital area, as a strenuous cult to carry out. Managers need to look for innovative strategies, acquire new management techniques and technologies that guarantee the involvement of everyone in the process [21].

In this aspect, the improvement processes are only mapped and implemented with the participation of all servers, from administrators to professionals who are on the front line (mainly the nursing staff) directly of patient care [22].

During the in-service training by the Residency in Nursing Management in Medical and Surgical Clinic in the Emergency Room, it was observed the participation of several professionals in the Lean implementation and improvement. However, the nursing team, specifically the male nurse, had a great collaboration in all stages of the process, which, due to their professional training, as evidenced in the literature, has ownership in the hospital services management. Complex management skills, in line with knowledge from training and experience, allow nurses to develop collective decision-making activities and lead the care team, planning, providing personnel management, and interacting with the

interdisciplinary team [6].

According to the authors, the Lean philosophy indicates that nurses are qualified to improve the management of hospital services. Despite the scarcity of publications, authors consider that the participation of this professional is essential for the philosophy to contemplate the institution as a whole and be implemented [22].

Concerning the maximum length of stay registered, a considerable reduction was identified, comparing February (2019), which registered the highest value during the study, and November (2019). Other studies that implemented Lean associated the prolonged length of stay of the patient in the emergency sector with a high hospital occupancy rate, consequently hindering transfer to inpatient units [23]. The hospital occupancy rate can be defined as the available beds' utilization degree; when high, they represent a high prevalence of comorbidities, low resolvability, little reserve for emergencies, or imbalance between supply and demand [24].

Considering the population coverage and the high complexity of care provided at the study site, it is plausible to consider a high hospital demand and occupancy rate. A study shows that teaching hospitals are associated with better operational performance, expressed by a high hospital occupancy rate and higher bed turnover rate [24]. Thinking about the efficiency of care and the Lean principle of continuous improvement [4], in addition to the results obtained so far, it is important to search for solutions that contribute even more to reducing the length of stay in the Emergency Room.

The turnover of professionals coincided with an increase in the LOS in August (2019). Among the factors that can hinder the Lean implementation, employee turnover has impacts beyond the financial, indirectly influencing the institution's efficiency, collaborating in the team productivity reduction, and loss of competent and skilled professionals [25].

In this sense, with the entry of new professionals, training should be provided on the institution's processes, including the Lean methodology, ensuring that improvements remain [26]. Corroborating with studies that observed factors such as the participation and professionals' engagement in the Lean implementation, defined as essential for the methodology success [1].

The limitations of the study are related to the collection of data by TASY, as it has weaknesses in its diet, the absence of complementary variables, having been carried out in a single center and the length of operation of the NIR, as well as the scarcity of similar publications for effective comparation.

CONCLUSION

As a whole, the data analyzed to demonstrate that the application of the Lean method has the potential to improve patient flow in the Emergency Room.

It is essential that hospital managers view management indicators as powerful allies in the face of monitoring and evaluating the implementations carried out, and that, through the analysis of these indicators, they look for alternatives that result in benefits in the care provided to the patient, considering the complex reality of the system of health.

It is worth pointing out the importance observed in the managerial role of the nurse. Participation in the Lean implementation, and, above all, the indicators monitoring, such as the LOS addressed in this study, strengthens managerial competencies, as well as the skills attributed to nurses, for the intra-hospital regulatory processes and flows management. Acting in this new space provides prominence and visibility for the category.

Furthermore, the Lean implementation will produce results for society and users who need highly complex care. The increase in the care capacity will collaborate with other services in the care network, promoting resoluteness in care.

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Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work - Rocha DO, Maraschin M, Tonini NS, Borges F, Cunha MA; Drafting the work or revising it critically for important intellectual content - Borges F; Final approval of the version to be published - Maraschin M, Tonini NS, Borges F, Cunha MA; Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved - Rocha DO. All authors approved the final version of the text.

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