



## **LEAN MEDICAL INVENTORY MANAGEMENT IN HOSPITALS**

### *Hastanelerde Yalın Tıbbi Envanter Yönetimi*

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#### **ÖZ**

Sağlık hizmeti tedarik zinciri yönetimi üzerine yapılan literatüre yalın sisteminin önemli katkılar yapacağını gösterdi. Yalın yönetimde başarı yalnızca çalışanlarla değil mevcut teknoloji ve klinik mükemmellikten geldiği bilinir. Hastaneler yeni teknolojinin ve yeni alanlara para harcamanın topluma hizmet etmekte ki gayretten geçtiğini ve bu durumun hastanenin de karına ve lehine olacak şekilde uyarlanması gerektiğini bilmektedirler. Dahası hastanelerdeki en büyük israfın ve kargaşanın stoklarda olduğu da belirlenmiştir. Bu yüzden sağlık hizmetindeki yalın envanter sistemi, gerekli malzemenin tam zamanında tedarik edilmesine odaklıdır. Ancak çok az sayıda yazı ortaya konmuştur ve kapsamı bilinmemektedir.

Bu araştırma yazısının amacı sağlık sektöründe yalın envanter sisteminin etkinliğini anlamaktır .Bu çalışma yazısı envanter yönetiminin karışıklıklarını basit ve kolay yoldan anlamakta çok faydalıdır ve konunun daha kolay anlaşılmasına yardımcı olacaktır.

#### **ABSTRACT**

Literature on healthcare supply chain management has shown that the lean system can provide significant benefits.It known that success in lean management doesn't come with employees but through current technology and clinical perfection.The effort of serving society causes hospitals to spend Money on new technology and new fields which they know that this must be adapted in their favor and with a profit. Furthermore it is stated that that the highest waste and confusion in a hospital is with inventory. So lean inventory system in healthcare is the system that focuses on timely replenishment of items. However, very few of its benefits have been empirically demonstrated and the extent of each of them remains unknown.

The purpose of this research paper is to know the effectiveness of the Lean inventory system in health care industry. This research paper is very useful in understanding the complexities of inventory management in a simple and easy way and thus help to easily understand the topic.

## **1. INTRODUCTION**

In recent times the service sector has grown and progressed quickly worldwide as well as in Turkey.This growth has also affected the health sector and health care industry has grown as a part of the service sector (Lopez et al., 2013: 7). Developments in the world especially for the last 30 years requires a review of the health services. With the influence of products from advanced technology in health care, an increase of service, quality and expectations of the users happened in a way that can not be ignored. Along side these developments there has been a gradual increase of the amount spent on health care. . As a result this forced the states to review their own health systems in order to look for ways to make services more affordable.

Within the health service, hospitals has always had an important and distinct place. One important reason for this is that most of the resources within the whole supply chain are used here. In terms of labour, human resources, capital for establishing and acquisition of medical equipment and running costs such as resupply of drugs and medical supply, hospitals can be described as an intensive enterprise (Cooper, 1994: 20). Hospitals are the foundation of the health care system in the world. Also, hospitals as profession are a place of developing knowledge and application of skills. Hospitals are institutions where a significant portion of a country's health resources are spent and applied. Ever since the first day we are experiencing major problems concerning hospitals in our country. The solution for these seems possible not by individual hospitals but upon the health care system in the country (Sur, 2008: 23).

In comparison to other health units the hospitals are very different in terms of both location and technology used in devices and in equipments. Technology management is therefore of paramount importance (Çetik and Oğulata, 2014: 22). Cases of inability to efficiently use or misuse of latest developments in technological devices or tools are a source of high costs to the health sector. In terms of the medical staff, experience and timing carries great importance and most often a quick decision is required (Çetik and Oğulata, 2014: 30). Therefore, conditions like flexibility and customer oriented work in the health care business is of great importance. In parallel with technological developments, Lean Production Tracking system which provides significant advantages to companies to realize these conditions, also emerged. Using RFID Technology and Lean Hospital Information Platform for Cloud and Mobile Proglama systems a Lean Kanban system should be established. Because of this lean is very important in health care (George, 2003: 15). Lean Thinking principles provides reduction in costs and wastage, improvement of quality, patient and staff satisfaction in health care. Because lean transformation allows to reduce the time spent on value adding processes while removing non-value adding activities. Almost 50% of the activities carried out in a non lean service process seems to be activities that doesn't add value For example, in a study of Lockheed Martin found that 83% of the activities carried out from purchase until delivery was seen as activities that doesn't add a value (George, 2003:18). Looking at values reached through studies determined that staff service time from a customer point of view is done with non-value activities and that these activities increase cost of services in a range of 30% to 80%. In 2005 H. James Harrington announced that each year nearly 2.2 million people world wide died due to improper intervention and treatment and that each year 150 million prescriptions of 3 billion recorded is incorrectly filled in also that each year there are 1500 patients with something forgotten inside them after surgery. In a 2003 New England Journal of Medicine magazine study shows that this occurred in one of every 1000 surgeries On top of this 50% of the hospitals are noted to experience financial problems (Arthur, 2011:25). According to a survey from April 2008 by a reliable organization The HealthGrades ([www.healthgrades.com](http://www.healthgrades.com)) the number of deaths due to medical errors in the United States is 238,000 every year. 12,000 of these deaths is a result of unnecessary surgeries and 80,000 is a number of deaths from germs caught in hospitals The number of patients who died as a result of adverse effect of administered drugs is 106,000, which is equivalent to half of deaths from medical errors (Munir, 2009: 35). Based on the studies conducted in advanced Western countries with the best probability estimate there are between 19,000 and 34,000 people who lose their lives in hospitals in Turkey due to medical errors and interventions every year (Munir, 2009: 30).

The aim of this research is to show the material and immaterial added values that can be gained by lean kanban practices in hospitals. Process efficiency and quality could be increased with the implementation of lean kanban process in the health sector while financial problems faced by hospitals could be reduced. At the same time by using lean kanban techniques in hospitals eliminates the cost due to waste while the aim is more customer satisfaction. This study is important for lean health care in terms of which division has implemented the lean

technique kanban card system and the improvements in service of care, employee and patient satisfaction, decrease in waiting time, organized workflow and as literature for hospital managers. Guiding the way for health managers implementing kanban card system in hospital care in our country and becoming a reference to the scarce publications has increased the importance of this study. There are very few studies regarding the applicability of lean kanban card system in our countries health care. Therefore, this study, in terms of differences in application and by demonstrating the applicability of lean kanban cards system in health care business provides a significant contributions in leading the way for academics and other people who do research on this subject.

## 2. THEORETICAL FRAMEWORK

### 2.1. Lean manufacturing

Lean manufacturing is a production system in which the least amount of resources in least possible time are used to meet customer requests fully and where the lowest wastage are achieved with flexible production factors (Lopez et al., 2013: 64). The work of Womack's, Jones' and Roos', seen as one of the most fundamental on lean production, "Machine that Changed the World" specifies that lean production is known as a production with no unnecessary elements in its structure and elements such as cost, inventory, labor, development time, production space, wastage, customer dissatisfaction are minimized (Womack et al., 1990:75). Lean production, "by least amount of resources, in a least amount of time, with the cheapest and zero defect production within customer requirements/ least amount of response time, least waste (even zero wastage) and as a result the use of all the factors of production in a best possible way by making use of every function", is the result of the question "How did you do it?" (Okur, 2000:24). The enemy of the word Lean in Japanese is "muda". Muda means waste. Muda indicates especially the operations that uses resources without revealing any value. The application for getting rid of Muda is lean transformation. Lean practices show the ways to define values, list the stages that make value in a best and descriptive manner, when the need arises the disposal of these steps without causing any disruption and for processes to occur more effectively. Taiichi Ohno, lists the following as conditions that cause waste (Womack and Jones, 1998:54).

- ✓ Defective products that needs to be reprocessed,
- ✓ Unsolicited production and as a result unnecessary storage in stock,
- ✓ Processes not really needed,
- ✓ Transportation of products and employees when in fact there is no need (unnecessary transportation)
- ✓ Idle staff due to assignments not completed in time and halting operations in the next stage,
- ✓ Products and services that do not answer customer requirements and expectations.

The goal of lean kanban card system is as the major objective of lean implementation to eliminate and reduce waste seen frequently in business. Constantly attempting to reduce and eliminate waste with this system results in significant decline in cost and cycle time (Alukal, 2003:30). In a application Lean kanban system production effects customer orders and no action is taken without any customer request Only when an order is received that the cell begins to manufacture. . Even when the machines are not in any kind of process, stock is not created without an order. Materials are resupplied in stock according to customer order managed by signals from kanbans. Kanban cards are placed into cells in a way that reflects the production flow.

After 1991, lean thinking and production began to be implemented around the world first by Western companies in different sectors, to be taught as a subject in universities and to take place in scientific research. Some governments even led companies to become lean by law. Lean

thinking is put forward to eliminate waste in business. This practice goes back to the beginning of the history of the industrial revolution (Meyers, 2002: 65). Lean thinking has given a new meaning to the concept and shape of production and changed it. This is because aspects of lean thinking and assumptions from past to present in conventional production contradicts one another in many points. Lean manufacturing is a process concerning the entire business from product development to long term plans. Lean business means the disappearance of all kind of things which doesn't add value and are not needed.

## **2.2. Lean Production in Hospital**

The lean idea emerged in the late 1980s and as the scope of applications grew it spread across all industrial sectors; Since 2000 it has been implemented in a ever increasing manner in health and hospital systems. Historically lean healthcare was first implemented in the UK in 2001 and in 2002 in the United States (Brandao de Souza, 2009: 38). The applications of lean thinking has increased in healthcare. So far in almost ten countries from the first applications up until now it is found in over ninety academic studies (Brandao de Souza, 2009: 122).

Womack and Jones (1996), Whitson (1997) stated that lean thinking can be applied to all types of businesses. After the positive results of simple applications in the industrial sector, institutions providing services such as hospitals began to apply lean thinking in different sectors. Womack and Jones are first to apply lean thinking in the health sector. However, the first successful application of lean in hospitals was accelerating the flow of patients in a hospital in the US obtained by Shelest and Bushell (2002). The lean status is related to humans and as long as humans manage institutions the lean principles can be applied to any institution.

Lean thinking offers an opportunity in solving difficulties and bottlenecks in the health business, educates personal in the use of lean tools and develop their businesses. It will also facilitate improvements by reducing the cost and improving capacity in healthcare. In addition the plainness improves quality and patient safety by reducing the standby and process time and eliminates waste through patient treatment thus increase patient satisfaction (Naraghi and Ravipat, 2009: 15). Young et al. (2004) stated that the implementation of lean principles in the health sector eliminates the wait time, repeated pauses, errors and redundant operations.

The health system is facing the challenges and opportunities of patients' expectations and their search for a higher quality environment in a rapidly changing operating environment (Shazali et al., 2013:21). Lean concept occurred in fact for high quality products and services in the automotive industry while improving administrative performance and increasing the number of satisfied customers. However, some organizations have adopted this concept for the health sector. Rexhepi and Shrestha (2011) states that health sector has needs for lean implementations. They even stated that this could be applied not only in hospitals but also in private clinics or nursing homes.

Womack and Jones are one of the first authors to put the how to implement lean practices in the service sector, especially in healthcare sector, in writing (Womack and Jones, 1996:21). They list the fundamental performance steps of the application of lean thinking in health services and systems as follows;

- ✓ Prioritize according to the condition of the patient,
- ✓ Ensure the quality,
- ✓ In patient care create the best patient care team,
- ✓ Ensure active participation of the patients in the patient care process.

A correct applied lean thinking is reported to be an effective means to detect and eliminate waste in hospitals (Hagg et al., 2007:76). The purpose and benefits of lean thinking in the health sector is to minimize or eliminate waste by reducing unnecessary transport and waiting times at the same time repairing the flexibility, the quality and the speed in the sector. Lean initiatives is not fixed to large scale investments, but rather it presents the health sector with different method for the way of improving without the need for high investments (Bahensky, et al., 2005: 41).

### 2.3. Kanban System Implementation

Kanban is an effective method for reducing preparation processes and raising the quality by bringing stability to the main production program and facilitating the production process with serialized flow of parts and materials and a fixed production rate thus improving productivity (Bahensky, et al., 2005:39). Kanban card is a stock card in a pull system. It is not to produce in any circumstance a service or a product without the need from internal or external customers located in the next step. In addition in pull systems the next process requests only the speed, amount and time it uses and takes the value thus a limited amount of stock is kept in such a system. Generally a rectangular plastic, cardboard or metal card is used in the system to carry information (Okur, 2000:25). The information retained on the kanban cards can be like the following listed:

- ✓ where it is used (stock origin point, the point of consumption, transport path)
- ✓ Part number
- ✓ Part name
- ✓ Part Definition
- ✓ Kanban number (Kanban identification number)
- ✓ Part Number / Kanban (the amount ordered by the kanban for each unit of the main part)
- ✓ The identifying code number, or the name of the box where Kanban is regularly placed
- ✓ The location to the workstation the Kanban will be delivered to (Code number or description)

Kanbans are named according to the place or purpose they are used. There are two types of Kanban. Pulling kanban and production kanban. While the pulling kanban takes in to consideration the nature of the type of product previous cell should withdraw from the next cell; the production kanban considers the type and amount of product that should be produced by the cell in which it resides. Also while the pulling kanban can move between other cells, the production kanban is movable only in its own cell. The system in which these two kanbans work together is also called the supermarket pull system. The rules in the Kanban system are as follows (Bahensky, et al., 2005: 39). The customer cell should only withdraw on the time needed, in the amount needed and the needed product from the previous cell. The following conditions must be fulfilled before applying the rule:

- ✓ There should be no pull without a kanban
- ✓ There should be no pull higher than the Kanban number.
- ✓ Supplier cells must produce in the amount of products pulled by customer cells.
- ✓ Production higher than the Kanban number should be prevented.
- ✓ If there are to be produced different parts in a supplier cells these should be done according to the order of each kanban delivery

The positive effect of the lean kanban system on hospitals can be listed as follows;

- ✓ Provides remote management of equipment and materials
- ✓ Provides a link between hospitals, vendors and to the logistical organization

- ✓ Migration from manual processes to automated, allows an effective cloud-based solution via RFID
- ✓ Creates a common database for any health products and identification Technologies

#### **2.4. Stockless Material Management System**

A necessary coexistence occurs among all members of the distribution channel in a system that aims to remove all of the stock in the central warehouse. With objectives, strategies and financial information shared from time to time distributors, vendors and customers can together improve the distribution channel. Hospitals are not only a customer but also a ring in the distribution chain. Patients are located at the end of these rings as end consumers. According to a research done by the American Hospital Association 57% of American hospitals are using the JIT or Stockless Material Management System. Hospital management constantly discuss the validity of a stockless system. Some express that the transferring of distribution and storage costs to the supply chain is a result of applying a Stockless Materials Management System. According to this view, the savings associated from purchases without creating stock are eliminated when the high seller's costs are added. On the other hand according to Whinney only if hospitals and their sources of supply develop the stockless materials management system together, the benefits will outweigh the problems that they may face. In addition the extra costs reflected on the suppliers will be reduced in part by the increase in sales.

#### **2.5 Barcode System**

The barcode successfully applied for many years by different enterprises such as textiles, food, pharmaceutical, automobile started to be applied in the health sector, especially as inventory tracking in hospitals, when inputting orders in to the system, tracking materials within the organization and management areas such as follow ups on laboratory samples, in pharmacy, radiology and in departments for patient reception (Lodge and Bamford, 2008: 18). In a barcode system the information is coded in way that it can be read by optoelectronic devices. . With the help of these instrument information is sent directly to the computer. In addition compared to manual methods information is transferred quickly and a lot less incorrectly (Lodge and Bamford, 2008:19). While the possibility of error in manual input is high, this rate is almost none with barcode.

According to a survey in US "The American Society of Hospital Materials Management" less than 40% of the materials used in hospitals are barcoded by the manufacturer. However, only 22% of hospitals in the country regularly apply the barcode system in a inventory control. It is determined that the hospitals save millions of dollars with this system. Patients are billed correctly thanks to the barcode system. The barcode labels of the materials used on a patient are recorded in to the patients account with an optical reader.

Barcode system eliminates many of the errors caused by the old system. Before this the nurses would remove the price tag from the materials used on a patient and bring it to a floorwalker so that it could be sent to patient reception for billing. However, this system eliminates the floorwalker as carrier personnel, thereby profiting from labor costs.

In order for successful operation of this system;

- ✓ A basis should be created for devices such as machinery and equipment
- ✓ An integration of the barcode system with the central automation system should be ensured
- ✓ Employees should receive sufficient training
- ✓ Material standardization should be provided
- ✓ Must ensure the support and conditions of senior management of the hospital

There are very few hospitals in Turkey with barcode application. In our country the system is being implemented mostly by exporters open to foreign markets. In addition, the necessary regulatory systems to be used widely in our country are not appropriate. The application of barcode has only been necessary in administration of materials such as medication since 1990. Implementation of barcode systems in all hospitals improve their competitiveness and allows for more efficient use of resources (Bahensky, et al., 2005:43).

## CONCLUSIONS AND RECOMMENDATIONS

Kanban is an effective method for reducing preparation processes and raising the quality by bringing stability to the main production program and facilitating the production process with serIALIZED flow of parts and materials and a fix production rate thus improving productivity. Members of the distribution channel within a system that aims to remove stock in the central warehouse are forced into an alliance. With objectives, strategies and financial information shared from time to time between distributors, vendors and customers can together correct the distribution channel. . Hospitals, are then no longer just a customer they are one of the rings in the distribution chain. The patients are the last ring of this chain as end consumers. According to a survey by the American Hospital Association 57% of US hospitals use Stockless Material Management System. Hospital managers constantly discuss the validity of a system without stock. One side, argues that with the implementation of Stockless Material Management System, distribution and storage costs are ultimately transferred to the supply chain. According to this view, the cost savings associated with the purchase without stock, would be eliminated by the high costs reflected on the seller's price. According to Whinney though, if hospitals and their suppliers develop a stock material management system together the benefits will outweigh the problems. Moreover, the additional costs of the suppliers will almost be eliminated by the increase in sales.

Information on the barcode system, which will further facilitate the work of Kanban cards can be encoded to be read by the optoelectronic devices. The information with the help of these devices can be transferred directly to the computer environment extremely fast with a lot less incorrect information compared to manual methods. With a manual entry errors are likely to be at a rate of one in 300 characters while in the barcode system it is one in 3 million characters. According to a survey conducted by the US "The American Society of Hospital Management Materials" less than 40% of the materials used in hospitals are barcoded by manufacturer. . However, despite the encouragement by suppliers and various groups in the country only 22% of hospitals regularly use barcode in inventory control systems. Hospitals can save millions of dollars with this system. Kanban and barcode system is implemented in the hospital briefly as follows: Every morning attendants scans materials at the service stations and at the departments with the barcode reader. The amount of material is thus transferred to a central computer via radio waves. At that moment the current inventory levels are compared with the desired stock level and if the amount of material available is not sufficient the amount needed is ordered from the central repository. Thanks to kanban card, finding out the location of the materials and the last person who handled them are easy and at same time thanks to the barcode system the account for the patient comes out correctly. The barcode labels on the material used for the patient is recorded with an optical reader to the patients bill.

Barcode system and kanban card application eliminates most of the errors caused by the old system. Previously, nurses took the price tag off of materials used for the patient and gave them to the floorwalker in order to record them on the account by sending them to the reception center. Or that the, what we call high value, products could disappear. The new system saves labor costs by eliminating these floorwalkers and by being in front of the disappearance of high value products it largely prevents the problems hospitals meet.

In order for successful operation of this system the following must be ensured;

- ✓ The creation of infrastructure for machinery, equipment, etc.
- ✓ The integration between the systems for the Barcode and kanban card and the central automation training of operating personnel.
- ✓ Providing standardization of material.
- ✓ The support and conditions of the hospital's senior management..
- ✓ Promoting the use of barcode systems in all hospitals will improve their competitiveness and will ensure an efficient use of resources.
- ✓ A study designed and conducted in a hospital environment with progressive and quantitative research methods would benefit to promote the system.

The 9-step process below is recommended for such a project:

- ✓ Establish objectives, targets and performance measurements for the Project
- ✓ Observation
- ✓ Develop the process stream
- ✓ Collect and gather available data
- ✓ Analyze data
- ✓ Identify bottlenecks and constraints
- ✓ Develop recommendations
- ✓ Implement solutions
- ✓ Performance measurement

When starting a new practical case study, knowledge of the area is important. Establish a contact that can especially answer questions and explain each stage of the process. It is useful to use flow diagrams and value stream mapping in order to visualize information. Flow charts should be updated continuously throughout the observation and data collection process. During the study information should be collected according to the rules of the kanban card system used.

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