



REVIEW ARTICLE

LEAN HOSPITAL APPROACH IN HEALTH CARE

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ABSTRACT

The cost of health care has been rising rapidly in our country and in the world and it takes more from the budget. Costs, malpractices, wasted time, and general bureaucratic inefficiencies has bought a need for the new approaches. Lean management is the elimination of any activity that does not add value to an organization's end product, and using what is referred to as a "just-in-time" inventory strategy, which aims to reduce inventory and associated carrying costs. Technology can reduce the manual labor involved in many processes that take place within a hospital and improve overall efficiency. Lean organizations differ from traditional organizations in putting the power of improving an organization into the hands of the employees that directly interact with the end product, rather than management. The largest difference between traditionally managed organizations and lean organizations is their focus on systemic improvement. Lean organizations focus on identifying the root causes of all problems and adjusting processes to stop the same problems from occurring in the future. The purpose of this study is to present lean hospital management system to the health sector in Turkey, which can benefit us in all means, can be used. In this way, lean system can support health care workers and doctors, making sure that they can give their full attention to the situation in their hands. This system will reduce risks, costs, and waste while empowering and making it easier for the hospitals to improve in the long run.

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INTRODUCTION

Lean thinking is, to dismiss any excessive movement and idea that has no contribution to value stream. According to lean these are considered to be and they must be eliminated. Lean thinking focuses on the production approach and is directly based on the actual activity whilst being oriented towards highlighting the necessity of value-added activities: therefore, lean thinking, products and means, leading to the elimination of waste and non-value added processes for customers. In other words, labor, materials, equipment, time and means to create high value-added processes (Womack and Jones, 2003). In this way, by removing all unnecessary burdens on businesses expenses in order to foster the process of simplification. Thus, the production process progresses faster, more efficiently and in a less costly manner (Graban, 2011). The underlying principles of lean thinking are: value, value stream, flow, pull and perfection. Value, stands for producing goods or services which customer pays a fixed price to fulfill his needs. Value stream implies the contributive or excessive energies to produce that good or service.

Flow means a product or service which fulfills the expectations of many of the activities that create value for customers and is arranged in a process. Tension means withdrawing from the production value of the resource to be consumed by the customer. Excellence can be defined as the constant efforts wasted to perform production process in the best way (Aktaş and Kargin, 2011). In the light of this informations lean implies to eliminating non-contributive energies, the production factors that is used, providing advanced technology equipments and the skilled labor, performing the task in once and best, preventing the errors as much as possible and managing all of the in accordance (Türkan, 2010). Lean consists of a bunch of norms and methods that the companies to be competitive in feature. Lean thinking, is applicable for any case in the presence of time, money and supply. The main interests of lean are product management. Product development, supply chain management and after-sales service (Warnecke and Huser, 1995). It is claimed that a lean activity is for the usages of resources build the process and capacity (Aronsson *et al.*, 2011).

The History of Lean Management

The definition of lean management as a historical development is also important.

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Henry Ford, in 1927 with the revolutionary Ford Production System (FPS Ford Production System) announced the basic principles underlying it. Toyota's founders have worked on FPS and further developed and defined the principles and tools for the Toyota Production System (TPS-Toyota Production System). Full-time (JIT) method were the key point of the Toyota production system. The main purpose was to reduce the costs of TPS. Quantity control and quality assurance are required to provide it. Thus only the necessary products, the required amount of time and the production is addressed. Due to the oil crisis of 1973, a sudden increase in interest in production and management application with new Japanese-hit North America and there have been many studies on this subject (Weinger, Matthew, Jason, Nelda, 2003).

To define the production system used by Toyota in 1988, "lean" is the word used. Lean system describing the details of the book "Machine that Changed the World" was published in 1990. This book introduced lean manufacturing, and the underlying components of Toyota's production system. There are many articles and books on lean thinking and lean systems from the time (Shah and Ward, 2007). Toyota has completed the evolution of production and management systems developed over many years. In today's health care budget excess healthcare costs, errors endangering patient safety, time wasted and patients and health workers from hospitals and bureaucratic inefficiency have led to the search for a new management style. First, lean management has become the indispensable standard for US hospitals, and later spread rapidly around the world. In all business processes with the principles developed by the Toyota hospital studies showed a significant improvement. Patients reduced costs, increased employee satisfaction and patient care services improved. The implementation of a lean thinking approach to this hospital led to the term "Lean Hospitals" being used (Womack, James, Daniel, Jones, Daniel, 2000).

Lean Management Approach in Health Care

Healthcare professionals eliminated waste maximizing value owned Lean hospitals, as well as other organizations, to determine the desired values of users, eliminating steps without added value and they have to move them all to the end of the beginning of doing value stream according to the needs of the patients (Grabana, 2011). Lean implementation of the health institutions has created a positive impact in both administrative and clinical processes which has been demonstrated in many studies. As well as to patients in the care process, and health workers in giving treatment, the operation process can also be applied in areas such as imaging services (Grabana, 2007). According to the stockpiling function of the instruments and equipment used in the treatment process, the creation of the checklist after each process and ensuring patient safety will minimize the possibility of error on the part of the medical staff. Ensuring product availability and minimizing storage space, it is possible to improve patient care areas (Ducharme and Lucansky, 2002). There are many positive effects of lean methods on these organizations. Therefore, collecting data relating to both medical and non medical processes, mapping and analyzing them are suggested to all health institutions and organizations operating in the health sector. Thus, they will be able to design their processes effectively and efficiently with activities such the use of an effective inventory management method, designing material flow processes by eliminating waste, making improvements in

the physical layout, establishing of the treatment process checklist and applying integrated decision support software (Grabana, 2007).

It is intended to ensure continuous improvements in the treatment process in Lean hospitals, to eliminate delays in patient care, to destroy waste and foreground respect for the individual. Lean thinking is the starting point of "value" which is a created concept. Time spent with the patient's physician when viewed in terms of health services, patient analysis processing, imaging processing, services such as surgery and care services are covered under the value (Aksoylu, 2014). The principals of lean management can be itemize such: end-user must name value as a service, value flow steps for each service must be determined, non-contributive steps must be eliminated in advance, the service must be delivered to customer regularly contributive steps must be augmented, this process must be pursued and repeated until value stream reaches to the peak (McConnell *et al.*, 2006).

Hospitals and processes are full of waste and inefficiency. Lean as applied to the hospital has the objective of providing six zeros: zero stock, zero defects, zero contradiction, zero wait time, zero dead-time and zero bureaucracy (Womack, James, Daniel, 2007). Lean techniques also allow us to improve service delivery by understanding and examining the details of how the provision of safe health services. Effective and high quality services to support our application process are required. Lean offers the best way to do it (Grabana, 2007). Most authors in the health sector assume a natural balance between cost and quality, and a higher quality in new Technologies. It is true that treatments or drugs are some of the more costly methods for promoting the healing quality. However, the hospitals, the quality of health service delivery methods and processes that can improve the way have many opportunities for reducing costs while increasing quality. All hospitals in the United States, by preventing mistakes may be able to make cost savings, and, it has been revealed, increase quality to a large extent. For example, the drug which may prevent adverse effects resulting from errors in hospitals is estimated to cost \$ 2 billion a year. Lean thinking is seen as a means of quality improvement and cost reduction. This philosophy yield more effective results comparing to the methods based on slightly focusing on cost. Lean, is rather a quality initiative relating to cost reduction initiatives. As a result, quality is improved and costs are reduced (Bodek, Norman, Kaikaku, 2004).

Lean thinking requires sustainable quality and process improvement. Looking at how we do our business, lean management considers ways to improve the way work is performed. Lean prefers to solve problems permanently instead of strolling around them. Lean management advocates on the one hand improving patient safety and preventing delays while employee satisfaction, and on the other quality and cost-effective methods of healing. Lean management of hospitals and creates higher growth while creating revenue opportunities, and also helps in terms of saving money. Ultimately lean methods can benefit everyone associated with the hospital. Understanding the Lean principle is only a starting point. The real challenge is to apply these principles and strategies. Lean leads support for transforming the way hospital services are presented. Everyone also has to be ready to adapt to this great transformation and lean thinking in the hospital should be taken responsibility for in this process (Galsworth, 2005).

Positive reasons for adopting lean management of the business are listed below (Maskell *et al.*, 2011):

- By providing better information in order to take simple decisions, an increase in revenue and profitability will occur accordingly.
- Procedures and systems that lead to wasted time and cost is reduced.
- Descriptions of the potential financial benefits of Lean thinking focus on development initiatives and strategies required to achieve these benefits.
- Knowledge of Lean Thinking is taken into account and is able to motivate improvement in the long term by providing the statistics presented in this line of thinking.
- It is to keep ahead of customers' values.

These activities add value to activities and can be expressed in value-added activities. These activities must be followed; in order to be distinguished from each other there are some special rules. The rules should be adhered to as specified by the value-added activities. Performed activities can be stated as follows. Lean Philosophy refers to the corporate culture (Pedersen, Philip and Douglas, 2005). Value and the Seven Waste: There are seven basic types of waste According to Lean approach: "More Production Waste Inventory Waste, Standby Waste, Transport Waste, Motion Waste, Process Waste and Faulty Production waste." Too many medical tests also create an overproduction of waste too, mia had passed drug in pharmacies and material inventory waste in the long patient queues to wait waste, missing drugs and materials handling waste in the medical device incorrect positioning of the moving waste-conceived and unnecessary treatment to process waste, improper treatment are examples of faulty production waste.

Lean Methodology

Lean methods started in the factory, but also proved successful in many service sectors, including the health sector. The idea of lean philosophy for creating greater impact, argues that you should start with smaller steps. Lean continuous quality improvement in hospitals provide cost reductions (Grabau, 2011). Lean management is used in many problem solving techniques and methods. They include the following prerequisites: 5S, Lean Philosophy, Values And The Seven Waste, 6 Sigma, Failure Mode and Risk Analysis, Value Stream Mapping, A3 Thinking, Pull System, Andon, Kanban, Muda, Muri, Mura, Kaizen, Genba, Poka-Yoke. 5S: This was first introduced in Japan and is arrangement in the workplace. The layout is simple and effective, a method used to ensure cleanliness and discipline. Land is visual basic. It is an organization consisting of 5 stages. Each of the 5 represents the first letter of the Japanese words. These; "Seiri" (Sweep, sorting), "Seiton" (Sort, Edit), "Seiso" (Delete, Clear), "Seiketsu" (standardization) and "Shitsuke" (Resume, Discipline). Waste removal of the "5S" method is very useful. Drug cabinets, anesthesia in sterile and non-sterile cabinets, code blue car and bedside units can be organized in this way. This ensures a more orderly and clean environment. Storage areas are destroyed, carrying waste is reduced, problems and hazards can be seen early and thus increase productivity (McConnell *et al.*, 2006). 6 Sigma: A measurement scale that allows the comparison of facilities and the measuring of the adequacy of services and processes. Define, measure, analyze, is a management strategy that pursues development and control

purposes. Increasing customer satisfaction, reducing cycle time and reducing error levels are the focus of 6 sigma. For the management of risks that may occur with the correct data analysis is a proven methodology that manages administrative and statistical tools. It moves with the philosophy of error-free processes as a result of drastic improvements. Structural and systematic change to achieve excellence in all areas is implemented. Error Types and Risk Analysis: These are processes aimed at preventing errors before they occur and perfect quality. It is an approach that aims to identify problems before they occur and to determine the elimination, and one of the most important techniques to prevent malpractice in health services (Grabau, 2007). Value Stream Mapping: This provides the ability to process a fresh look. To understand the functioning of the present process, to see how resources are being wasted, to understand the root causes of waste and visual techniques used to plan for simple applications. Earnings are calculated to provide a roadmap for achievement. This road map is an important tool to perform simple applications in a short time.

A3 Thinking: Actually A3 "is just a paper size" (11X13). A3 processes large or small, all the plans or reports are shown on a page in a visual representation everybody can understand which tell a story visually and clearly. The A3 process in the PDCA (Plan, Do, Check, Measure) takes place in the process. It makes it possible to take decisions based on facts. Pulling

System: If you have only what you need, the services being offered voluntarily to make it are never spent on unnecessary energy.

Ando: This is a system that is used as a warning tool. Sound or light stimulus is used for notifying. Problems that occur in the main objective of this system service are quickly revealed, and it continues without loss over the service.

Kanban: Kanban again is a Japanese term and means card or sign. The main purpose of Kanbans is to show which work has to be done at what time to ensure optimal flow. Due to their physical presence these signs are somewhat self-evident or self explanatory and belong to the pull concept

Muda: This is the process of eliminating non-value adding supply. For example, it can do the work of five or six people. Muri: Employees are allowed to work more than willingly excessive load. For example, it is like a person can do the work of four to five people.

Mura: Causing the operator to hold or to rush in a continuously variable operation is caused by the improper operation of the production plan. That consists of a mixture of Muria Muda.

Kaizen: Kaizen describes the Japanese philosophy of continuous improvement. With Kaizen, all functions of a business are analysed and all participants involved in the business process are focused

Genba: Risk factors for the business areas is analyzed consideration. All the facts of the organization is seen in this walk.

Poka-Yoke: This means error prevention. A lean production methods to prevent the errors made during the service. It aims

to prevent human errors before they occur rather than fix or uncover them. The adoption of the Lean manufacturing approach in the hospital should be considered, and should then be carried out according to these principles is shown in Table 1 (Şengözer, 2011). According to Graban (2011), lean hospitals and patients reduce errors occurring in transactions, and reduction in the waiting time to a minimum is an approach that allows them to improve the quality of care provided to patients. Value is the total of the activities carried out for the diagnosis and treatment of any disorder occurring in a patient (Osmanbeyoğlu, 2013). These activities add value to activities and value added activities are divided into two categories.

These rules are in line with the hospital, the value of adding value to the activities carried out in the stream, and it is possible to specify the value-added activities (Graban, 2011). It is a medical laboratory technicians working in service of any patient's test results of the sample activities that add value to interpret the value stream processes. This, as well as medical technicians to repair the damaged tool in laboratory. Values to the same amount can be given as an example of the process flow-added activities. Hospital clinical laboratory service processes located in the patient sample are identified as products that add value to activities samples.

Table 1. The Lean Manufacturing Principles

Principle	What lean hospitals need to do
Value	The value should be determined in terms of the end user i.e. the patient
Value Stream	All value-added services beyond the borders of the steps in the hospital identified that value streams, creating value in non-flow steps should be removed.
Continuous Flow	Eliminating collective work and the reasons for the delay as quality problems arise in the hospital, the process should flow smoothly.
Pull	Work to be done should not be pushed to the next process or service, it should be allowed to withdraw when the job should and facilities.
Excellence	Continuous improvement should be achieved by ensuring excellence in the hospital.

Table 2. The types of waste as seen in hospitals

Waste Type	Brief Description	Examples Hospital
Errors	Doing something wrong, correct the error or errors by checking the time spent	Surgical supplies car is missing a substance; Giving patients the wrong drug or the wrong dose
Necessity more production	Because customer needs to do more or has less time than thought	Apply unnecessary diagnostic procedures
Unnecessary Material Movement	The product of the system (patients, samples, materials) unnecessary movements	The catheter laboratory as a bad layout is very far from the emergency services
Wait	The realization or the next business activities for the next event wait	Waiting staff are required to be equal to the workload; Patients waiting for appointments
Excess Inventory	Financial costs, storage and moving costs, because of corruption and clear excess inventory costs	Unnecessary drugs, expired supplies need to be destroyed
Unnecessary Human Movement	Unnecessary movement of employees in the system	Laboratory workers walking for miles each day due to bad layouts
Too many Operations	Customers that do not value or do not meet the definition of quality jobs that lead to patient needs	When overcome Form / date stamp; but history will never be used
Human Potential	Not including employees, listen to the ideas arising from or supporting the career..	They give employees offers and suggestions and development

Table 3. Findings of three separate research groups about the benefits of the implementation of lean management in the health sector

Papadopoulos	UK NHS NHS Hospital Pathology Unit	inpatient and outpatient satisfaction has increased
		increased motivation of staff
		Costs are reduced
		It helps to speed clinical decision
		Patient care is more effective and efficient
Rexhepi and Shrestha	Kosovo University Clinic Center in the Department of Rheumatology	Waiting times are reduced
		It decreases stress in employees
		Patient safety is increased
		Organizations have higher revenues
Folinas and Faruna	Abuja and Nigeria in the Federal Capital Territory's three major hospitals in	There is no unnecessary movement within the hospital
		Waiting times are reduced
		Patient safety is increased
		Costs are reduced
		Excellence in service flow process can occur with the elimination of waste

These activities have some specific rules that must be followed in order to be distinguished from each other:

- Patients do not want to pay for an activity.
- Activities of the product or service in a way conversion.
- The activity needs to be done right the first time.

The example of the value-added activities, with transport as part of a collective work of the samples taken from the patient, is waiting (Şengözer, 2011). The other concept of waste identified as belonging to a lean approach by Graban (2009/2011), is hospital patients and is defined as the act or having made the effort to provide any value (Sengözer, 2011).

According to another definition, hospitals, businesses, and patient care in the case of work done on the problems and obstacles that may be the continuation of the difficulties of these problems can be defined as waste. The waste types that occur in hospitals are shown in table 2 (Osmanbeyoğlu, 2013). Table 2 also revealed the types of waste as seen in hospitals: more production, inventory, shipping, motion, waiting, errors, unnecessary processing, are expressed in human potential. Thanks to the prevention of waste from hospitals and remarkable achievements in lean process improvement, and the lean thinking movement in health, "Lean Healthcare" has entered into a global movement. First, the US hospital practices spread rapidly. A number of problems have been fundamentally solved with lean management practices. Today, many examples of the positive impact on lean hospitals all over the world are available. Some striking examples of the results of lean methods are as follows:

Espirito Santo Hospital in studies of the lean management approach has been applied to the material procurement process. At the time of supply, as a result of studies using process flow diagrams of the process a reduction in stock levels was observed (Bendito, Martins, 2012). "Seattle Children's Hospital," the surgical clinic: Due to the mapping process, comprehensive data collection and analysis, elimination of patient value added process elements, immediate implementation of the modified process and reduced process steps due to the re-evaluation process, valuable time for patients has increased; patients have been treated with a reliable method for flow and provision of health care to those patients and more time was able to be spent on them.

Avera McKennan Hospital: The histology laboratory, pharmacy, emergency room, surgical services, maintenance and cleaning, medical surgical nursing, engaged in lean projects in many fields such as clinical activities. For example, a project to improve patient discharge processes from leaving the patient's room, shortened the delay between the preparation of the next patient's room. Thus, increased room use. The length of the patient's stay decreased by 29% which prevented the new emergency services building spending 1.25 million dollars.

Alegent Health (Nebraska): In staffing or the addition of new tools, the time taken for clinical laboratory results were reduced by 60%. Kingston Hospital (Ontario): The instrument sterilization cycle time was shortened by more than 70%. Obion Health (Obion): Operating income 808.000 dollars plus per year (Graban, 2011). Lean is an improvement strategy that concentrates on waste-free production and process optimisation. For lean leaders, it is indispensable to identify, analyse and categorise existing types of waste to successfully elaborate a strategy for breaking the cycle of waste. Hospitals are complex business environments with a multitude of wasteful situations that require distinctive solution approaches. Kanban, Kaizen, 5S principle and Value Stream Mapping are adequate tools that help to identify and eliminate waste and non-value adding activities. However, certain problems may remain unresolved or difficult when systems and structures are too complex to be streamlined with lean principles only. This is the moment, when Lean Sigma comes into play because with Six Sigma the lean methodology is supported by error proofing and future avoidance thereof. Since the healthcare environment is a fast moving business field, state-of-the art technology such as telemedicine and e-health are becoming

more and more important. In addition to the main goal of cost reduction, telemedicine further enables hospitals to cope with international competition and to fulfil current demands of EU standards and regulations within the European Single Market.

Patient-Oriented Management

Patient-oriented management is another priority of lean management in hospitals. It helps hospitals to concentrate on their core competencies and to avoid ineffective and inefficient activities. Above all, patient satisfaction and loyalty are important for the continuity and profitability of a hospital. To increase this satisfaction and loyalty level, hospitals must stand out from its competitors by differentiation. This calls for a comprehensive analysis of the company's resources and capabilities as well as for the understanding of patient demands. As a result, strategic alliances gain interest because it turned out that strategic alliances are one possibility for hospitals to cope with harsh market conditions. Thus, hospitals can expand their service portfolio without additional financial costs; they can concentrate simultaneously on their core competencies and follow trends by streamlining their activities according to patient demands; they can increase their profitability and efficiency without personnel cutbacks. Moreover, any business cooperation should also be supported by professional marketing. In times of increasing competition and changing patient self conception, hospitals cannot afford to neglect marketing activities that help to stick in to customers' minds (Graban, 2011).

One of the most important aspects in hospitals is the successful management of patients. This is true just because of one simple reason: without patients there is no need for hospitals. The patient satisfaction, strategic alliances in the healthcare environment and hospital marketing are of main focus since all these aspects are considered value-adding steps that help to increase service quality and to streamline processes in hospitals. Patient satisfaction and loyalty have a considerable impact on bed occupancy rates which are actually the basis for a hospital's profitability. Consequently, it is this aspect of profitability which forces hospitals to increasingly direct their attention to patient satisfaction and loyalty.

Findings of three separate research groups about the benefits of the implementation of lean management in the health sector are shown in Table 3.

Conclusion

Leaders who have successfully exploited lean thinking in many hospitals, knows that this is not an academic practice. However, simple methods are a useful approach that allow us to improve the hospitals' current management style. The health services relate to human life; any problems occurring in the process can lead to irreversible consequences. Adding value to processes and increase efficiency by eliminating waste is possible with simple applications and "security", "cost-effectiveness", "quality", "activity", "profitability", "innovation" and "work-life quality" in the health institutions as well as important changes on key concepts for each business can be created.

Summing up, it can be stated that key factors for successful implementation of lean management in hospitals are concentration on process optimisation, knowledge about main

lean principles and intelligent application of its general tools. For Lean to tap its full potential, the human aspect must be considered likewise. Thus, a patient oriented management as well as engaging and leading employees will lead to success of lean management in the healthcare environment (Verena, 2011).

REFERENCES

- Aksoylu, S. 2014. Hastane İşletmelerinde Değer Akış Maliyetlemesi, Niğde Üniversitesi İİBF Dergisi, Cilt: 7, Sayı: 1, s.250 - 283.
- Aktaş, R. and Karğın, M. 2011. Yalın Muhasebe: Yalın Üretim Ortamında Yeni Bir Yönetim Muhasebesi Yaklaşımı, Muhasebe ve Öğretim Üyeleri Bilim ve Dayanışma Vakfı
- Aronsson, H., Abrahamsson, M., Spens, K. 2011. Developing lean and agile health care Supplychains. Supply Chain Management: An International Journal.
- Bendito, S. and Martins, A. L. 2012. Applying lean management in a hospital purchasing Process: A case study. International Conference on Industrial Engineering and Operations Management, Portekiz.
- Bodek, Norman, Kaikaku 2004. The Power and Magic of Lean (Vancouver, WA: PCS Press), s.115. Committee on Quality of Healthcare in America and Institute of Medicine, To Err is Human (Washington, D.C.: National Academic Press, 2000), 1. Dergisi, Sayı: 3
- Ducharme, L., ve Lucansky, P. 2002. The lean supply chain. PharmaChem Magazine. Galsworth, G. Visual Workplace, Visual Thinking (Portland, OR: Visual-Lean Enterprise Press), S.13.
- Grabau, M. 2007. "Riverside Medical Center Puts Lean in the Laboratory", Society of Manufacturing Engineers Lean Manufacturing, S.53-57.
- Grabau, M. 2011. Allocating Internal Audit Costs In A Lean Environment. Pinar Şengözer (Çev). İstanbul, Optimist Yayınları.
- Lindenau-Stockfisch, V. 2011. Lean Management in Hospitals, Principles and Key Factors for Successful Implementation
- Maskell, B., Baggaley, B. and Grasso, L. 2011. Practical Lean Accounting: A Proven System for Measuring the Lean Enterprise?, Newyork.
- McConnell, K.J. Ve Ark. 2006. "Ambulance Diversion and Lost Hospital Revenues", *Annals of Emergency Medicine*, 702-715.
- Osmanbeyoğlu, N. 2013. Yalın Hastane, Sağlık Hizmetindeki İsrافی Ortadan Kaldırabilir Mi?, İstanbul'da Sağlık Dergisi, s.18 – 40.
- Pedersen, C., Philip J. Ve Douglas S. 2005. "ASHP National Survey of Pharmacy Practice In Hospital Setting: Prescribing and Transcribing-2004", *American Journal of Health-System Pharmacy*, s.378-379.
- Shah, R., ve Ward, P. 2000). Defining and developing measures of lean production. *International Journal of Operations Management*.
- Türkan, Ö. U. 2010. Üretimde yalın dönüşümün temel performans kriterleri. BAÜ Fen Bilimleri Enstitüsü Dergisi.
- Warnecke, H. J., Hüser, M. 1995. Lean production. *International Journal of Production Economics*.
- Weinger, Matthew B., Jason S. ve Nelda O. 2003. "Retrospective Data Collection and Analytical Techniques for Patient Safety Studies", *Journal of Biomedical Informatics*, s.104-119.
- Womack, James P. ve Daniel T. 2007. Yalın Düşünce. Optimist Dağıtım.
- Womack, James P., Daniel T. Jones ve Daniel R. 2000. Dünyayı Değiştiren Makine (Panel Matbaacılık), 13.
