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Reduction of Surgical Setup in University Hospital with Implementation of Quick Tool Exchange as an Improvement for Patient Safety

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Abstract

Introduction: *Patient safety in the surgical environment is a worldwide concern, therefore, improvements in management efficiency and excellence in the quality of services provided in the surgical center are sought.*

Aim: *To analyze the implementation of the Rapid Tool Exchange (TRF) methodology to reduce surgical setup in a university hospital through the improvement of patient safety. Methodology: This was a descriptive cross-sectional study conducted between June and December 2015, in which the TRF methodology was implemented based on the lean concept, with adaptation to 13 rooms of a surgical suite of a university hospital in Porto Alegre in five surgical specialties. Project was approved by the institution's Ethics Committee.*

Results: *In all the surgical specialties analyzed, there was a reduction in surgical setup time, with a maximum decrease of eight minutes.*

Conclusions: *The implantation of TRF made it possible to reduce the surgical set-up by validating the times to create a performance indicator, promoting improvements in room utilization rates, optimizing the protocol for safe surgery and promoting quality care.*

Keywords: *Surgical Centers; Perioperative Nursing; Patient safety; Surgical rooms; Organization and Administration;*

Introduction

Annually, around 260 million surgeries are carried out around the world, with more than 143 million performed in low-and middle-income countries[(1)]. Improving the quality of care during surgical procedures is a great challenge and there is a constant search by professionals for perfecting processes and practices to minimize the risks to patients[(2)].

There is a worldwide trend that seeks, through qualification and management efficiency, to reach a level of excellence in the quality of the services provided, using maximum organizational capacity with reduction of costs. This search for efficiency has become a differential among companies that have begun using quality indicators and applying software that incorporate rigorous assessment parameters[(3)].

Corroborating this, the health sector has been increasingly applying lean concepts as part of an area of knowledge called lean healthcare[4-5]. Lean is a management system whose main objective is to improve the processes required to perform any type of work, always focusing on safe and efficient processes[6].

In the United States, among the top ten hospitals listed by US News magazine in 2013, eight have a structured program with operational excellence that seeks to continually improve processes by identifying and eliminating waste and valuing the workforce using lean healthcare system[7].

In Brazil, health care institutions such as Rede D'Or, hospitals such as São Camilo, Albert Einstein and Instituto do Câncer Dr. Arnaldo Vieira de Carvalho stand out in using the lean philosophy in their management programs, obtaining significant improvements in quality and safety of patient care[7].

Adapting concepts and methodologies of the lean system to the hospital environment meets the requirement for more efficiency, quality, safety and optimization in the application of human, technical and economic resources[4].

The tools of the lean healthcare system can have several applications for process management in health services and organizations, which can improve patient care and patient safety[8]. In this system, principles are based on patient care, with better therapeutic and interventional results, and reduction of waste, unsafe processes and costs.

Among the different services provided by hospitals, the surgical center stands out due to the technical and procedural complexity involved. It mobilizes a multidisciplinary team that acts in the surgical practice of different specialties and manages activities. It is understood that the surgical center is one of the key sectors of a hospital, where there must be a continuous search for the improvement and refinement of processes.

Processes linked to surgical practice generally recommend the construction and monitoring of specific quality indicators that can guide the management and safety processes. These quality indicators usually refer to the rate of surgeries that do not perform safe-surgery check-ups, to the rate of surgery delays due to inaccessibility of beds in the post-anesthesia care unit and to the analysis of the efficiency of surgical centers related to cancellations of surgeries and their causes.

In terms of management, the performance measures in a surgical room are related to occupancy rate, which considers the time the patient remained in the room, and the time for cleaning and preparing the room between surgical procedures[9], usually called surgical setup. These indicators are directly related to the management and safe care of surgical patients.

Minimizing the time interval between surgeries is of fundamental importance in improving productivity and efficiency. However, it is important to remember that the safety and responsibility of care cannot be compromised[10].

The main objective of applying lean concepts to the surgical center is to increase efficiency, and to obtain a superior operational performance by the multidisciplinary team acting there, through process improvements[11]. The literature on the use of lean system concepts in surgical centers is limited.

Although lean thinking began in industry, it is not a strictly industrial production strategy. As all organizations develop their work through a series of processes designed to meet the needs of their clients, lean concepts present a universal applicability (6). Apesar do pensamento *lean* ter iniciado na indústria, não se trata de uma estratégia de produção estritamente industrial. Como todas as organizações desenvolvem o seu trabalho por meio de uma série de processos planejados para satisfazer as necessidades de seus clientes, conceitos *lean* apresentam uma aplicabilidade universal[6].

Of the lean-system concepts used in the industrial sector, the single minute exchange of die (SMED) stands out. This is one of the methodologies of the lean system, which can be considered a concept or an improvement program to reduce the surgical setup time required to exchange, in a more agile and efficient manner, a process model or tool[12]. SMED can be used as a methodology to reduce setup times, helping to reduce production lead times, enabling fast responses without compromising system safety[13].

The SMED methodology was developed by Shigeo Shingo and widely disseminated from the 1970s. It was

divided into four stages. There are many publications about SMED applications, but only in the industry[13-14].

The surgical center studied here identified, along with the managers and other employees, the situation of high surgical setup time, which contributed to an increase in time until delivery of the room for the next procedure. This situation caused delays in surgical procedures, noncompliance with scheduled times, harm for patients from other cities and increased hospital stay, with all its risks.

On a surgical scale, this scenario estimated a period of 30 minutes between the exit of one patient and the entrance of another in a surgical room. It was, however, a theoretical time, without practical validation. Therefore, it was necessary to construct and monitor a performance indicator related to the surgical setup, in order to improve the management process and optimize the application of the surgery safety protocol, making patients safer.

In view of the above, the question posed here is: is it possible to reduce the time interval between one surgery and another by changing the work process, while at the same time improving and ensuring patient safety? To answer this question, the objective of the present study is to analyze the implementation of the Single Minute Exchange of Die (SMED) methodology to reduce surgical setup in a university hospital as a means to improve patient safety.

Methodology

This is a cross-sectional, retrospective study with a quantitative approach, with the application and implementation of the Single Minute Exchange of Die methodology[13-14] in a surgical ward to reduce surgical setup, using the theoretical concepts of the lean system, ensuring safe surgical procedures. The article originates from the research of the final paper of the Post-Graduation course in Health Operations Management of the School of Production Engineering of the Federal University of Rio Grande do Sul.

The study location was a surgical ward of a university hospital in the city of Porto Alegre, state of Rio Grande do Sul, Brazil; in the period from June to December 2015. The surgical ward studied has 13 rooms and serves 16 specialties. Its operating hours are from 7 am to 7 pm in 13 operating rooms, and from 7 pm to 1 am in 6 operating rooms. It has an immediate assistance room and an emergency room that operates 24 hours a day. The number of surgeries performed monthly is around 1000 procedures.

Five surgical specialties were registered for implantation of the SMED: orthopedics, urology, gynecology, thoracic and general surgery. The inclusion criteria were use of the operating room in two shifts, the number of instruments, the surgical complexity and the surgery quantitative of the team. The days when the team performed only one procedure in each shift (7 am to 7 pm) with interval greater than one hour were disregarded.

A total of 129 surgeries were analyzed before application of the SMED and 241 after. There was a difference in times within the same specialty due to surgical complexity. Considering studies presented as reference of productivity improvement in different sectors of industry, the technique chosen to conduct the surgical setup improvement activities was SMED[13-14]. A work model based on four stages was used:

Stage 1 – **Strategic:** convincing top management, setting goals, choosing the implementation team, training the implementation team and defining the implementation strategy. The strategic stage begins with the step of **Convincing top management**. The project should be aligned with the institution's strategies, clearly stating the need for changes, in addition to possible improvements. In this way, the management will be committed and engaged in the implementation of the new process. For this, the SMED strategies and techniques, and the results that may come from its application, should be presented.

After that comes the step of **Definition of goals**, which should consider the existence of indicators that corroborate the baseline situation of the surgical setup times before the start of the project, defining the percentage of reduction of surgical setup time that is desired, and defining an implementation schedule that includes the sequence of implementation activities, those responsible for each activity, and finishing times.

The following is the **Selection of the implementation team**, to be composed by multidisciplinary professionals engaged in the improvement processes and who work in the surgical center. This multidisciplinary team is responsible for defining the actions to be performed and, together with the

surgical room team, will conduct the improvements at an operational level. They are also responsible for the coordination and monitoring of the implementation of the SMED.

Following, comes the **Training the implementation team** about the SMED methodology. The training should include analysis of strategies and techniques for applying SMED, correlating the practice with opportunities for improvement. The team must have enough knowledge to pass it on to the operational implementation teams. Regarding these teams, the training, in addition to the practical application of the methodology, should focus on raising awareness about the reduction of surgical setup, involving all in seeing an improvement opportunity.

The last step of the strategic stage is the **Definition of the implementation strategy**, which corresponds to the planning of the SMED project. The implementation strategy will be shown in the implementation schedule.

Stage 2 – **Preparatory:** definition of the product, process and operation to be addressed. This stage starts with **Product Definition**. In this study, which brings the application of the SMED to a surgical center, the product will be the surgical room. Any reduction in surgical setup time will have an impact on scheduling and performance of surgical procedures, minimizing possible delays in the scheduled surgical scale.

Following is the **Definition of the process to be addressed**. A SMED methodology should be applied to all productive activities that contain setup operations. The process to be addressed should focus on what gains will be possible by reducing setup times and whether this will bring improvements to the delivery of the room for the next procedure[14].

The last step is the **Definition of the operation to be tackled**, which should be defined after an assessment of the time intervals needed to prepare the room according to surgical specialty. In the surgical center studied, 16 surgical specialties work using various materials and equipment. These specialties were grouped by level of complexity and, from this, it was defined in which specialties the work would be developed.

Stage 3 – **Operational:** composed of the steps of analysis of operation initially addressed, identification of internal and external setup actions, conversion of internal to external setup, and practice of setup operation and standardization.

The stage begins with the step of **Analysis of operation addressed**. Once the surgical specialties in which the SMED will be applied have been selected, all the activities related to the cleaning and assembly of the operating room should be listed in a checklist. This list should include, in a way that enables analysis of each action, a description of all the activities performed, the individuals responsible, as well as the average time of execution, from the moment the patient leaves the operating room until the next patient.

Following is the **Identification of internal and external setup actions**. This activity identifies and separates the setup operations that can be performed before the end of surgery and release of the room from activities, from the ones can only be performed after the patient leaves.

Next, the step of **Conversion of internal to external setup**. Once the internal and external setup operations have been identified, the activities should be reassessed to verify the possibility of a higher number of them being performed before the patient leaves the room.

The last step in this stage is the **Practice of setup operation and standardization**. The actions defined in the observation and analysis should be put into practice, accounting for the improvements achieved and repeating the actions until achieving the best result. The improvements should be documented, disseminated and standardized for later application in the other specialties.

Stage 4 – **Corroboration:** composed by the step of **Consolidation of SMED**, which seeks to stabilize and standardize all company processes. The systematization of the preparation of surgical rooms, through an organized methodology, is an important element for the maintenance of the improvements achieved.

This article aims to describe a tool developed for the industry that was adapted for application in a hospital, specifically in a surgical center. We attempted to apply the steps of the tool (SMED) according to the model described by the authors of the SMED[1314], which was a challenge, as it modifies the work process, to implement improvements in patient care, promoting

more safety and qualifying management. The analysis of the data occurred concomitantly with the implementation of the stages of the methodology, and the surgical setup times were submitted to a descriptive analysis.

The study followed ethical precepts and was registered and approved by the Ethics Committee of the institution, under number 140712.

Results

From the information provided by the surgical scheduling sector, it was identified that the surgeries are scheduled by the surgical teams until 1 pm the day before the procedure. The teams' surgical scale is distributed in the 13 rooms, with a scheduled time interval of 30 minute between surgeries. The scale is released at 1:00 p.m., along with the request of materials and equipment that will be necessary to perform the surgeries the next day, for later analysis and conference by the nursing team.

For the application of the SMED methodology, the stages were planned according to Chart 1, described in the methodology. Some steps were applied immediately and others, defined and planned with medium- and long-term results. At the Corroboration stage, the consolidation of the SMED in all specialties will depend on future developments.

Chart 1. *Stages and steps for the implementation of SMED*

Strategic	Definition of goals Selection of the implementation team Training the implementation team Definition of the implementation strategy
Preparatory	Product definition Definition of the process to be addressed Definition of the operation to be tackled
Operational	Analysis of operation addressed Identification of internal and external setup actions Conversion of internal to external setup Practice of setup operation and standardization
Corroboration	Consolidation of SMED

Source: Authors (2015)

For the first stage of implementation of the SMED methodology, the nursing and medical service heads were involved, as well as professionals from the surgical ward (SW) and from the material and sterilization center (MSC). Convincing the institution top management was done by demonstrating the tool and the opportunities for improvement and results that could be achieved with it. The project for implantation of the SMED was presented in a meeting of the collegiate of the surgical centers that occurs once a month., The surgical, anesthesia, nursing and administrative heads participate in these meetings.

The first stage, **strategic**, considered short-term (up to 40 days), medium-term (360 days) and long-term (from 360 days) goals. The short-term goals included selecting and training the implementation team, preparing the schedule for the implementation of the SMED methodology and application of the process.

Medium-term goals included training the implementation teams. Five surgical specialties (orthopedics, urology, general surgery, thoracic, gynecology) were chosen to be analyzed from Monday to Friday for 60 days. The goal of 30 minutes for surgical setup was established, in order to validate this time interval, which was previously estimated in the surgical schedule. The application of the methodology in the other specialties was defined as a long-term goal.

The implementation team was composed of staff from the chosen specialties (orthopedics, urology, general surgery, thoracic, gynecology), MSC staff, cleaners and the project coordinator. The training was conducted by the coordinator of the surgical ward for two weeks with a 15-hour workload. The content taught was basically the strategies and techniques for implementing SMED.

In the **preparatory** stage, the product addressed in the implantation of the SMED was the operating room. The process to be analyzed was the setup of the surgical room, which involved all the activities performed from the patient's exit to the next patient's admission. These activities included tasks performed by the nursing team, the anesthesiologists, and the cleaning staff.

The **operational** stage included the analysis of the assembly of the room, involving the anesthesiologist, nursing and cleaning staff. This activity begins with the removal of the surgical instruments, removal of the equipment that will not be used for the next surgery, cleaning benches, tables and the anesthesia machine and its accessories. After that, the floor is cleaned, and waste is removed by the cleaners. Afterwards, the room is setup, with replacement of materials, drugs, instruments, equipment and preparation of anesthesia. The **Corroboration** stage is the stabilization and standardization in other surgical specialties of the institution.

For analysis, all the steps were described in a list that separated the activities of each professional and the times for execution of each task, shown in Chart 2.

A total of 129 surgeries were performed prior to the application of SMED in the 5 surgical specialties listed, and 241 after. There was a difference in times within the same specialties due to surgical complexity. The unit values represent the average times.

Chart 2. *Activities performed during the surgical setup*

Activity	Time	Professional	Note
Instrument assessment	8 min	Scrub nurse	Activity concurrent with the ones by the circulating nurse
Organizing the room (removal of equipment that will not be used for the next surgery, cleaning of benches, tables, anesthesia machine, replacement of materials, drugs, instruments)	15 min	Circulating nurse	Activity concurrent with the ones by the scrub nurse
Organizing the instruments in the room for the next surgery	10 min	Scrub nurse	Activity concurrent with the ones by the circulating nurse
Preparation of anesthesia	15 min	Anesthesiologist	Activity concurrent with the ones by the scrub nurse
Cleaning the floor and removing waste	15 min	Cleaners	

Source: Authors (2015)

To identify the internal and external setup activities, they were separated by adding up the time spent on each of them. The external setup activities are those performed after the patient leaves the operating room and the internal setup activities are those performed with the patient still in the operating room.

All activities shown in Chart 3 were performed after the patient left the room. The only activity performed prior to the patient leaving was requesting instruments and clothing for the next surgery from the MSC, which was available in the arsenal (temporary stocking area) of the surgical center.

The conversion from internal to external setup started with the analysis of the checklist to see which activities could be performed before the patient left the room. Two activities could be performed with the patient in the room: assessment of instruments and replacing materials and drugs.

To obtain the desired improvements, the following solutions were considered: (1) the MSC employee would be part of the surgical setup, assessing the instruments before the patient left the room (exceptions are transplants, cardiac surgery and hip prosthesis); and (2) the circulating nurse would supply the drawers with drugs and other materials during the intraoperative period.

All the actions defined were put into practice by the implementation team. For this, there was a reorganization of the MSC and training of the nursing technicians of this unit to check the instruments in the operating room. The adoption of counting and assessment of in-room instruments by MSC

employees had a significant indirect impact on the operation of the MSC, as it reduced the number of lost instruments, facilitated the identification of instruments requiring repairs, and improved the process of cleaning, since the parts undergo a pre-cleaning process at the time of assessment.

Regarding the replacement of materials and drugs, an adjustment and standardization of the quantitative variables that remained in the room were carried out. Employees were instructed to replace the missing items during the intraoperative period.

Table 1 shows the surgical setup times before and after the application of smed, with the improvement actions.

Table 1. *Comparative table of surgical setup times of five specialties before implementation (June 2015), during transition (July 2015) and after implementation (August and September 2015) of the Single Minute Exchange of Die.*

DAYS OF THE WEEK	SPECIALTY	ROOM	JUNE (BEFORE SMED)		JULY (TRANSITION)		AUGUST (AFTER SMED)		SEPTEMBER (AFTER SMED)	
			Av time	Qtt.	Av time	Qtt.	Av time	Qtt.	Av time	Qtt.
MONDAY	GYN	3	00:29	18	00:31	18	00:30	18	00:28	10
	URO	8	00:38	16	00:39	13	00:37	14	00:36	7
TUESDAY	ORT	4	00:36	19	00:27	13	00:32	12	00:28	15
	URO	8	00:32	11	00:30	15	00:34	12	00:31	14
WEDNESDAY	ORT	4	00:30	12	00:33	13	00:28	15	00:26	11
	GEN	10	00:36	11	00:30	11	00:32	6	00:30	10
THURSDAY	ORT	4	00:36	9	00:36	14	00:34	11	00:32	10
	GEN	5	00:34	11	00:25	10	00:33	14	00:30	10
FRIDAY	URO	8	00:32	12	00:32	15	00:23	15	00:30	16
	THO	11	00:44	10	00:38	9	00:38	11	00:36	10

Source: Authors (2015)

Note: GYN = gynecology; URO = urology; ORT = orthopedics; GEN = general; TOR = thoracic; Av time = average time; SMED = Single Minute Exchange of Die; Qtt = quantity.

The specialties that had a significant reduction in surgical setup time from the observation of the average values were thoracic surgery (8 min), orthopedics (8 min) and general surgery (6 min). Three specialties were not within the 30-minute goal (urology, orthopedics and thoracic); all, however, presented a reduction in setup time.

Initially, a reduction of time seems not to be of great relevance; however, it enabled a change in the work process, mobilized the teams, and validated the time of surgical setup, improving patient safety.

Discussion

The practical application of the SMED methodology made it possible to share the activities and responsibilities of the team regarding a commitment to optimize surgical setup without jeopardizing the safety of the patient in the next surgical procedure. During the study, applying all the steps of the SMED, there was improvement in the relationships between the teams of the surgical center, MSC, cleaners, surgeons and anesthesiologists.

As a result, the study found that 30 min is an indicator that can be reached for surgical setup, not only for the specialties contemplated in the implantation of the SMED. However, it should be noted that all specialties analyzed reduced the time interval of the rooms. The specialties with greater reduction impact were orthopedics, thoracic and general surgery, from subjective observation of the average values.

Some studies related to efficiency indicators in surgical centers show that the surgery delays and cancellations are directly related to poor prediction of surgery time, affecting 47% of cases. However, there is limited evidence to demonstrate the direct association between the frequency of cancellations on the same day and variables related to surgical or patient setup and also the most prevalent reasons for cancellations as a global profile [15].

Studies show that the reasons for patient-related delays or cancellations are non-attendance or for clinical reasons, and can reach up to 63% of cancellations[16]. Other evidence demonstrates that surgery delays and cancellation can be related to structural aspects of the health institutions.

Resources and institutional structure may compromise the safe care of patients. Evidence shows that up to 30% of surgical cancellations could be avoidable. The most frequent reasons are delays at the beginning of the previous surgical procedure, unavailable or broken equipment, errors in schedules, communication problems between surgical center staff, nursing staff shortages, delays of anesthesiologists and surgeons and mainly sterile material not being available in a timely manner[17].

The improvement actions implemented in this study brought positive results to the surgical center and MSC. The instrument assessment in the operating room by the MSC employees, in addition to reducing surgical setup time, promoted immediate dispatch of the instruments to be cleaned, reducing the time to prepare the tray and to return it to the surgical center, besides minimizing risks of loss of essential instruments for subsequent surgical procedures.

A study evaluating the time management of the operating room showed that one of the main causes for delay between surgeries of the same specialty was the time between the patient waiting at the reception of the surgical center and after entering the operating room before intubation. However, the reasons were not stratified in both moments[18]. Another study analyzed the use of the surgical room and identified that the longest time wasted between surgeries was the patient's immediately post-operative, waiting to be transferred to the post-anesthesia care unit, which reached 30 minutes of waiting, putting into discussion the quality of care provided to patients [19].

There is no agreement in the literature regarding the most prevalent reasons for surgical delays or cancellations; however, there are very few studies evaluating the influence of surgical setup and the use of SMED as a tool to aid in the surgical center, contributing for safe surgical procedures.

Conclusions

The objectives of the study were reached, since the implementation of the SMED, adapting the methodology for a surgical center in a university hospital, resulted in the reduction of the surgical set-up in all the specialties involved.

Several teams were involved in the application of the methodology, among them, nursing, anesthesiology, surgical, administrative, cleaning and management. All the actions defined were put into practice by the implementation team through training conducted by the study coordinator. To this end, there was a reorganization of the work process of the SW and the MSC, reinforcing the culture of patient safety.

It was possible to verify that the interval times between one surgery and another estimated previously by the system were close to reality and applicable. This fact allowed a performance indicator related to surgical setup to be determined, in order to improve room utilization rates, the management process and surgical safety.

Other improvement actions may be discussed with the implementation team so that the 30-minute goal can be reached in the specialties in future actions.

Delays, surgery cancellations for organizational reasons are debatable issues when analyzing the quality of care. In analyzing the surgical setup for all possible causes of surgical delays and cancellations discussed in this study, we can conclude that the inefficiency of the surgical center can cause a great deal of inconvenience and costs to the patient and their families. The use of methodologies and tools that can help minimize these disorders and promote safe surgical procedures should be discussed and implemented, increasing the capacity of institutional care, optimizing resources in an efficient and safe way.

The study presents an important contribution for health institutions in the management of surgical centers and teaching, by adapting the methodology to the studied area, optimizing the preparation of operating rooms to minimize the time between two procedures scheduled for the same room. In the field of research, there is a need for more studies to consolidate this tool as an aid in the management of surgical wards, so it can be used in other scenarios.

The originality of the application reported here, and the limitations of the study should be noted, since it has no parallel in the literature.

Finally, this proposal contributed to changing the work process in the surgical ward, keeping the surgery protocols safe and reducing the surgical setup (interval between the end of one surgery and the beginning of the other), with improved patient safety.

References

[1] Organização Mundial Da Saúde (OMS). Segundo desafio global para a segurança do paciente: cirurgias seguras salvam vidas (orientações para cirurgia segura da OMS). Rio de Janeiro: Organização Pan-Americana da Saúde, Ministério da Saúde, Agência Nacional de Vigilância Sanitária; Brasília (DF); 2014

[2] Ng-Kamstra JS, Arya S, Greenberg SLM, Kotagal M, Arsenault C, Ljungman D, et al. Perioperative mortality rates in low-income and middle-income countries: a systematic review and meta-analysis. BMJ Glob Health [Internet]. 2018 [cited 2018 jun 15];3(3):1-12. Available from: https://gh.bmj.com/content/3/3/e000810.

[3] Aboumatar HJ, Weaver SJ, Rees D, Rosen MA, Sawyer MD, Pronovost PJ. Towards high-reliability organising in healthcare: a strategy for building organisational capacity. BMJ Qual Saf [Internet]. 2017 [cited 2018 jun 15];26(8):663-70. Available from: https://qualitysafety.bmj.com/content/26/8/663.

[4] Rotter T, Plishka CT, Adegboyega L, Fiander M, Harrison EL, Flynn R, et al. Lean management in health care: effects on patient outcomes, professional practice, and healthcare systems. Cochrane Database Syst Rev. 2017 Nov 03;11: cd012831. doi: 10.1002/14651858.CD012831.

[5] Abdelhadi A. Investigating emergency room service quality using lean manufacturing, Int J Health Care Qual Assur [Internet]. 2015 [cited 2018 jun 15];28(5):510-9. Available from: https://www.emeraldinsight.com/doi/abs/10.1108/IJHCQA-01-2015-0006.

[6] Cardoso GOA, Alves JM. Análise Crítica da Implementação do Lean Office: um estudo de casos múltiplos. GEPROS, Gest. Prod. Oper. Sist. [Internet]. 2013 [citado 2018 jul 10];(1):23-35. Disponível em: https://revista.feb.unesp.br/index.php/gepros/article/view/1003/484.

[7] Faria PA. *Lean Healthcare*: um estudo sobre a aplicação do pensamento enxuto em serviços de saúde [dissertação]. Rio de Janeiro (RJ): Programa de Pós-graduação em Engenharia de Produção, Departamento de Engenharia Industrial da PUC; 2013.

[8] Maijala R, Eloranta S, Reunanen T, Ikonen T. Successful implementation of lean as a managerial principle in health care: a conceptual analysis from systematic literature review. Int J Technol Assess Health Care [Internet]. 2018 [cited 2018 jun 20];34(2):134-46. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29642955.

[9] Jericó MC, Perroca MG, Penha VC. Mensuração de indicadores de qualidade em centro cirúrgico: tempo de limpeza e intervalo entre as cirurgias. Rev Lat Am Enfermagem [Internet]. 2011 [citado 2018 jun 20];19(5):1239-46. Disponível em: http://www.scielo.br/pdf/rlae/v19n5/pt_23.pdf.

[10] Lopes JO, Carvalho R. Criação e Implantação do Processo de "Giro de Sala": relato de experiência. Rev. SOBECC [Internet]. 2014 [citado 2018 jun 27];19(3):173-7. Disponível em: http://www.itarget.com.br/newclients/sobecc.org.br/2014/pdfs/revista-jul-set-2014.pdf.

[11] Collar RM, Shuman AG, Feiner S, McGonegal AR, Heidel N, Duck M, et al. Lean Management in Academic Surgery. J Am Coll Surg [Internet]. 2012 [cited 2018 jul 01];214(6):928-36. Available from: https://www.ncbi.nlm.nih.gov/pubmed/22626546.

[12] Buzzi D, Plytiuk CF. Pensamento enxuto e sistemas de saúde: um estudo da aplicabilidade de conceitos e ferramentas *lean* em contexto hospitalar. Revista Qualidade Emergente [Internet]. 2011 [citado 2018 jul 10];2(2):18-38. Disponível em: https://revistas.ufpr.br/qualidade/article/view/25187/16832

[13] Fogliatto FS, Fagundes PRM. Troca Rápida de Ferramentas: Proposta Metodológica e Estudo de Caso. Gest. Prod. [Internet]. 2003 [citado 2018 jul 10];10(2):163-81. Disponível em: http://scielo.br/scielo.php?pid=S0104-530X2003000200004&script=sciabstract&tlng=pt.

[14] SHINGO S. Sistema de Troca Rápida de Ferramenta. Porto Alegre: Bookman, 2000.

[15] Sharouf F, Baig Mirza A, Moosajee V, Plummer S, Bhatti IM, Zaben M. Analysis of Neuro-theatre Utilisation and Reasons for Cancellation to Improve Efficiency and Productivity. J Perioper Pract [Internet]. 2017 [cited 2018 ago 06];27(4):82-7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29328748.

[16] Appavu ST, Al-Shekaili SM, Al-Sharif AM, Elawdy MM. The Burden of Surgical Cancellations and No-Shows: Quality management study from a large regional hospital in Oman. Sultan Qaboos Univ Med J [Internet]. 2016 [cited 2018 ago 06];16(3):298-302. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27606108.

[17] Abeeleh MA, Tareef TM, Hani AB, Albsoul N, Samarah OQ, ElMohtaseb MS et al. Reasons for operation cancellations at a teaching hospital: prioritizing areas of improvement. Ann Surg Treat Res [Internet]. 2017 [cited 2018 ago 06];93(2):65-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28835881.

[18] Olusanya A, Aladelusi T, Osinaike B, Akinloye S, Arotiba J. An audit of oral and maxillofacial procedures under general anaesthesia at the University College Hospital Ibadan, Nigeria. J West Afr Coll Surg [Internet]. 2017 [cited 2018 ago 10];7(1):32-56. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6018029/.

[19] Stavrou G, Panidis S, Tsouskas J, Tsaousi G, Kotzampassi K. An Audit of Operating Room Time Utilization in a Teaching Hospital: Is There a Place for Improvement? ISRN Surg. 2014 Mar 13; 2014:431740. doi: 10.1155/2014/431740.

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