Methodology to reduce cancellations of scheduled surgeries

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Abstract

Purpose - This study presents an integrated methodology to support the logistics management in health facilities in waste reduction and elimination, by providing simple and low cost solutions to minimize the cancellation of scheduled surgeries. The methodology is applied in a Portuguese public hospital. This approach promotes and improves the quality of services to patients.

Design/methodology/approach - The methodology is a problem-solving process which could be applied to manage the flows of services (and materials), and associated information, from the point of origin to the point of care. This approach integrates several stages such as definition, measurement, analysis, improvement and control (DMAIC), and uses the quality and management tools required to obtain efficient and effective solutions to patients.

Findings - The enhanced methodology contributes to an understanding the origins of the difficulties and waste. For the case study, the cancellation rate ranges from 19% and 21% in 2011 and 2012, respectively, and increases to 29% in 2013, although, this year the operating room performed the highest number of operations. The most critical root causes of cancellations are related to the changing patient's state of health, delays in previous surgeries, scheduling of emergency operations, refusal to undergo surgery and other causes.

Originality/value - One of the main contributions of this paper is to apply the DMAIC based approach to study the cancellations of scheduled surgeries in a given Portuguese public hospital, which is an issue rarely addressed in the literature.

Keywords: Quality, Surgery, Logistics, Improvement

Article Classification: Research paper

1. Introduction

This paper proposes a methodology to support the logistics management in health facilities in waste reduction and elimination, by providing simple and low cost solutions to minimize the cancellation of scheduled surgery in a given healthcare facility. This approach requires the study of the waste associated with forward and reverse flows of services (and materials) and associated information, from the point of origin to point of

surgery performed. Only this logistics and integrated perspective can allow an effective reduction of waste, avoiding its transference from one subsystem to another, or internally, from a clinical department to another.

The cancellation of scheduled surgery is one of the parameters which is used to assess the quality of care provided to users, and the quality of the management system. According to Taner et al., (2007), the quality of a healthcare system is characterized by providing safe, equitable, efficient and effective health services to the user at the right time and on equitable access which should be patient-centred. The proposed methodology focuses on achieving efficient patient-centred solutions at the right time by reducing waste. The waste is related to waiting time or delay, medical and diagnostic errors, long or redundant processes, unnecessary transport and movements, excess stock, a variety of materials and unpredictability which often prejudices the delivery of safe and effective patient care.

The proposed methodology involves making decisions taking into account the interdependence and coordination between all stages of the process and functional areas, by ensuring that the surgery is performed at the scheduled time. Thus, the need to provide a high service to the patient, at the right time and at the lowest cost, makes the logistics more complex in healthcare management (Vaz, 2012). A further objective is to investigate the cancellations problem in the Portuguese public hospital.

The methodology integrates several stages such as definition, measurement, analysis, improvement and control (DMAIC), and uses the quality and management tools required to obtain efficient and effective solutions for patients. DMAIC (Montgomery, 2005; Taner et al., 2007), is a five-step improvement methodology with the aim of continuously reducing waste which can be used in developing and improving the service performance.

Cancellations of scheduled surgeries has been an important and longstanding problem for global healthcare organizations (Dimitriadis et al., 2013). This problem affects also the Portuguese health facilities which are characterized by the increasing costs of providing care services, deterioration of the financial situation and time-consuming processes which, combined with increasing demand, result in providing poor quality service to the patients (Kumar and Gandhi, 2012). There is a scarcity of studies which investigate this problem in Portuguese health facilities. One of the main contributions of this paper is to apply the methodology proposed to study the magnitude of this problem in a given Portuguese public hospital.

The proposed approach should be performed by multidisciplinary teams which requires the involvement of professionals in health and management areas (Carvalho and Ramos, 2009). This increases the success rate on implementation of the proposed improvements by avoiding the conflict between managers and health professionals and the possible risk of penalizing the quality of health services to patients.

The following section presents the literature review about the cancellations of scheduled surgeries. Section 3 describes the proposed methodology which is applied to a Portuguese public hospital and discusses the results obtained. The main conclusions are presented in section 4.

2. Literature review

In international studies, the rate of cancellation of surgeries in different hospitals is highly variable and could reach 40% (González-Arévalo et al., 2009; Haana et al., 2009; Kumar and Gandhi, 2012; Rai and Pandit, 2003; Schofield et al., 2005).The variability of this value is dependent on the definition of the point in time at which it is considered that

the surgery was cancelled, which can vary from hospital to hospital, type of surgery, size of the institution, characteristics of population health and health system (Dimitriadis et al., 2013; González-Arévalo et al., 2009; Kumar and Gandhi, 2012). It is observed that there are a few studies (González-Arévalo et al., 2009; Robb et al., 2004; Seim et al., 2009) that investigate data for more than one year although the evolution of the cancellations problem is rarely explored.

There are studies that focus on collecting data and identifying the services (Cavalcante et al., 2000) most affected by cancellation of surgeries. Other studies also investigate the main causes for cancellations (González-Arévalo et al., 2009; Kumar and Gandhi, 2012), classifying them into several groups (e.g., patient, medical and surgical, operating theatre, administrative and logistical). Most of the studies indicates that the lack of time available in the operating-room, increased number of emergency admissions, failure of patients to attend and deterioration of health status of the patients are the most important causes of cancellation of operations (Basson et al., 2006; Haana et al., 2009; Kumar and Gandhi, 2012; Rai and Pandit, 2003; Robb et al., 2004; Schofield et al., 2005).

The literature emphasizes the importance of health units identifying the main causes of cancellation, since, although some causes are unavoidable, others can be avoided (González-Arévalo et al., 2009; Kumar and Gandhi, 2012). The different studies agree that over 50% of cases of cancellation of surgery occurring on the day of surgery, can potentially be avoidable (Dalwani et al., 2010; Schofield et al., 2005).

The following section describes the proposed methodology which is applied to a Portuguese public hospital and the results obtained. The main conclusions are presented in section 3.

3. Methodology

The methodology is based on the DMAIC approach and uses the quality and management tools required to obtain efficient and effective solutions for patients. In the first stage (Definition), the process where the problem occurs is identified by collecting information, clarifying scope and defining goals. In the second stage (Measurement), the performance of the current process is measured by collecting the data required. In the third stage (Analysis), the root causes of waste, which hypothetically influence the problem, are analyzed and the most critical factors are identified. This stage requires the involvement of employees who contribute to the process. In the fourth phase (Improvement), the improved process is proposed which enables the elimination of/decrease in the root causes of waste, measurement of results, definition of standard solutions and implementation of changes by designing solutions to enhance the quality of services provided to patients. Lastly (Control), it is necessary to control the changes proposed by monitoring the performance of the process studied.

The waste elimination or reduction observed in the processes is supported by the use of quality tools and lean principles which allow the obtaining of simple, and low cost solutions by involving all employees. The next sections describe how the DMAIC approach can be used to eliminate/reduce the cancellation of scheduled surgeries. The methodology is illustrated by studying the cancellation of operations in a Portuguese public hospital which provides health services to a population from two cites in the same geographical area. This hospital receives about 5% patients from the north of Portugal. The central hospital has two operating rooms: the central room is devoted to non-day surgery and another unit is devoted to day surgery services. The other facility has only one operating room which is devoted to day surgery. This study investigates the

cancellations of scheduled non-day surgeries in the central operating room, during the period from January 2011 to December 2013, in which operations in the following specialities were performed: orthopaedics, general surgery, otorhinolaryngology, urology, vascular surgery, gynaecology, obstetrics and obesity surgical treatment. This study classifies a “cancellation” as any surgery that is scheduled in the information system but subsequently did not occur.

3.1. Definition

The main objective of this stage is to visualize where the root waste to eliminate/reduce is, and identify opportunities for improvement. In this stage, a multidisciplinary group is established by involving managers and health professionals who participate in the process.

The flowchart or value stream mapping are some visual tools that can be used to graphically represent the current state of process, which helps to identify unnecessary procedures, simplify and visualize waste. Due to space restrictions imposed, the main steps of the current process of scheduling surgeries are represented in Figure 1, from the consultation for initial examination of the patient to the phase that the surgery is performed or cancelled.

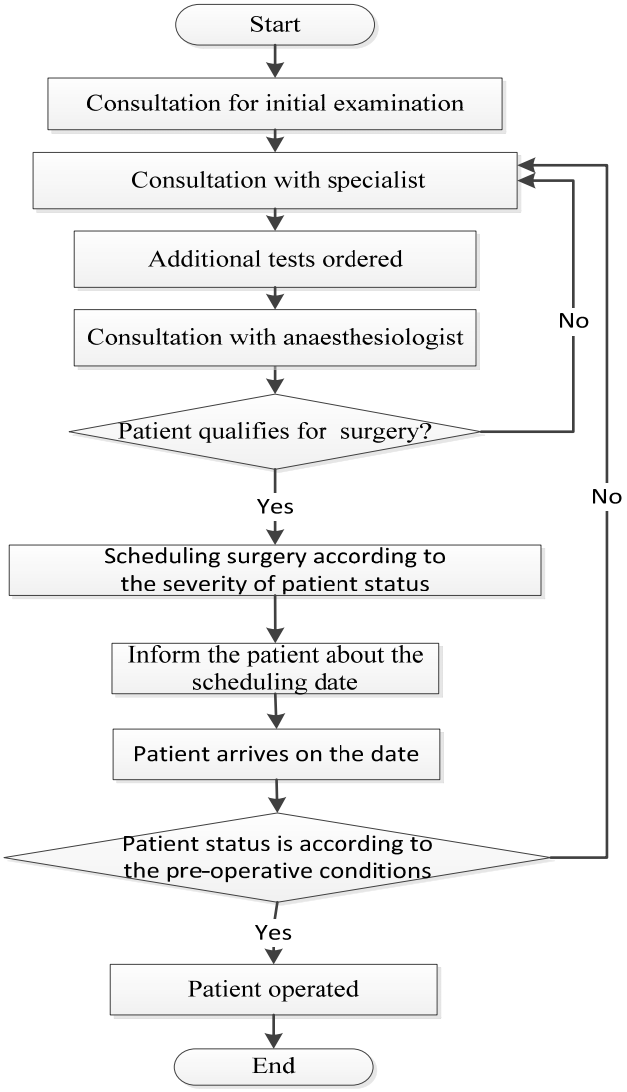

Figure 1 - ***Scheduling surgical operations process***

3.2. Measurement

The purpose of the measurement stage is to evaluate and understand the current state of the process. This stage involves collecting data on measurements of the magnitude of the problem which enables us to assess the performance of the current process and monitor the impact of future improvements. These measurements can be indicators of the utilization of health services or indicators of resource utilization. The cancellation rate of scheduled surgical operations (r_c) is defined as the ratio between the number of cancelled operations (n_c) and the total number of scheduled operations (n) to assess the performance of the scheduling surgery process.

Table 1 - ***Rate of cancellations of scheduled operations***

Year	**n**	**n_c**	**r_c (%)**
2011	3518	675	19%
2012	3984	837	21%
2013	4861	1430	29%

During the three years, the hospital scheduled an increasing number of operations, from 3518 in 2011, to 4861 in 2013. The cancellation rate ranges from 19% and 21% in 2011 and 2012, respectively, and increases to 29% in 2013. Specifically, this year the operating room performed the highest number of operations, 3431. Next, we explore the extent of cancellations relative to the various specialities.

Table 2 - ***Rate cancellations of scheduled surgical operations by speciality***

	Year								
	2011			**2012**			**2013**		
	n	**n_c**	r_c	**n**	**n_c**	r_c	**n**	**n_c**	r_c
Orthopaedics	939	243	36%	1095	310	37%	1522	798	56%
General surgery	953	163	24%	1176	187	22%	1566	318	22%
Otorhinolaryngology	453	111	16%	430	138	16%	464	136	10%
Urology	378	71	11%	453	91	11%	447	76	5%
Vascular surgery	184	22	3%	200	34	4%	205	41	3%
Gynaecology	406	21	3%	453	45	5%	475	25	2%
Obstetrics	99	32	5%	95	16	2%	32	18	1%
Obesity Surgical Treatment	106	12	2%	82	16	2%	150	18	1%
Total	3518	675		3984	837		4861	1430	

Table 2 shows that the highest cancellation rate is observed for Orthopaedics which has increased significantly over time. It is critical to investigate the causes of the poor performance in this speciality. The decreasing trend has been observed for the remaining specialities, with the exception of vascular surgery which has maintained the cancellation rate at 3%. The lowest cancellation rate is observed for obstetrics and in the Obesity Surgical Treatment Unit, in 2013.

3.3. Analysis

The root causes of waste which hypothetically influence the problem are analyzed and the most critical factors (reasons for cancellation) are identified. This stage requires the involvement of staff which contributes to the analysis.

The factors (causes) that, hypothetically, influence the problem of cancellations (effect) are analysed by using the Cause-and-Effect Diagram (or fishbone diagram) to select the most critical factors. The Cause-and-Effect Diagram is a graphical tool frequently used in uncovering potential causes which allows the ranking of factors by order of importance. For the case study, the causes of cancellation for scheduled surgical operations were collected and structured by using the Cause-and-Effect Diagram. Thus, the main causes (factors) for the cancellations can be initiated by issues related to the patient, logistics and administration, medical, equipment, clinical material and medications, operating room, staff and other reasons. The main factors and the subsequent breaking down into secondary factors are structured by a Cause-and-Effect Diagram, presented in Figure 2.

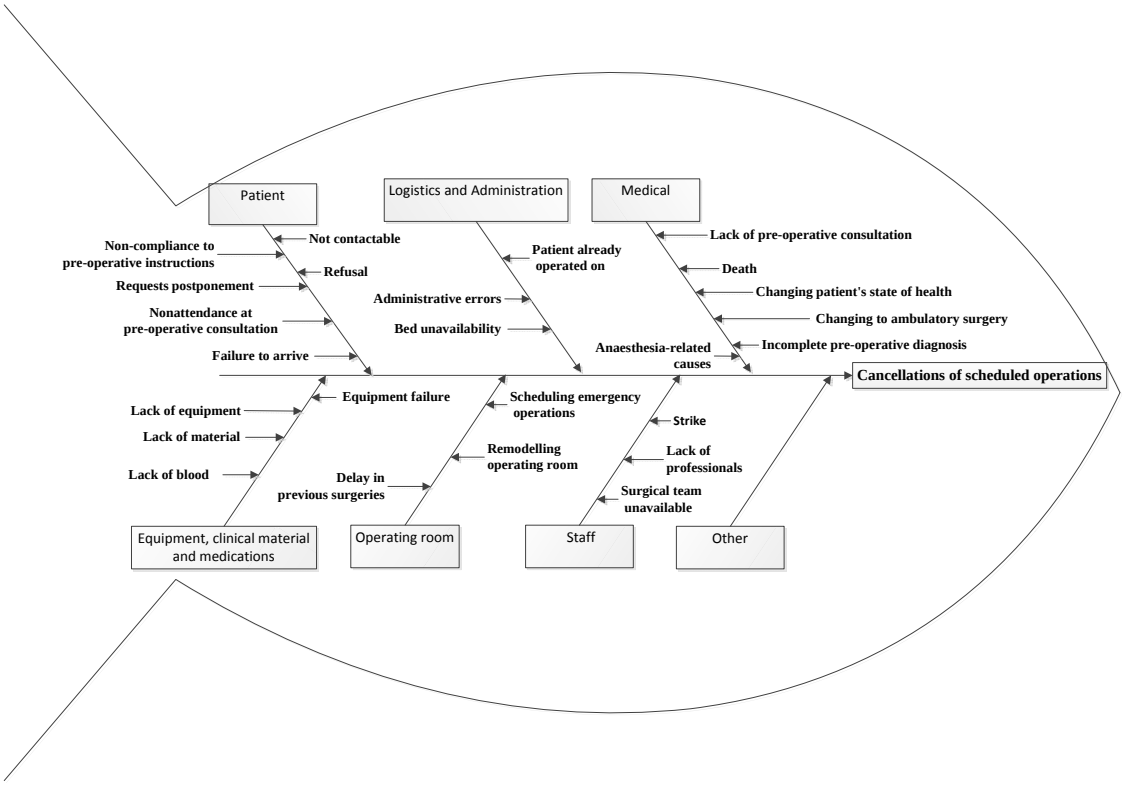

Figure 2 – ***Cause-and-effect diagram for cancellations of scheduled surgeries***

The majority of causes for cancellation are self-evident but some need a little explanation. Cancellations due to ‘Changing patient's state of health’ can be due to the improvement in patient health, or the original diagnosis was judged incorrect for the surgery or sometimes the intervention was not necessary. In this case, the operations can be booked by junior staff or by a different consultant than the one responsible for the operating room list (Haana et al., 2009; Rai and Pandit, 2003).

As the hospital has an ambulatory surgery unit, the non-day surgery can be cancelled and replaced by scheduling a day-surgery.

Cancellations due to ‘Delay in previous surgeries’ are very common because the duration of surgeries scheduled exceed the available operating-room time and, frequently, the list is overbooked with surgeries. Sometimes the duration of the procedures can be underestimated and the preparation time between the procedures is not included in the scheduling. At other times, the late starts and long waiting times between cases can be due to delayed transportation, operating room cleaning and preparation which involves other services related to the surgical care provision. Another different cause is when the surgery cancellation occurs due to performing an emergency surgery.

Sometimes, some error can occur in the process and the pre-operative consultation is not scheduled. At other times, the patient does not attend the scheduled pre-operative consultation.

The patient may be operated on in another facility if the hospital does not schedule the surgery in the time regulated by the public health administration and, in this case, the surgery can be transferred to another health facility. In other cases, the patient can arrange to have the surgery performed in a private health facility by using health insurance.

At other times, the patient needs to postpone the date due to personal reasons, such as death of a family member, new job or family. In these cases, the public health administration assesses the cancellation causes which are acceptable to schedule again the surgery. Other cancellations can occur due to the patient not accomplishing the pre-operative preparation such as fasting or not stopping the medications. Other reasons include the cases of cancellation that are not classified by the staff who do not register the cause. Regarding the staff, sometimes the surgeon or the anesthesiologist is not available or, at other times, all the professionals are unavailable.

The hospital has a procedure which enables the registrations and classifications can be made by administrative services, although some causes of cancellation are classified as “Other causes” without explanation of the reason. This information is collected and analysed to quantify the causes selected, as this simplifies the further selection of causes which influence more significantly the problem. The rate of cancellation for each main and secondary factor is assessed, as is indicated in Table 3.

Broadly speaking, medical causes are more significant, although this magnitude decreased during the period analysed from 35.6% in 2011 to 29.8% in 2013. This is also observed for the causes relating to the operating room which decreased from 28.1% in 2011 to 15.8% in 2013. An opposite behaviour is observed for patient causes which increased from 13.8% in 2011 to 20.8% in 2013. This is also noted for other causes that went up from 10.2% in 2011 to 17.7% in 2013. The main causes relating to equipment, clinical material and medications are less frequent than the problems with Logistics, Administration, and staff. Next, the Pareto analysis is used to investigate the individual factors causing cancellations to identify potential improvements in the process.

The Pareto analysis can be used to select the most critical factors and identify priority causes responsible for cancellations of scheduled operations, by quantifying their impact. The stacked Pareto chart, presented in Figure 3, shows the frequency distribution arranged by cause of cancellation, over the period analysed. Through this chart, the user can quickly and visually identify the most frequently occurring types of causes of cancellations.

Table 3 – ***Causes for cancellation in relation to the total of cancellations***

	Cancellation as % of total cancellations		
	2011	**2012**	**2013**
Medical causes	35.6%	30.3%	29.8%
Changing patient's state of health	29.8%	25.0%	23.3%
Changing to ambulatory surgery	2.4%	4.2%	4.8%
Death	0.9%	0.6%	0.8%
Anaesthesia-related causes	1.0%	0.1%	0.4%
Incomplete pre-operative diagnosis	0.9%	0.4%	0.2%
Lack of pre-operative consultation	0.6%	0.1%	0.3%
Operating room causes	28.1%	26.8%	15.8%
Delay in previous surgeries	17.9%	12.2%	9.3%
Scheduling emergency operations	8.7%	14.6%	6.5%
Remodelling operating room	1.5%	0.0%	0.0%
Patient causes	13.8%	14.5%	20.8%
Refusal to undergo surgery	6.7%	9.2%	9.5%
Failure to arrive	4.4%	3.7%	2.0%
Nonattendance at pre-operative consultation	0.3%	0.1%	5.7%
Patient requests postponement	0.1%	0.2%	2.7%
Non-compliance to pre-operative instructions	1.6%	0.8%	0.5%
Patient is not contactable	0.6%	0.4%	0.5%
Other causes	10.2%	9.8%	17.7%
Logistics and Administrative causes	5.8%	4.7%	5.7%
Patient already operated on	3.4%	2.2%	4.0%
Administrative errors	2.4%	1.0%	0.6%
Bed unavailability	0.0%	1.6%	1.2%
Staff causes	3.7%	8.4%	7.8%
Strike	1.5%	7.5%	6.8%
Surgical team unavailable	2.1%	0.8%	0.3%
Lack of professionals	0.1%	0.0%	0.7%
Equipment, clinical material and medications causes	2.8%	5.6%	2.4%
Equipment failure	1.5%	1.8%	0.7%
Lack of material	1.3%	3.7%	1.5%
Lack of blood	0.0%	0.1%	0.1%
Lack of equipment	0.0%	0.0%	0.1%

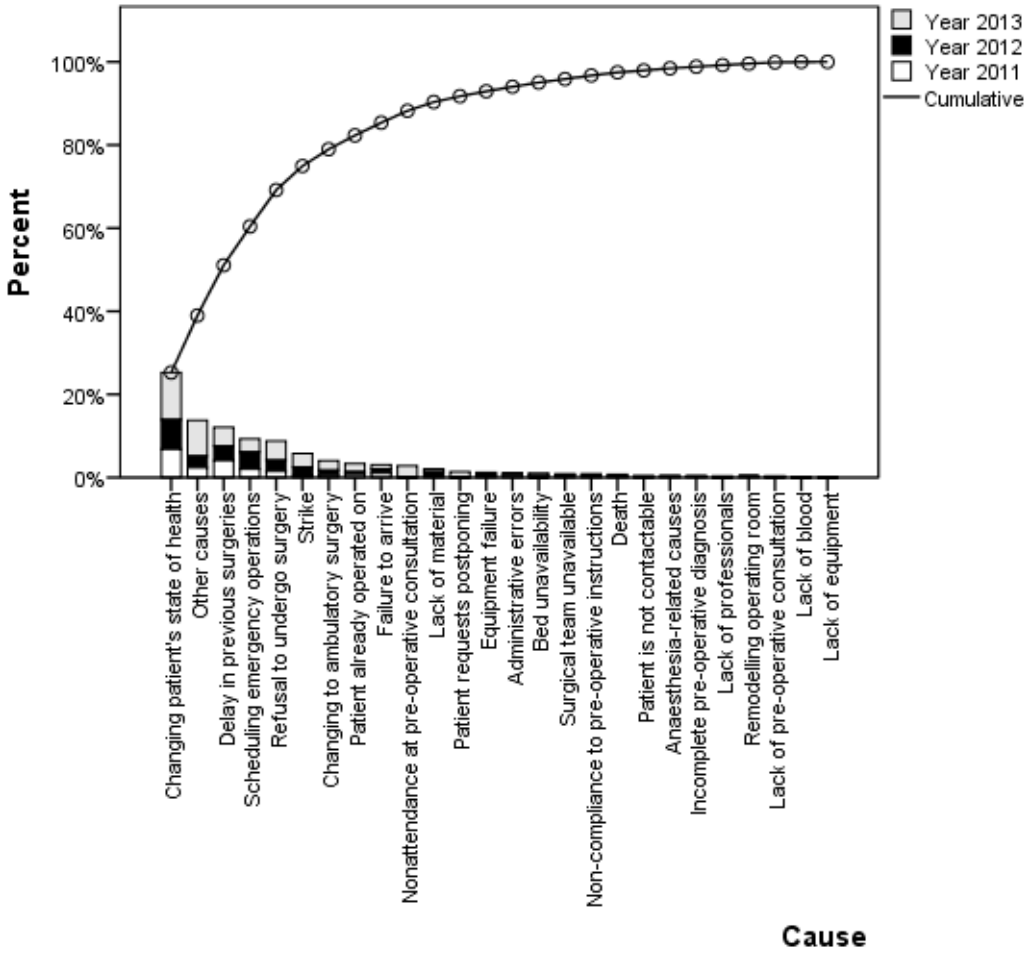

Figure 3 – ***Stacked Pareto chart of the causes of scheduled surgeries cancellations***

The Pareto chart identifies that the most critical root causes of cancellations are related to the changing patient's state of health, delay in previous surgeries, scheduling of emergency operations, refusal to undergo surgery and other causes whose possible solutions are discussed in the next stage. It is interesting to observe that the causes of cancellations have remained the same during the three years analysed.

3.4. Improvement

In the fourth stage, the improvements in the process should be proposed which enables the elimination of/decrease in the root causes of waste. The cancellations of scheduled surgeries should be eliminated or reduced and the best practices should be identified. Generally, this analysis involves studying the activities of processes, eliminating unnecessary tasks, combining or simplifying tasks relative to the flows of materials, services and associated information (Montgomery, 2005).

In the case study, the possible solutions to cancellations of scheduled surgery are explored by focusing critical causes identified in the previous stage and by taking the best practices referred to in the literature. It is also important that the improvements should focus on the causes that can be avoided.

Changing patient's state of health

This cause can be reduced by the establishment of pre-assessment clinics before the operation (Knox et al., 2009; NHS Institute for Innovation and Improvement (Great

Britain), 2010). This can be performed by a multidisciplinary team supervised by an anaesthetist assisted by a check-list to verify important information about the patient's state of health. The pre-assessment clinic should involve checking the protocol of performing surgery to decide if the operation is even necessary or if the operation should be performed in the non-day regime. In case of surgery, it is very important to clarify the pre-operative instructions which should be adjusted to the current medications of the patient. If the patients are pre-assessed too early before the surgery, their health status can change in the time period until their intervention and if patients are pre-assessed too late, the time available for any procedures implemented (such as the request of additional diagnosis exams) in order to avoid the cancellation, is limited. In this case, the reduced time available reduces the possibility of making the appropriate changes to the operative list. The pre-operative assessment can also enable the decrease in cancellations due to other medical and patient causes identified before.

Delay in previous surgeries

It is necessary to reduce/eliminate the causes of delay in previous surgeries by improving the current utilisation of the operating room time (Garg et al., 2009; Kumar and Gandhi, 2012). This involves the monitoring the deviation from the planned to the actual start time, duration and waiting time for each intervention and by achieving more accurate operative lists. It is also necessary to reduce/eliminate waiting times between cases by improving the efficiency of the multidisciplinary team operations such as transportation, operating room preparation and cleaning, material and medications supply, equipment maintenance and other services related to surgical care provision.

Scheduling emergency operations

This has to be seen as a non-avoidable cause due to the severity of health status of the patient. One way that can be used to reduce its impact on the cancellations of scheduled surgeries is to monitor the time of operating room that is used for emergency operations to forecast the time that is required for these kinds of interventions in the operative list.

Refusing to undergo surgery

The pre-operative assessment can significantly decrease the refusal of a patient to undergo surgery as this situation is identified early to introduce changes in the list of scheduling operations. Other possible solutions to reduce this cause is to communicate with patients the day before the operation by telephone in order to confirm their attendance for surgery (Haana et al., 2009). If the cancellation is confirmed, some arrangements can still be made in order to minimize the waste of resources such as calling other patients to cover the vacancy in the operative list.

Other causes

The staff should classify each cause of cancellation to allow the investigation of the causes of the problem, avoiding the use of "Other causes". As the data set considers all the cases of cancellation during the period analysed, it is expected that the distribution of the causes investigated will remain the same if the other causes were classified.

These solutions should be described and illustrated. This proposal should also be supported by the use of graphical and visual tools. Thus, the comparison between the graphical representations "as is" and "to be" regarding the current state process and future state process, respectively, should be provided as clear evidence that the problem has been reduced or eliminated. This facilitates the acceptance of the solution proposed by the administration and the staff involved in the process. The application of the methodology

to the case study is in this stage, where the improved solutions are proposed to the hospital.

Finally, the proposed improvement should require some organizational changes which should be performed. The procedures of the proposed improvement should be documented to avoid future deviations and variations from the standards proposed. The changing procedures require the training of staff involved in the process studied. The visibility of the proposed improvement in the process should be underlined by using visual tools during the entire process.

3.5. Control

The performance of the process must be assessed in order to determine whether the improvement was implemented. Thus, the performance indicators should be monitored to check the impact of improvement and to correct some deviations from the plans and objectives. In the case study, it is necessary to control the changes proposed by monitoring the performance of the process studied through the use of the rate cancellations of scheduled surgical operations over time and per specialty. It is necessary to register and classify all the causes of cancellation.

4. Conclusions

This paper proposes a methodology to support the logistics management in health facilities of waste reduction and elimination, by providing simple and low cost solutions to minimize the cancellation of scheduled surgery in a given healthcare facility. This approach is a problem-solving process and service/process improvement system which should be applied to manage the forward and reverse flows of services, and associated information, from the point of origin to the point of care. Only this integrated perspective can allow a continuous reduction of waste, avoiding its transference from one clinical department to another.

This methodology is a DMAIC based approach that integrates the quality and management tools required to achieve efficient patient-centred solutions at the right time by reducing waste. A high success rate on implementation of these solutions requires that the methodology should be performed by multidisciplinary teams which involve professionals in health and management areas.

This paper applies the DMAIC to study the cancellations of scheduled surgeries in a given Portuguese public hospital. This can contribute to the investigation of the magnitude of this problem in Portuguese health facilities, which is an issue rarely addressed in the literature. From the application of the methodology to a case study, we concluded that it facilitates the analysis of the problem, contributing to the ranking of causes of problems and understanding of the origins of difficulties and waste, making the proposal more obvious and acceptable to the staff.

For the case study, the cancellation rate ranges from 19% and 21% in 2011 and 2012, respectively, and increases to 29% in 2013, although, this year the operating room performed the highest number of operations. These results can be explained by the worst performance of the Orthopaedic speciality, whose cancellation rate has increased significantly over time, while a decreasing trend has been observed for the remaining specialities, with the exception of vascular surgery which has maintained the cancellation rate. This may indicate that the hospital has developed efforts to decrease the cancellations for some specialities, although it is critical to investigate the causes of the poor performance in Orthopaedics.

The main causes for the cancellations of scheduled surgical operations can be explained by issues relating to the patient, logistics and administration, medical, equipment, clinical material and medications, operating room, staff and other reasons. These main factors and the subsequent breaking down into secondary factors are structured by a Cause-and-Effect Diagram. The Pareto chart identifies that the most critical root causes of cancellations are related to the changing patient's state of health, delays in previous surgeries, scheduling of emergency operations, refusal to undergo surgery and other causes whose solutions are explored by taking the best practices referred to in the literature. It is observed that the causes of cancellations have remained the same during the three years analysed. The improvements proposed focus on the causes that can be avoided by the establishment of pre-assessment clinics before the operation, monitoring and auditing the utilisation of the operating-room time, improving the efficiency of the services related to surgical care provision, monitoring the time of operating-room that is used for emergency operations and confirming the attendance for surgery with patients the day before the operation.

In the future, this methodology can be applied to solve other logistical problems of health facilities, to improve the quality of care provided to patients.

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