Implementing Lean In Operating Room Medical Supplies Of RSIA Grand Family

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Abstract: This research aims to assess the results of lean implementation in reducing the cost of medical supplies in the operating room of a hospital in Indonesia. These results can be used as a motivation to extend implementation to other aspects of overall operating room and hospital management. Resource inventory to build management commitment, willingness to share data, and information of implementation history was the initial stage of research. Furthermore, the research was conducted by applying 5S methodology to medical supplies in the operating room of RSIA Grand Family, Jakarta. The 5S procedure then was evaluated using descriptive and inferential statistics. The inferential statistics used was Wilcoxon Signed Rank test. Lean implementation that was carried out successfully reduced inventory costs to an average of Rp 331,555,768 per month in three months after lean implementation, from Rp 381,140,031 per month in the previous three months before lean implementation. This means that there is a cost reduction of 13.01%. Furthermore, the number of medical supplies items was reduced by an average of 12.45%. This research has a number of limitations. First, this research was conducted on the aspect of medical supplies from the operating room. Second, this research was still on a small scale and only evaluated the cost aspect of medical supplies.

Index Terms: lean implementation, waste of inventory, operating room, health service

1. INTRODUCTION

Operating room is one part of the hospital that is faced with inefficiency problems, both due to human factors and managerial factors [1]. Inefficiencies that occur in the operating room might affect patient safety problem because it can lead to delay in procedures and failure to carry out surgical procedures [2]. One important element in operating room inefficiency is medical supplies. Inventory is needed for the procedure and hence, all need to be prepared before the surgery is carried out [3]. Medical supplies can be difficult to obtain due to improper placement. Some of these problems are caused by excessive inventory so that important items become difficult to find while other items are actually not needed and have never been used in surgical procedures. Parts of it can be derived from the problem of secondary space placement design for the storage of medical supplies [4]. Indirectly, this also leads to problems related to the costs that the hospital must pay to buy items that are not needed, only to fill the shelves and inhibit item search that are very necessary. Efforts to improve the efficiency of medical supplies in the operating room are the right step to improve patient safety while reducing waste from the financing side. The end result of this effort is medical supplies that are really needed and sufficient for operating the operating room. Lean is a quality improvement method that is directed at disposal of waste and concentrates on processes that add value [5]. Although derived from manufacturing, lean has been successfully applied in the field of health services with good results [6]. Research on lean implementation through TPOT (The Productive Operating Theater) Program held at eight hospitals in New Zealand shows saving between 15% - 26% in inventory costs [7]. This is achieved by releasing a number of unnecessary or excessive stocks from the medical supplies of operating room. In this research, lean implementation was carried out in a mother and child hospital in Indonesia. In contrast to New Zealand, Indonesia is a developing country with specific challenges in providing quality services to the large numbers of patients. This research was conducted at RSIA Grand Family Operating room located in North Jakarta.

2 LITERATURE REVIEW

Detailed Lean is a method of improving quality directed at the pursuit of perfection (continuous improvement) by identifying and removing processes that do not add value.8 These processes are called waste. Something is said to be wasteful because consumers are not willing to pay for it to get service. This waste elimination is aligned with practices that contribute to cost reduction and scheduling accompanied by improvements in the performance of products, processes and organizations as a whole [9].

The first lean concept emerged in 1970s under the name of Toyota Production System (TPS). This concept is called Toyota Production System because it was present first at Toyota and its application in this company made the company a success and could defeat its competitors in the automotive industry. Along with Toyota's popularity, TPS was adopted for manufacturing with the name lean. Its implementation in the context of health services emerged after the implementation in manufacturing was also relatively successful and gained its own popularity as a method of improving quality. In 2009, surveys in hospitals in America showed that 53% had implemented lean at least in one department in their hospital [10]. Lean uses various tools to achieve its goals. Various types of quality improvement tools are applied in combination according to their needs. These tools include, for example, value flow map, kaizen, total productive maintenance, cellular manufacturing, kanban system, SMED (Single Minute Exchange of Die), standardization, visualization (andon, SS, heijunka, and jidoka) [11]. Many of these tools are used in various contexts, both manufacturing and health services. Each has advantages and disadvantages so that the selection of the right tools is critical for achieving the desired results [12]. The study of lean implementation in the context of health services has been also successful in showing effects on inventory reduction, increased productivity, and waiting time reduction [13]. More specific benefits include consumer waiting time reduction, patient flow improvement, direct savings, patient mortality reduction, blood process time reduction, staff travel distance reduction, lab space reduction, specimen
processing time reduction, labor reduction, length of stay reduction, morale increase, decision making acceleration, more efficient patient care, stress employee stress reduction, patient satisfaction increase, hospital income increase, stop unnecessary movements, and decrease in number of infections [14],[15]. In general, lean provides benefits on the work speed, which in turn reduce other undesirable aspects [16]. Lean implementation studies have also been conducted on various aspects in operating room. Aij’s research was directed at perioperative process increase by using lean in operating room. This research reveals lean’s ability to reduce door movement, increase scheduling, and improve the service process for cancer patients [17]. Other research by Aij and colleagues studied the challenges faced in leading lean programs in the operating room [18]. The challenges found were the complexity of work and environment. Lean implementation in the operating room was also conducted by Meredith et al (2011) who found a trade-off potential between efficiency and clinical attention such as infection control [19]. Therefore, lean research directed at infection control does not address the issue of efficiency, and vice versa [20]. The meta-analysis of quality improvement methodology in the operating room was carried out by Nicolay et al. This research found 34 previous studies and concluded that in general, the quality improvement methods, including lean, can be applied and provide good results on various aspects of operating room management [21]. A broader study on various aspects of the operating room had been carried out by Moore and Blick. The research was conducted at eight operating rooms in eight hospitals [7]. The results showed that in general, a number of advances were found, but they were not completely clear and could not be sustained. Specifically, for medical supplies, in one hospital the results of the release of storage space reached 25% by getting rid of 129 consumables. In various other hospitals, various savings between 15% -26% were found.

- Medical supply is one part of the waste of inventory in a lean-based waste typology. Lean recognizes seven types of waste in health services. This waste is as follows: [22] Waste of transportation, where staff must walk to the other end of the department to take notes or equipment storage center rather than the equipment stored in the location where it is used.
- Waste of inventory, in which there is an excess inventory in unused storage; patients waiting to be released, or waiting list.
- Waste of motion, such as unnecessary staff movements due to administrative problems for example, medicine form is not returned to the right place, syringe storage in a distant place; and do not have basic equipment in each examination room.
- Waste of waiting time, such as patient waiting time, examination results, medication, staff, prescription, or doctor to release the patient.
- Waste of production, such as carrying out unnecessary pathology test, or storing an investigation slot just in case.
- Waste of process, such as duplication of information (requesting patient details repeatedly).
- Correction, such as readmission due to failed release or drug reaction and repeated tests because correct information is not provided.

The success of lean implementation lies in the degree of leanness of an organization [6]. Leanness is the ability of an organization to think in a lean perspective including understanding of lean concepts, commitment to run improvement programs, ability to identify waste, and the existence of lean culture [6]. Other factors that are known to determine the success of lean implementation include increasing solution retention, cross function work, maintaining a long-term view of improvement, involving senior management, and encouraging value creation for patients and other customers from the hospital [23]. This will lead lean to be more than just partial improvements on the certain segments of the organization, but as improvements made by understanding the organization of the organization as a whole [24].

3 OBJECTIVE
This research aims to find an idea of the effectiveness of the application of lean medical-based inventory management in the Operating room of RSIA Grand Family, North Jakarta.

4 LEAN IMPLEMENTATION STEPS IN THIS RESEARCH
RSIA Grand Family is a hospital with 63 inpatient beds, 20 outpatient polyclinics and medical support facilities consisting of pharmaceutical, laboratory, radiology and physiotherapy units [25]. It is a private hospital that provides good maternal and pediatric services both medical and surgical. We observed that medical supplies in the operating room were classified as expensive but many were not used and they might hinder effective operational implementation in the operating room. After conducting a resource inventory, in September 2018, the surgical unit started a lean intervention aimed at reducing medical unit medical supplies. Lean team leader and a staff nurse worked unit staff to arrange schedules, carry out training, and brainstorming process. The intervention carried out was the application of 5S, consisting of sort, set-to-order, shine, standardize, and sustain. The 5S methodology is known to be able to make space cleaner, organized, and efficient, so as to improve safety and productivity while reducing inventory and supply costs, capturing valuable space, as well as minimizing overhead costs [26]. The 5S steps taken including:

a. Sort. At this stage, the team collects all available medical supplies and classifies them based on their lifetime and frequency of use. Inventories classified as expired or rare until they have never been used are immediately removed.

b. Set to order. A number of activities are carried out at this stage. Activities carried out including:

1) Classify medical supplies into classifications based on ABC system [28]. ABC system is created by giving the importance and frequency of use of item. The results of the degree of importance and frequency of use are called inventory value. Items that make up 80% of the total inventory value are classified as A category, items that make up 15% of total inventory are classified as B category, and items that make up 5% of total inventory are classified as C category.

2) Analyze the space requirements for storing medical supplies.

3) Place the shelves at the specified location.

4) Label the shelves and item.

5) Provide clear instructions for the shelves’ position.
c. Shine. In this stage, the team creates a periodic cleaning mechanism.

d. Standardize. To standardize medical supplies, several action were carried out, among others:

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5) Provide clear instructions for the shelves' position.

e. Sustain. For 30 days after the four steps above, the team continues to carry out activities to ensure all existing rules are obeyed.

5 DISCUSSIONS AND FINDINGS

As shown in Table 1, the baseline data in September 2018 produced 1347 medical supplies items consisting of seven types of inventory. From the seven types of inventory, medical devices and medicines were the most abundant types of supplies. Both comprised 96% of the total operating room medical supplies.

Table 1. Baseline data of operating room medical supplies of Grand Family RSIA September 2018.

<table>
<thead>
<tr>
<th>Inventory Type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Device</td>
<td>493</td>
</tr>
<tr>
<td>Raw Material</td>
<td>18</td>
</tr>
<tr>
<td>Consumable</td>
<td>25</td>
</tr>
<tr>
<td>F/A Medical Equipment</td>
<td>12</td>
</tr>
<tr>
<td>F/A Non-Medical Equipment</td>
<td>1</td>
</tr>
<tr>
<td>Housekeeping Equipment</td>
<td>1</td>
</tr>
<tr>
<td>Medicine</td>
<td>797</td>
</tr>
<tr>
<td>Total</td>
<td>1347</td>
</tr>
</tbody>
</table>

The team calculated that the inventory cost of 1347 items reached Rp. 371,508,783. When compared to the previous two months, it was found that this value was still relatively low. A month earlier, the inventory value reached Rp 390,126,482 while in July it reached Rp 381,784,828. The average inventory value for the three months reached Rp 381,140,031. Based on the data and condition of the items, the team then performed the 5S step. Through sort step, the team removed 168 items because they were expired or rarely used. The value of this removed item reached Rp. 41,357,826. That is, through 5S, the team managed to save inventory costs by 11.13% in September, or 13.38% from the average quarterly cost of medical supplies.

In November, five new items were added to medical supplies due to the increased goods needs. Even though the number of items was added, the actual total inventory value was lower than October. In November, the inventory value was lower than Rp. 2,726,833 compared to October with 1,184 items compared to October with 1,179 items. In December 2018, the evaluation showed the value of the medical supplies item by Rp. 337,092,224. This value was 11.56% lower than the average value of July-September 2018 quarter. The value in December was actually higher at Rp 9,668,100 than the value of inventory in November. Indeed, there were fewer actual inventories. When compared to September, the number of inventories in December was fewer by 172 items. Note that in November, the total inventory was fewer by 163 items than in September. This is because there were a number of expensive items that must be added while many items removed were cheap items.

Table 2. Reduction of total items after lean implementation compared to the final condition of total items in September 2018

<table>
<thead>
<tr>
<th>Month</th>
<th>Item Reduction</th>
<th>Reduction Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td>168</td>
<td>12.47%</td>
</tr>
<tr>
<td>November</td>
<td>163</td>
<td>12.10%</td>
</tr>
<tr>
<td>December</td>
<td>172</td>
<td>12.77%</td>
</tr>
<tr>
<td>Average</td>
<td>168</td>
<td>12.45%</td>
</tr>
</tbody>
</table>

However, the average inventory value of three months after lean implementation had decreased by 13.01% from the average inventory value three months before lean implementation. This value was associated with an average reduction of 168 items from the initial number of items of 1347.
This change can be observed in Diagram 1 below. To assess the significance of the changes, the analysis of Wilcoxon Signed Rank Test was conducted on three comparisons: conditions for October with September, November with September, and December with September. Wilcoxon Signed Rank Test compared two sets of values that belonged to the same item. The inventory values for October, November and December were paired with each inventory value per item in September. Wilcoxon Signed Rank Test was used because after the normality test was done on the distribution of the score difference from the two paired months, an abnormal distribution was found. Table 3 shows the test results.

Diagram 1 Load of RSIA Grand Family operating room medical supplies three months before and after lean implementation

Table 3 Wilcoxon signed-rank test

<table>
<thead>
<tr>
<th></th>
<th>October-September</th>
<th>November-September</th>
<th>December-September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>-5.797</td>
<td>-4.853</td>
<td>-4.509</td>
</tr>
<tr>
<td>Asymp. Sig (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

As the Wilcoxon test shows, there is a significant difference between inventory values in October with September, November with September, and December with September. Reduction in inventory costs by 13.01% achieved by this research was lower than that reported in the study in New Zealand that was 15%-26%.7 Similarly, Chiarini (2012) identified that in the case of medicine, in average the department ordered 38% more medicines than needed from the pharmacy department, highlighting the possibility of reducing the medicine supply to 38% [29]. Items reduced in the present case are not all medicine supply items. Even if all reduced was medicine supply item, the reduction achieved was still at 20-21%. This shows that there is a potential for more item reduction in the future and hence, reducing the inventory costs. The average reduction of one item in inventory in this research case was Rp. 238,911 per item. If the team could reduce up to 15%, the savings achieved could reach Rp. 48,259,944. If the reduction could reach 26%, the savings achieved was Rp. 83,618,715. If the reduction could reach 38%, the savings achieved was Rp. 122,322,234. Each of these values was associated with a reduction of 12.66%; 21.94%; and 32.09% of the cost of medical supplies in the operating room. More item reduction is possible based on various previous studies on the reduction of medical supplies. In addition to the research above, there are studies that reduce the number of inventory items up to 45% for pharmaceuticals, 24% for other materials, and an average of 35% for all materials [30]. However, efficiency efforts in the operating room require extreme care. There are two important reasons why this should be maintained. First, efficiency activities have trade-off on infection control [19]. Activities on medical supply items can result in health and safety risks specifically as pollutant sources, moreover if medical supply shelves are in the operating room [4]. Even so, SS activities also have benefits of the infection control. Disposal of medical supplies that are expired and not needed in sorting stage will certainly reduce the threat of medical supply aging. Meanwhile, the shine stage will ensure that the existing inventory is properly maintained so as to minimize the pollution risk. Second, there will be cases where the supplies needed in an emergency are not found. They have been removed from the shelves as they are considered never or rarely used. In an emergency situation, this might threaten the patient. For this reason, it is very important that certain inventory items, even if they are never used or rarely used, remain in the inventory shelves. The lean method used in this research also has limitations. Lean criticism is not able to accommodate variation or reduction in demand that may occur in certain situations such as emergency [31],[32]. Such situations may not occur in the mother and child operating room because there is a small chance of an emergency situation resulting in sudden fluctuations in the number of patients requiring surgery. This will be different in a situation such as in emergency room at public hospitals that can experience a high demand when situations such as mass accidents or natural disasters happen. Therefore, lean implementation to more general spaces requires more consideration and caution. Another challenge in lean implementation criticized by the literature is the lean focus on production aspect in product life cycle [33]. This requires lean to be applied in the long term and includes various other aspects in the product life cycle including the final aspects such as disposal of items removed from medical supplies so that it meets the sustainability requirements. This can encourage the practitioners to develop a lean culture throughout the life cycle of products and services provided by the hospital to produce a green hospital. One variant of lean implementation that has begun to be applied in operating room studies is lean combination with six sigma [34]. While lean focuses on doing the right thing through activities that add value, six sigma focuses on doing the right thing through anti-error efforts [21]. There is no doubt that it is very important for surgery to run without error. Often, errors that occur in the operating room are attributed to the people inside [35]. These errors can be minor failures, major failures, threats, errors, technical errors, and non-technical errors [36]. This can be damaging because in addition to carrying out activities which is closely related to the patient life, the operating room also relies on collaboration [37]. Imposing mistakes in one person can damage the important collaboration to be maintained in the operation of operating room. Lean has a philosophy to blame the system, rather than humans. This avoids the emergence of a culture of blame each other and vice versa, fosters a lean culture that emphasizes the identification and elimination of the waste cause factors [38]. The combination with six sigma makes error as a form of waste which is then addressed by a methodology based on six sigma.

6 RESEARCH LIMITATIONS
This research has a number of limitations. First, this research...
was conducted on aspects of medical supplies from the operating room. Opportunities for lean implementation are still very broad in the operating room, even in the aspect of medical supplies themselves. For example, lean can be applied to determine the ergonomic and safety aspects of medical supply shelf position. On a broader aspect, lean can be applied to reduce patient waiting time before surgery, reduce infection, increase perioperative antibiotic prophylaxis, reduce variability and increase surgical service experience, as well as reduce LOS (Length of Stay) [20],[34],[39–41]. Second, this research is still on a small scale and only evaluates the cost aspects of medical supplies. Lean can also be applied not only to excess inventory, but also at waiting time. Other wastes have not been addressed such as transportation, movement, production, process and correction. Moreover, lean steps are still limited to one department. Lean can be extended to other departments, across departments, up to the organization of hospital as a whole.

7 RECOMMENDATIONS

Inventory reduction can be done in almost all hospitals using lean methods. For the inventory reduction in operating room, we provide several recommendations as follows:

a. Operating room can improve its efficiency with 5S practice in medical supplies that is able to reduce costs while improving the safety of surgical patient.

b. Integration of lean implementation is needed more broadly in the aspects other than efficiency, for example in the aspect of infection prevention.

8 CONCLUSION

The implementation and development of lean intervention on the inventory in hospitals make it possible to be applied by academic practitioners and researchers. First, the 5S step used in this case allows other hospitals to improve cost efficiency in various departments, especially the surgical department. Even so, caution is needed considering that the characteristics of other departments can differ from the characteristics of surgical department that becomes the focus of current research. Therefore, small-scale pilot studies need to be conducted first as a trial for the application of medical supplies on the room other than the operating room. Second, for academics, lean implementation research can be assessed from a broader perspective such as the perspective of HR management or its relevance to other quality management theories such as six sigma and total quality management. Researchers can also conduct empirical studies of the factors that influence the success of lean implementation in reducing waste, especially in the hospital and other health service settings.

REFERENCES


