Process Management and Improvement in Health Services: A Hospital Appointment System Example

Gülseren GÜÇ[1]
Merve GEDİK[2]
Cüneyt ÇILGIN[3]
Tutku TUNCALI YAMAN[4]

ABSTRACT

In today's competitive conditions, businesses that produce goods or services frequently benefit from process improvement and similar methods to achieve their goals. Being process-oriented means giving importance to the creation of quality, not quality control. The Hospital Appointment system is the admission of patients to polyclinics at certain time periods. The purpose of the appointment system for the patients is to organize and spread the time of the patients' arrival at the hospital outpatient clinics. In general, to solve the waiting problem in hospitals, health services are provided by distributing patients to certain time periods. However, due to the insufficient capacity of the hospital, the patients' demand for health services cannot be met, and therefore the appointment problem continues. Patients spend days on the internet and on the phone to get an appointment from some medical units. In this context, the aim of the study is to evaluate the problems experienced in the appointment

[1]Graduate Student, Institute of Social Sciences, Marmara University, Istanbul, Turkey
[2]Graduate Student, Institute of Social Sciences, Marmara University, Istanbul, Turkey
[3]Graduate Student, Institute of Social Sciences, Marmara University, Istanbul, Turkey
[4]Associate Professor, Faculty of Business, Marmara University, Istanbul,Turkey

*Corresponding author: tutku.tuncali@marmara.edu.tr

process in health services in terms of quality, time, technique and customer satisfaction, to make improvements and evaluate results.

Keywords: Appointment System, Health Services, Process Improvement

1. INTRODUCTION

Healthcare entails a lot of responsibility. All hospital services should be carried out with professionalism and sensitivity. The most important thing patients expect from the hospital is to find healing or to be healed. The slightest mistake can have serious effects on human health. For this reason, it is essential that the interventions in the hospital are done correctly and on time.

The health service must be of high quality and reliable so that patients can trust their treatment. The most important indicator that determines the quality of service is patient satisfaction. The focus of health institutions, which are tasked with protecting and treating people from diseases, should be patients. While doing this, they should organize their processes according to the expectations of the patients as much as possible.

To provide quality service to patients, processes should be periodically reviewed and improved. This helps ensure that the care patients receive is of the best possible quality. It is necessary to apply process improvement methods to reduce errors and improve patient care. Process improvement activities help increase the efficiency and success of a process by quickly identifying and resolving problems. The process is analyzed comprehensively, and any issues found are resolved. To ensure high service quality, the elements that can reduce this are determined and eliminated.

The subject of the study is to carry out the improvement work in the process of making/giving appointments in health services and to evaluate the result. When the literature is reviewed, it has been observed that there are not enough studies on the process of making/giving appointments within the scope of hospital services, and it has been observed that there are improvement studies mostly related to polyclinic services. Studies with the appointment system process in the literature are also limited to the applications in public hospitals on the Central Physician Appointment System (MHRS) in the example of Turkey (Pekgör et al., 2017; Küçük et al., 2021). For this reason, it is aimed to contribute to the literature by guiding the health institutions that currently offer this

system with the improvements made in the process of making an appointment in a private hospital.

It is aimed to evaluate the applications and results of the appointment system, which is considered as an example of process improvement applied in a selected private hospital within the scope of the study, in terms of quality, time, technique, and customer satisfaction. For this purpose, the stages of the appointment system before and after the improvement in this hospital were interpreted by examining value stream maps. As a result, it was revealed that the new appointment system made significant contributions to the hospital management by means of process improvement in terms of time, quality, technique, and customer satisfaction, and suggestions given.

The study consists of four main parts. In the next section, process management and process improvement studies in health services, and in the third section, detailed information about the concept of health services and hospitals is given. In the fourth section of the study, the definition, classification, parameters, and functions of the hospital appointment system, which is the basis of the application, are mentioned. In the last section, the information about the hospital where the application was carried out was mentioned and the improved appointment service, which is one of the health services processes, was emphasized.

2. PROCESS MANAGEMENT

2.1. Concept of Process

The process of producing something includes a series of related steps that begin with an input. By adding value to this input, we can produce a specific output. Processes are considered as a set of activities that transform inputs into outputs that are useful to their customers (Hammer, 2015).

According to the Turkish Standards Institute, the process is a set of activities that create a product (output) for the customer by taking input and adding value. In this process, it is the conversion of inputs (equipment, methods, manpower/service, environment, and materials) into output form. This includes creating or adding value in form, time, and place. Value-related issues are examined in terms of form, time, and place (Bozkurt, 2005). A process can also be defined as a set of activities that create added value on various inputs and are used to achieve planned results. In other words, they are processes that

aim to obtain value-added output by using a series of inputs to create value for the customer (Özkan, 2015). It is a group of input items that are usually inter-related and grouped into five categories. These inputs can be listed as people, equipment, materials, methods, and environment (Dumas et al., 2013).

2.2. Process Management

The traditional management approach that prioritizes hierarchy (level) and division of labor (expertise) creates obstacles to the natural flow of the organization. The management approach that has come to the fore to save business processes from these obstacles is called Management with Processes, or in other words, Process Management. As a management technique, process management is defined as a series of activities carried out to monitor and improve processes regularly and continuously. In this respect, process management can also be applied in the new management approach (Bozkurt, 2005).

Process management is an umbrella term that encompasses all activities that help identify the needs of different stakeholders, establish processes, monitor performance, and make necessary changes. It can also be expressed simply as "the systematic management of processes". It is a way of systematically managing the processes of a system. Within the scope of process management, it is necessary to determine, improve, maintain, and update the ongoing works in the organization based on processes and ensure their continuity in line with the objectives and targets. Process management can also be considered in the context of monitoring, evaluating, and improving the functioning of the organization within the existing hierarchy (Rosemann and Brocke, 2015).

2.3. Process Improvement

In process management, it is very important to identify and eliminate activities that do not add value to any process. For this reason, companies must constantly monitor and control their business processes. (Türkan and Görener, 2017). In this way, faults can be detected, and action can be taken within the scope of improved processes. Especially in today's competitive business environment, various process improvement methods are used to provide customers with high-quality and low-cost services or products, and enable them to stay in business and stand out from the competition. One of the most important aim of these methods is to improve business processes that do not create value by providing financial benefits and customer satisfaction (Avunduk, 2019).

Improvements in processes are a culture that should be adopted by the companies which desire to retain their existing customers and increase their potential. Every service and/or product goes through a business cycle. The concept of process is a systematic set of activities performed in a specific order to produce goods or services. At the end of the process, the goods or services will be finalized (Parlak, 2017). The production process is the sum of the materials, people, methods, and other factors that interact to obtain a product (Arslan et al., 2015). The service process is the activities in which information replaces raw materials, configurations replace methods, and computer/information systems replace machines (Dumantepe, 2017).

Process improvement can be defined as the elimination of non-value-added steps that affect the workflow. When improvement practices cover all process activities, it reduces the waste, cost, and time spent on each activity. Thus, work will be carried out faster, easier, and at a lower cost. Process improvement research is a tool that is always on the agenda for companies with different concepts. This is done by companies to reduce errors, inventory, costs, and also to improve quality, speed up operations, and increase efficiency and productivity. In this context, processes are first defined in a successful process improvement application. An improvement team is formed by deciding which processes need to be improved. By determining the source of the problems in the processes, appropriate improvement methods are determined and then the most appropriate one is selected. Improvements are tested and evaluated. If positive results are obtained, it is expanded, but restoration works are started again if necessary (Eyüboğlu, 2012).

The preferred methods are very important for the success of the process improvement study. Because different businesses have different processes that need to be optimized for efficiency. Each business should use the most appropriate optimization method for its process. There are various ways to achieve an effective result, so making the right choice is important (Özan, 2021).

2.4. Process Improvement Methods

Process improvement is a set of activities that increase the performance of managers and other employees and complement each other (Kovancı, 1999). It is applied to recognize problems that may arise during process improvement and to find solutions. The most important expectation in process improvement

efforts is to determine what happens and improve the process by using the data obtained as a result of process activities (Öztürk et al., 2011). These improvement methods can be listed as six sigma (Ateekh-ur-Rehman, 2012; Bubevski, 2016; Çağlar and Kurt, 2016; Öztürk, 2010; Özveri and Çakır, 2012; Senger and Cengiz, 2018), kanban (Rauch et al., 2016), 5S (Çakırkaya and Cengiz, 2018; Acar, 2016), 8D, kaizen (Tatham and Worrell, 2011), simulation (Çil and Yalçın, 2018; Doğan and Takci, 2015), debugging poka-yoke (Farrington et al., 2018), cause-and-effect diagrams, FMEA, PFMEA, histograms, control charts, brainstorming, distribution charts, pareto chart (Yılmaz et al., 2021), work studies (Dora et al., 2015), performance chart (Jeyaraman and Teo, 2010), nominal grouping (Thomassey, 2014), flowchart (Fisher et al., 2011), value stream mapping (Kuğu and Köse, 2021; Ömürgönülşen and Çatman, 2018; Vinodh et al., 2016), strategy comparison (Yılmaz, 2019), dashboard and SWOT analysis (Kaygusuz, 2014). Due to the different business processes of the companies, there is not only one method that is applicable to all of them but a few of the techniques can be applied together. The current methods will vary depending on the process being improved. In this sense, the process improvement methods used in companies in the literature are given in Table 1 below.

Table 1. Methods Used in Process Improvement

Brainstorming	Flow diagram	Quality Circles
Nominal Group Technique	Pareto Diagram	Scoreboard Diagram
Cause-Effect Diagram	Product tree	Histogram Diagram
Matrix Diagram	Kanban	Relationship Diagram
Scatter Diagram	Experimental Design Methods	Simulation
Supply chain management	Simulation (Simulation)	Poka - Yoke Practices
Force Field Analysis	Total Efficient Maintenance	5S
Analytical Hierarchy Process	Kazien	Statistical Process Control
Total quality Management	Total Equipment Effectiveness	Theory of Constraints
Lean manufacturing	Failure Mode and Effects Analysis [PFMEA/FMEA]	Information Management
Six Sigma	EFQM	Quality Management Standards

In this study, Value Stream Mapping and brainstorming methods were used in practice. General information about these two methods is given below.

2.4.1. Value Stream Mapping (VSM)

The work and actions to be performed in the process are clearly defined with VSM. The technique provides a visual explanation of what needs to be done as well as a written explanation. In this way, the works to be done are listed in order and it will be determined by whom, in which time frame and how (Yalçınkaya, 1997; Andrade et al., 2016)

2.4.2. Brainstorming

Brainstorming is a group work done when it is desired to bring ideas, solutions, and basic reasons together on any subject (Eyüboğlu, 2012). The number of participants in the group cannot be less than 6 people and not more than 20 people. For many ideas to emerge, it is preferred for this method to have people in different age groups with different perspectives in the group. In addition to the experts, there should be people who are not directly involved in the subject to evaluate different perspectives (Çavuş, 2004).

The brainstorming application process includes the steps of defining the problem, generating unlimited ideas, categorizing, and evaluating the ideas produced. Instead of traditional brainstorming, reverse brainstorming can also be used for the same purpose. Although the same kinds of steps of the brainstorming technique are used in its application, the most important difference between them is the way how the problem is handled. In this method, the participant has to think about the problem or situation that has been turned upside down while generating an idea and reach an answer by returning to the problem (Karataş et al., 2016). For example, when considering the hospital appointment process, which is the main subject of this study, the problem statement in the traditional brainstorming method is "What are the problems encountered in the hospital appointment process?" While it is expressed as "How do we cause problems in the appointment process?" in the reverse brainstorming method.

2.5. Improvement Studies in Health Services Literature Review

Considering the subject of the study, when the academic papers on the appointment systems processes offered in health services are examined, it is seen that a group of studies consists of studies on the design and structuring of this

process (Gupta and Denton, 2008; Lian et al., 2010; Aktepe et al., 2015; Tekin and Erol, 2016; Zhao et al., 2017; Cox and Boyd, 2020). Among them, a subgroup reveals the aspects of the system that are open to improvement by creating profiles of patients using the existing appointment system or evaluating patient satisfaction (Samadbeik et al., 2018; Pekgör et al., 2017; Küçük et al., 2021).

When process improvement studies are examined in a broad sense; in general, it was seen that business problems were determined by brainstorming, causes of the problems were detected by the fishbone method, and also evaluated in order of their importance. Business processes were mapped using flow charts. By doing so, gaps in the processes were observed and eliminated. (Barber and Deste, 2021). In addition, the most important causes of the problems were revealed by using Pareto analysis (Kara, 2018). Improvements have been made using process FMEA methodology to detect possible malfunctions, to identify the causes of errors and their effects by observing business processes. Here again, it has been seen that statistical process control (IPC) was used to ensure that errors are detected at the source to increase the overall quality (Tanik, 2013). It is seen that the lean production approach based on achieving error-free production with fewer resources in the shortest time and preventing waste in the applications used is used in both manufacturing and service sectors for the efficiency of the business process (Cox and Ulmer, 2015; Yıldız and Yalman, 2015; Yılmaz et al., 2017).

Table 2. Literature Review

Author	Area	Improvement Method
Yamamoto et al., 2010	Insulin administration plans process improvement study	Six Sigma
Rexhepi & Shrestha, 2011	Rheumatology service process	Kazien and Value Stream Mapping
Laganga, 2011	Appointment scheduling system	Metrics and indicators
Mandahawi et al., 2011	Eye diseases processes	Six Sigma
Yeh et al., 2011	Health clubs management	Six Sigma
Papadopoulos, 2011	process improvement	Continuous Improvement Methods
Gul & Guneri, 2012	Pathology service process	Simulation
Mohammadi & Eneyo, 2012	Emergency service process	Theory of Constraints and Simulation
Efe & Engin, 2012	Radiotherapy unit patient flow process	Value Stream Mapping
Ince et al., 2013	Emergency service process	Value Stream Mapping
Lama et al., 2013	Film shooting process	Six Sigma
Toussaint & Berry, 2013	Hospital's service processes review	Value Stream Mapping
Ryan et al., 2013	Surgical service process	Value Stream Mapping and Theory of Constraints
Lightning, 2014	Emergency service process	Flow diagram
Öztürker et al., 2014	Outpatient services	Six Sigma
Mannon, 2014	Trabeculectomy surgery	Continuous Improvement Methods
Poyraz, 2015	Design of hospital processes	Workflow Studies
Amonge, 2015	Medical consumable process review	Theory of Constraints
Yükçü & Yüksel, 2015	Emergency service process	Theory of Constraints
Doğan & Ersoy, 2016	Medical imaging process	Value Stream Mapping and Simulation
Aguilar-Escobar, Garrido Vega & González Zamora, 2016	Physical Therapy and Rehabilitation unit improvement	Theory of Constraints
Gleich et al., 2016	Medical record logistics service	Six Sigma
Dumantepe, 2017	Patient transfer process	Process Flow Chart
Tagge et al., 2017	IVF center processes	Six Sigma
Alkinaidri & Alsulami, 2018	Children's hospital pre-operation processes	Six Sigma

Author	Area	Improvement Method
Deniz & Özçelik, 2018	Improving the dispatch system	Value Stream Mapping and Heijunka
Gage, 2018	Physical Therapy and Rehabilitation unit processes	Simulation
Grida & Zeid, 2019	Emergency service process	Simulation and Theory of Constraints
Toda & Ginj, 2019	Surgical unit services	5S and Kanban
Bauer, 2019	Procurement and workflow improvement in the pharmacy	Theory of Constraints
Colhan, 2020	Emergency service process	Kaizen
Akbal, 2021	Process improvement in healthcare workplace hazardous materials management	Theory of Constraints, Lean Manufacturing and Simulation

When the studies in the literature on process improvement methods used in health services are examined, it is seen that Hellström, Lifvergren, and Quist (2010) performed a pioneering, comprehensive, and descriptive study by analyzing all aspects of the business processes in a hospital in Sweden and revealed the important points that should be in the processes in this sector. Other studies carried out in the health sector on process improvement practices are given in Table 2 according to the area and improvement method.

3. HEALTH SERVICES AND HOSPITALS

3.1. Healthcare Concept and Features

The level of health services, which play an important role in the survival of people by improving and protecting their quality of life, is a strong indicator of the level of development of the population. The concept of health services could be described as all the services provided for the detection, treatment and rehabilitation of diseases and the activities carried out to prevent diseases and improve the health status of the society (Unsal, 2017). Health services are provided by health businesses and include multifunctional and comprehensive services that should be handled separately from delivery, financing, purchasing and stakeholder processes. The World Health Organization defines health care as "a permanent system used to employ different health professionals in specific medical settings, organized throughout the country to achieve goals that vary according to the needs and desires of the society". In addition, healthcare service is to provide individual and social health services with all kinds of

preventive and therapeutic activities. Again, health care can be defined as the effort of different types of health professionals to diagnose and treat diseases and protect health in different settings and institutions (Akar and Özalp, 2002).

Easy usability, quality, continuity, and efficiency are the requirements of an effective health service (Kavuncubaşı, 2000). Health services differ from other goods/services produced in many aspects due to their qualifications. These features can be listed as follows (Yazgan, 2009)**:**

- The service offered in health services is very diverse. Therefore, it is very complex and variable.
- The demand-supply relationship in health services is balanced. It is irreplaceable and unpredictable.
- In health services, patients cannot determine the quality and quantity of the service because they have limited information about the features of the services.
- The patient's expenses are uncertain, there is no negotiation.
- It is difficult to be homogeneous in health services.
- Health services are urgent, they cannot be postponed.
- The services provided in health institutions have a low tolerance for errors and uncertainties.

3.2. Hospitals

Health services are gathered in four main groups. These are preventive health services, treatment services, rehabilitation services and health promotion services (Aktan and Işık, 2009). Hospital is a service enterprise that provides diagnosis, treatment, rehabilitation, and preventive health services, enables scientific research and also functions as an educational institution. The delivery and activities of health services are planned in line with the goals and objectives. Having measurable and comparable activities, evaluating results, and measuring performance are the most important elements in terms of ensuring both service quality and patient satisfaction (Dereköy and Kalmış, 2013).

According to the World Health Organization, hospitals are "health care establishments that have organized medical and other professional personnel, inpatient facilities, health care and related services 24/7." In the Statistical

Yearbook of Inpatient Treatment Institutions, the hospital is defined as follows: "It is the institution where the sick and injured, those who suspect the disease and those who want to have their health status checked, are observed, examined, diagnosed, treated and rehabilitated, as well as give birth." (Erdemir, 2015).

4. HOSPITAL APPOINTMENT SYSTEM DEFINITION, CLASSIFICATION, PARAMETERS AND FUNCTIONS

4.1. Hospital Appointment System Definition

The hospital appointment system can be defined as a system that regulates the admission of patients to polyclinics at certain times according to predetermined rules (Şahin, 2010). Its main function is to set appointment dates and times for patients, to regulate the workload of physicians in the polyclinic, and to allocate sufficient time for patients' visits. First, patients request an appointment through methods such as call center, internet or in-person application. After the hospital evaluates these requests, the polyclinic gives appointments to the patients on certain days and hours by spreading the appointments to various times according to the number of physicians and other personnel (Kağan, 2014).

With an effective and successful appointment system, patient waiting times are reduced, patient satisfaction increases, there are no long queues at the doctor's door and the doctor provides better service. (Kağan, 2014). In appointment systems, the number of patients that a doctor will examine during the day and the examination times should be well organized. A well-planned appointment system enables both the time patients wait for the doctors and the doctors to use their time more effectively. (Alagoz, 2013).

4.2. Types of Appointment

Hospital appointment systems are designed to use the clinic efficiently and to reduce patient waiting times. It is of great importance to increase patient access to the hospital through the appointment system. In an effective appointment system, it is necessary to minimize the waiting times in clinics and polyclinics where patients come for examination, and to use the appropriate hours of health care physicians in an efficient and planned manner. When the current appointment systems are examined; It is seen that appointments can be made via telephone, internet, and kiosk device or by applying in person (Alagöz, 2013).

4.2.1. Appointment by Phone

In this method, patients are provided to call the call center of the hospital and make an appointment through the operator. In this system, where operators make appointments by entering the necessary information of the person, first, the working days of the doctors and the number of patients they will see are determined and these data are recorded in the Hospital Information Management System (HIMMS). Patients call the call center to request an appointment, and the operators who pick up the phone request their identity and contact information from the patient and save them in the appointment system. Afterwards, an appointment is made for the medical unit, day and time that the patients want. In the meantime, it is asked whether the patient has a particular preference for a doctor, and if there is, an appointment is made with the desired doctor, if not, with any doctor, in accordance with the desired day and time. The system continues until all appointments on the days determined in this way are filled (Arslan, 2011).

4.2.2. Online Appointment System

In the internet appointment system, patients can make appointments from the Ministry of Health Central Physician Appointment System (MHRS) website or from the websites of the hospitals themselves. The internet appointment system includes the medical units and polyclinics in the hospital, the doctors working in these polyclinics and the examination hours of these doctors. By making an appointment with the polyclinic of the hospital they want, they can be examined by the doctor they want on the day and time they want (Arslan, 2011).

4.2.3. Personal Application

The method of making an appointment with the hospitals through personal application is a manual process that allows patients to apply to the patient registration units and get an appointment from the physicians they want, at the appropriate hours. After the appointment, patients wait in the waiting rooms for the time they will receive service. In this system, patients who apply to busy institutions often must queue and wait in long lines both to get an appointment and to be examined by the doctor. However, when there are patients who make an appointment over the phone or the internet and do not come, the system is prevented, since the patient who comes with a personal application is taken to the examination. This appointment method is preferred by hospital adminis-

trations since examination hours are not empty by maintaining this method in parallel with the others (Alagöz, 2013).

4.2.4. Appointment with Kiosk Device

In the appointment systems where the device called kiosk is used, patients can get the outpatient clinic queue number from the device without the need for auxiliary personnel. This device, which works in integration with HIMS and other appointment systems, allows patients to get sequence numbers from the doctor with the medical unit they want (Arslan, 2011).

4.3. Classification of Hospital Appointment Systems

Hospital appointment scheduling and giving systems are classified in four ways: single block, individual block, block appointment systems and individual-block appointment systems (Soylu, 2017).

4.3.1. Single Block

In the single block appointment system, the diagnosis and treatment of patients who come at the same time are made according to the order of arrival of the patients. In the single block appointment system, it is not known how long the patient will wait and it is the oldest system used to date. Some medical centers still use this appointment system today. The main reason for this is that some specialist doctors and administrators argue that it is difficult to predict how long a patient visit will last and that patients often arrive late for their scheduled appointments (Şahin, 2010).

4.3.2. Individual Block

In individual block systems, a different appointment time is assigned to each patient to be seen during the day. Each subsequent appointment time is tried to be matched with the end of the previous person's examination process. In this way, it is possible to reduce waiting times for appointments and to benefit from health services effectively (Şahin, 2010).

4.3.3. Block Appointment Systems

In block appointment systems, the duration of the outpatient session is divided into several blocks. Instead of giving different hours to each patient, block planning is done for more than one patient. In general, the length of each block and the number of patients in the blocks are equal in the outpatient clinic. In this system, the risk of patients arriving late for an appointment, not showing up at all, or waiting in the same block for a long-time spread to all blocks (Şahin, 2010).

4.3.4. Individual Block Appointment Systems

In individual block appointment systems, some patients are first given a block appointment for an outpatient appointment. Individual appointments are then scheduled for the patient. This system aims to make an efficient planning based on a workload storage strategy at the beginning of the outpatient visit (Şahin, 2010).

4.4. Appointment System Parameters

The indicators in the determination of hospital appointment systems are the rates of absenteeism of the patients by appointment, patient arrival times, average examination time, patient admission interval and doctors' schedule (Alagöz, 2013).

Absence Rates: It is the ratio of the number of patients who did not come to their appointment in a certain time to the total number of patients who made an appointment at the same time. For example, a patient who makes an appointment from the hospital but does not come will extend the outpatient treatment period of the patients.

Patient Arrival Times: This parameter expresses the arrival time of the patient who made an appointment from the hospital. Arriving at the hospital before the scheduled time causes crowds in front of the outpatient clinic and waiting rooms. The patient's late arrival at the scheduled time also interferes with the system and prolongs the waiting time.

Average Examination Time: Refers to the average time doctors spend on a patient for examination and treatment. If the time allocated by the doctors to the patients in the polyclinics exceeds the time in the planning, the appointment times of the other patients will be interrupted in a chain, the waiting times will be longer and ultimately the patient will be dissatisfied.

Patient Admission Interval: It refers to the difference between the examination times of two patients who are given consecutive appointments. After a patient's procedures are over, the patient admission interval may be extended if the examination is interrupted due to the prolongation of the preparation time of the polyclinic for the admission of the new patient to the outpatient clinic, the doctor taking a break due to any needs of the doctor, and therefore the delay in the appointment time, the phone call to the doctor during the examination or the constant opening of the door of the doctor's room by the

patients. . In this case, there may be disruptions in the scheduled appointment times.

Doctor's Schedule: The doctor can terminate the health service before or after the scheduled time. Doctors completing the examination and treatment before or after the specified period may also cause disruption of the appointment system.

4.5. Hospital Appointment Systems Functions

There are some functions of hospital appointment systems where patients request an appointment by applying to hospitals via the internet, call center or in person (Şahin, 2010):

- The system should have functions such as making a new appointment, deleting the defined appointment, searching the registered appointment, confirming the appointment, and closing the appointment.
- The appointment system should cover the polyclinic units that accept patients.
- The work schedule including the working days of the doctors should be followed, and appointments should be made for free time according to the calendar.
- It should be possible for doctors to close their appointment times during leave, temporary assignment, or training-giving periods.
- Appointment start and end time must be specified.
- Whether the patients came to their appointments on time, and if they did not, the reasons for this situation should be followed up.
- If an appointment is cancelled, the reason should be stated.
- Two or more patients should not be given an appointment to the same doctor on the same day and time.
- Appointments should not be made without obtaining the contact (mobile phone) number used by the patients.
- After the appointment is saved, all previously saved appointments of the patient can be viewed.

5. A HOSPITAL APPOINTMENT SYSTEM EXAMPLE

### 5.1. General Information About the Hospital

The application of the study was carried out in a private hospital operating in the health sector for many years in Istanbul and providing health services

to patients. The name of the hospital was not specified at the request of the authorities in the health institution that was the subject of the study, and it was named "X private hospital". In the research, the flow of the appointment system in the X private hospital is discussed and this covers the whole process of making an appointment for the patients who come to the hospital to be examined. Appointment procedures in this institution; can be done in person, over the phone or online.

To evaluate the current situation of the appointment process, which is considered in the context of the purpose of the study, a team including the chief physician, assistant chief physician, business director, nursing services manager, quality management director, information technology director and call center manager in the hospital management is formed and the current situation analysis is made by brainstorming method. recommendations have been developed.

Total duration of the appointments made from the internet is 2,134,565 minutes. and 424,000 min. of the total annual duration of in-person appointments. appears to be. Looking at the performance indicator, the average processing time for making an appointment in person is 8 minutes, and the average processing time for an appointment from the internet is 6.50 minutes. and the average processing time to get an appointment from the call center is 10 minutes. was detected.

Figure 1. Value Stream Map of the Appointment Process
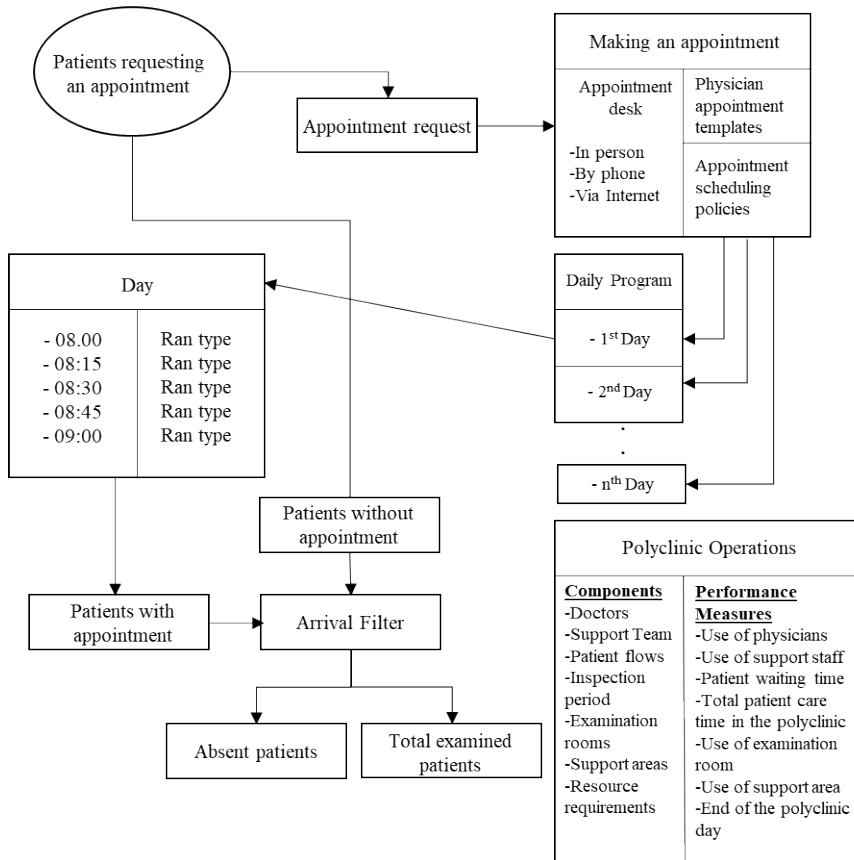
In the first step, as is value stream map of the appointment process was drawn by the team (see Figure 1) and the performance indicators of the previous year were examined. The route followed in the process of making/receiving appointments from the first step to the last step is mapped on the map containing the current situation. In the mapping process, different numbers of observations were made at different times, and the service flow was transferred from the beginning to the end, in a complete manner, into the value stream map of the current situation. When the indicators regarding the current situation are examined, the annual total duration of the appointments made from the call center is 682,220 minutes, and the annual

By drawing the as is map, the opinions of everyone in the team were taken

by brainstorming and the problems experienced were revealed. These identified problems are listed below:

- There are lost times due to personnel among the processes.
- Not using advanced software programs causes longer waiting times and conflicts in the appointment order.
- Doctors' appointment information in all buildings cannot be displayed on a single screen.
- The absence of different language options in the online appointment system directs patients to make an appointment through a call center or in person.
- Time losses cause delays in appointment times and increase in total service time.
- In addition, due to the short days of the doctor's calendar opened in the appointment system, it was observed that the patients could not make an appointment for examination when they wanted.

To solve the problems encountered in the current situation, the team carried out a new brainstorming in the next stage and the following suggestions were developed:

- Accelerating the appointment process with the technical development made in the appointment system software,
- Increasing the doctor's calendar created by the call center from 5 days to 10 days and updating the system accordingly,
- Ensuring that notifications are requested in case the appointment is canceled for appointments to be made over the Internet,
- Organizing customer service management, effective communication, and user trainings for the developed software for the personnel,
- Adding English and Arabic language options to the internet appointment system.

By making a simulation study of "to be" situation, the suggestions were evaluated, and it was decided to put into practice. The systemic changes implemented in the process improvement application are given below (see Figure 2-5):

1. With the development, patients who want to make an appointment can view the appointment information of existing doctors in all buildings on a single screen.

2. Doctor-based appointment links were created and directed to the doctor-specific 'make an appointment' buttons on the hospital website.

Figure 2. Make an Appointment System Display on the Doctor's Screen

3. If the doctor appointment slots are full, the "Call Me" system has been created, where patients will leave records.

Figure 3. "Call me" System Display

4. English and Arabic language options have been added.

Figure 4. Language Options System Display

5. A structure has been established based on the polyclinic where appointments can be made 10 days in advance.

After the improvements made, the performance indicators of the new application were examined. Indicators for 2021 representing the pre-implementation and 2022 representing the aftermath are as follows:

- With the improvement in the appointment process, an increase in the number of patients visiting the polyclinic has been observed. While the number of patients who applied to the hospital in 2021 was 449,617, it was realized as .360 in 2022, an increase of 32% in patient capacity. This situation led the hospital management to increase the number of polyclinic rooms.
- While the number of foreign patients who applied to the hospital was 18,763 in 2021, this figure increased to 27,139 in 2022.
- When the duration of the appointment process is examined, the average processing time for making an appointment in person is 8 minutes, the average processing time for appointments from the internet is 6.50 minutes, and the average processing time for making an appointment from the call center is 10 minutes. The average process time of getting an appointment from the internet was 4.58 minutes, and the average processing time of getting an appointment from the call center decreased to 7.23 minutes. In general, the processing time has been shortened by 21.52% and time loss has been reduced.

Table 3. Appointment Compliance Rate

Appointment Compliance Rate by Channel	2021	2022
Call Center Appointment Compliance Rate	**81%**	**86%**
Number of Appointments Given by the Call Center Unit	68,222	45,800
Number of Patients Who Didn't Come to Their Appointment	12,879	6,380
Number of Patients Who Came to Appointment	55,343	39,420
Online Appointment Compliance Rate	**90%**	**95%**
Number of Online Appointments	328,395	509,560
Number of Patients Who Didn't Come to Their Appointment	32,789	23,261
Number of Patients Who Came to Appointment	295,606	486,299
In Person Appointment Compliance Rate	**64%**	**69%**
Number of Personal Appointments	53,000	38,000
Number of Patients Who Didn't Come to Their Appointment	18,943	11,758
Number of Patients Who Came to Appointment	34,057	26,242

• To measure customer satisfaction each year, the results of the survey conducted by the hospital in the center and in all additional service buildings with the participation of a total of 500 people were also compared. Accordingly, the patient satisfaction before the improvement was 63%, while the post-improvement rate was 89%.

• Indicators including appointment compliance of patients before and after process improvement are detailed in Table 3.

6. CONCLUSION AND RECOMMENDATIONS

In this study, the process followed in the provision of appointment service for hospitals was handled through the example of a private hospital, and the improvement of the current process was carried out by applying value stream map and brainstorming methods, and the results were evaluated through performance indicators determined on the value stream map.

According to the results obtained, the problems experienced during the appointment process are focused on quality, time, technique, and patient satisfaction. After the improvement, the process efficiency has increased compared

to the old system. Thanks to the new software developed with both a patient and doctor-oriented approach and as part of the improvement steps, the system has become more useful, and it has been observed that patient satisfaction and the number of patients examined have increased. At the same time, with these software developments, the processing times in the call center and online appointment processes have been shortened and time losses have been reduced. With the increase in the number of patients applying to the hospital, an increase of 32% was observed in the patient admission capacity. The absence of a foreign language option in the online application system was identified as a problem in the improvement work, and an increase in foreign patient capacity was observed by including English and Arabic languages for foreign patients in the system.

A survey was also conducted to measure patient satisfaction regarding the improved appointment system. These surveys were carried out with the participation of 500 people in total, both in the center and in all additional service buildings of the private hospital considered within the scope of the study. According to the survey results, the patient satisfaction before the improvement was 63%, while the post-improvement rate was 89%. This is another indicator of the effectiveness of the improvement work.

In studies dealing with hospital appointment processes, two important points stand out when we look at the literature that aims to design the process and to investigate patient satisfaction. First, it is recommended that the use of such systems directly affect patient satisfaction as it reduces patient waiting times, increases the importance of remote appointment systems especially after the Covid-19 pandemic, and also, various arrangements are made to facilitate the use of patients living in rural areas with low digital literacy. However, it is revealed that the central appointment system does not eliminate the inequality of high demand and low physician supply, and it is necessary to ensure the sustainability of this process by limiting the patients who come without an appointment. In this study, the problems encountered in the current process and the parallel improvement areas are aimed at reducing the number of patients coming without an appointment by increasing the ease of use and ensuring the effective use of the system. It is foreseen that the system will be able to use more advanced software by considering the long-term improvements, feed-

backs and similar problems of other hospitals experiencing problems in the sector. In this way, as a health institution that follows the developing technological developments and adopts innovative solutions in this context, a positive effect can be achieved to gain a place in the minds of patients. In future studies, the problems encountered by users in similar systems can be analyzed by process mining and applications can be made to identify new improvement areas.

Ethical Approval: This research does not require ethics committee approval.

Authors' Contributions: All authors contributed equally to this work.

Funding and Acknowledgement: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of Interest Statement: Authors have no conflict of interest to declare.

REFERENCES

Aguilar-Escobar, V. G., and Garrido-Vega, P. (2016). Applying the theory of constraints to the logistics service of medical records of a hospital. European Research on Management and Business Economics, 22, 139-146.

Akar, Ç. and Özalp, H. (2002). Sağlık Hizmetlerinde Yönetim. Ankara: Songür Yayıncılık.

Akbal, H. (2021). Sağlık sektöründe süreç iyileştirme: Bir eğitim ve araştırma hastanesinde kısıtlar teorisi-yalın üretim-simülasyon bütünleşik yöntemi ile bir uygulama, Nevşehir Hacı Bektaş Veli Üniversitesi. (Unpublished Master's Thesis)

Aktan, C., Işık A. K. (2009). "Sağlık Hizmetlerinin Sunumu ve Alternatif Yöntemler",www.canaktan.org/ekonomi/saglik-degisim-caginda/pdf-aktan/sunumalternatif.pdf

Aktepe, A., Turker, A. K., and Ersoz, S. (2015). Internet based intelligent hospital appointment system. Intelligent Automation and Soft Computing, 21, 135-146.

Alagöz, M. A. (2013). Kamu hastanelerinde kuyruk, randevu sistemleri: Merkezi hastane randevu sistemi. Beykent Üniversitesi. (Unpublished Master's Thesis)

Alkinaidri, A., and Alsulami, H. (2018). Improving healthcare referral system using lean six sigma. American Journal of Industrial and Business Management, 8, 193-206.

Amonge, A. O. (2015). Application of Goldratt's Thinking Process to Constraints Within an Emergency Department—A Case Study, Western Kentucky University (Unpublished Master's Thesis)

Andrade, P. F., Pereira, V. G., and Del Conte, E. G. (2016). Value stream mapping and lean simulation: a case study in automotive company. The International Journal of Advanced Manufacturing Technology, 85, 547-555.

Arslan, F. (2011). Hastaneye muayene için gelen hastaların bekleme süreleri ile ilgili kuyruk modelleri ve analitik bir uygulama, Haliç University. (Unpublished Master's Thesis)

Arslan, H. M., Yıldız, M. S., and Uysal, H. T. (2015). Kesim hattında süreç iyileştirme ve etkin tasarruf: ağaç işleri atölyesine yönelik bir uygulama. Journal of World of Turks/Zeitschrift für die Welt der Türken, 7, 121-137.

Ateekh-ur-Rehman, L. U. R. (2012). Safety management in a manufacturing company: Six Sigma approach, Engineering, 4, 400-407.

Avunduk, H. (2019). Yalın altı sigma: bir pet şişirme makinasında süreç iyileştirme uygulaması. Elektronik Sosyal Bilimler Dergisi, 18, 633-653.

Bauer, J. M., Vargas, A., Sellitto, M. A., Souza, M. C., and Vaccaro, G. L. (2019). The thinking process of the theory of constraints applied to public healthcare. Business Process Management Journal. 25, 1543-1563.

Bektaş, F. (2014). Hastanelerde çalışan sağlık personelinin moral ve motivasyonunu etkileyen faktörlerin hastane yönetimine katkısı, Beykent Üniversitesi. (Unpublished Master's Thesis)

Berber, G., and Deste, M. (2021). Bir gıda işletmesinde süreç iyileştirme uygulaması: dondurma fabrikası örneği. Anadolu Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 22, 53-72.

Bozkurt, R. (2005). Süreç İyileştirme. Milli Prodüktivite Merkezi Yayınları, No:661, 3. Basım, Ankara: Milli Prodüktivite Merkezi Yayınları.

Bubevski, V. (2016). A Six Sigma Security Software Quality Management. Journal of Computer and Communications, 4, 40-60.

Cox III, J. F., and Boyd, L. H. (2020). Using the theory of constraints' processes of ongoing improvement to address the provider appointment scheduling system design problem. Health Systems, 9, 124-158.

Cox, C. R., and Ulmer, J. M. (2015). Lean Manufacturing: An Analysis of Process Improvement Techniques. Franklin Business and Law Journal, 2015, 70-78.

Çağlar, M. A., and Kurt, M. (2016). Altı sigma yaklaşımı ve savunma sanayi sektöründe bir uygulama. Endüstri Mühendisliği, 27, 13-24.

Çakırkaya, M., and Acar, Ö. E. (2016). 5S tekniği aşamaları ve makarna sektöründe bir uygulama. Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi, 30, 845-868.

Çavuş, R. (2004). Beyin Fırtınası, (1. Baskı). İstanbul: Kariyer Yayıncılık.

Çil, İ., and Yalçın, S. (2018). Yalın üretimin bankacılık sektörüne uyarlanması ve bir benzetim çalışması. Sakarya Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 22, 622-636.

Çolhan, M. K. (2020). İstanbul Bahçelievler Devlet Hastanesinde tehlikeli madde yönetiminde sürekli iyileştirme çalışması. Sağlıkta Performans ve Kalite Dergisi, 16, 31-39.

De la Lama, J., Fernandez, J., Punzano, J. A., Nicolas, M., Nin, S., Mengual, R. and Ramos, G. (2013). Using Six Sigma tools to improve internal processes in a hospital center through three pilot projects. International Journal of Healthcare Management, 6, 158-167.

Deniz, N., and Özçelik, F. (2018). Improving Healthcare Service Processes by Lean Thinking. Pamukkale University Journal of Engineering Sciences, 24, 739748.

Dereköy, F., and Kalmış, H. (2013). Hastanelerde performans ölçümünün muhasebe bilgi sistemiyle ilişkilendirilmesi. Muhasebe ve Finansman Dergisi, 58, 139-160.

Doğan, N. Ö., and Ersoy, Y. (2016). Hizmet sektöründe değer akış haritalama uygulaması: Bir üniversite araştırma ve uygulama merkezi örneği. Dumlupınar Üniversitesi Sosyal Bilimler Dergisi, 48, 103-116.

Doğan, N. Ö., and Takci, E. (2015). Bir Tekstil İşletmesinde Simülasyon Yardımıyla Süreç İyileştirme. Ege Akademik Bakis, 15, 185-195.

Dora, M., Lambrecht, E., Gellynck, X., and Van Goubergen, D. (2015). Lean Manufacturing to Lean Agriculture: It's about time. In IIE Annual Conference. Proceedings (p. 633). Institute of Industrial and Systems Engineers (IISE).

Dumantepe, H. (2017). Bir sağlık kuruluşunda süreç iyileştirme uygulaması. İstanbul Ticaret Üniversitesi. (Unpublished Master's Thesis)

Dumas, M., La Rosa, M., Mendling, J., and Reijers, H. A. (2013). Fundamentals of business process management (Vol. 1, p. 2). Heidelberg: Springer.

Efe, Ö. F., and Engin, O. (2012). Yalın hizmet-değer akış haritalama ve bir acil serviste uygulama. Verimlilik Dergisi, 4, 79-107.

Erdemir, A. (2015). Sağlık hizmetlerinde toplam kalite yönetimi. Beykent Üniversitesi. (Unpublished Master's Thesis)

Eyüboğlu, F. (2012). Süreç yönetimi ve süreç iyileştirme. Sistem Yayıncılık.

Farrington, T., Antony, J., and O'Gorman, K. D. (2018). Continuous improvement methodologies and practices in hospitality and tourism. International Journal of Contemporary Hospitality Management, 30, 581-600.

Fisher, W. W., Barman, S., and Killingsworth, P. L. (2011). Value stream mapping for improving academic advising. International Journal of Information and Operations Management Education, 4, 45-59.

Gege, C. (2018). A Simulation Optimization Study for An Emergency Department of a Hospital in Izmir. Dokuz Eylül Üniversitesi. (Unpublished Master's Thesis)

Gleich, S. J., Nemergut, M. E., Stans, A. A., Haile, D. T., Feigal, S. A., Heinrich, A. L., ... and Tripathi, S. (2016). Improvement in patient transfer process from the operating room to the PICU using a Lean and Six Sigma–based quality improvement project. Hospital pediatrics, 6, 483-489.

Grida, M., and Zeid, M. (2019). A system dynamics-based model to implement the Theory of Constraints in a healthcare system. Simulation, 95, 593-605.

Gul, M., and Guneri, A. F. (2012). A computer simulation model to reduce patient length of stay and to improve resource utilization rate in an emergency department service system. International Journal of Industrial Engineering, 19, 221-231.

Gupta, D., and Denton, B. (2008). Appointment scheduling in health care: Challenges and opportunities. IIE transactions, 40, 800-819.

Hammer, M. (2015). What is business process management? In Handbook on business process management 1 (pp. 3-16). Springer, Berlin, Heidelberg.

İnce, A. R., Erol, Y., and Karagöz, N. (2013). Bir süreç iyileştirme örneği olarak görüntü arşivleme ve iletişim sisteminin (Pacs) değerlendirilmesi (Sivas Numune Hastanesi Uygulaması). İşletme Araştırmaları Dergisi, 5, 243-257.

Jeyaraman, K., and Teo, L. K. (2010). A conceptual framework for critical success factors of lean Six Sigma: Implementation on the performance of electronic manufacturing service industry. International Journal of Lean Six Sigma, 1, 191-215.

Kağan, G. (2014). İstanbul ili Anadolu yakasında merkezi hastane randevu sisteminin hasta memnuniyeti açısından değerlendirilmesi, Sağlık Bilimleri Enstitüsü. (Unpublished Master's Thesis)

Kara, N. (2018). Bir Uçak Montaj Alanında Karşılaşılan Problemler ve Yapılan İyileştirmeler. Mühendis ve Makina, 59, 69-77.

Karataş, S., Akçayır, G., and Gün, E. T. (2016). Yaratıcı düşünme becerisinin geliştirilmesinde ters beyin fırtınası tekniğinin etkililiği üzerine nitel çalışma. Eğitim Teknolojisi Kuram ve Uygulama, 6, 42-58.

Kavuncubaşı, Ş. (2000). Hastane ve Sağlık Kurumları Yönetimi, Ankara: Siyasal Kitabevi.

Kaygusuz, S. (2014). Süreç iyileştirmenin işletme performansına etkileri. Paradoks Ekonomi Sosyoloji ve Politika Dergisi, 10, 31-50.

Kovancı, A. (1999). Toplam Kalite Yönetimi. Ankara: Hava Harp Okulu Yayınları.

Kuğu, S., and Köse, R. (2021). Isı değiştirici üretim hattında değer akış haritalama uygulamasının etkileri. Kırklareli Üniversitesi Mühendislik ve Fen Bilimleri Dergisi, 7, 135-146.

Küçük, A., Demirci, M., Kerman, G., and Özsoy, V. S. (2021). Evaluating of hospital appointment systems in Turkey: Challenges and opportunities. Health Policy and Technology, 10, 69-74.

LaGanga, L. R. (2011). Lean service operations: reflections and new directions for capacity expansion in outpatient clinics. Journal of operations management, 29, 422-433.

Lian, J., DiStefano, K., Shields, S. D., Heinichen, C., Giampietri, M., and Wang, L. (2010). Clinical appointment process: improvement through schedule defragmentation. IEEE Engineering in medicine and biology magazine, 29, 127-134.

Mandahawi, N., Al-Araidah, O., Boran, A., and Khasawneh, M. (2011). Application of Lean Six Sigma tools to minimise length of stay for ophthalmology day case surgery. International Journal of Six Sigma and Competitive Advantage, 6, 156-172.

Mannon, M. (2014). Lean healthcare and quality management: The experience of ThedaCare. Quality Management Journal, 21, 7-10.

Mohammadi, A., and Eneyo, E. S. (2012). Application of drum-buffer-rope methodology in scheduling of healthcare system. POMS 23rd Annual Conference, Chicago, Illinois, U.S.A.

Ömürgönülşen, M., and Çatman, R. (2018). Bir Kamu Kurumunda Değer Akış Haritalama ve Simülasyon Yöntemiyle Hizmet Sürelerinin Değerlendirilmesi. Finans Politik ve Ekonomik Yorumlar, 636, 47-70.

Özan, M. (2021). Süreç yönetimi ve süreç iyileştirmenin işletme performansına etkilerinin analizi. İşletme Araştırmaları Dergisi, 13, 1144-1161.

Özkan, N. (2015). Fabrika Organizasyonu ve Yönetimi. Seçkin Yayıncılık: Ankara.

Öztürk, A., Arıkan, V., and Öztürk, M. (2011). Süreç iyileştirme yöntemleri ve yöneylem araştırması. Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi, 25, 391-405.

Öztürk, Z. S. (2010). Süreç iyileştirmede Altı Sigma yaklaşımı ve otomotiv sektörü üzerine bir uygulama, Marmara Üniversitesi. (Unpublished Master's Thesis)

Öztürker, C., Şahbaz, İ., Öztürker, Z. K., Taner, M. T., Bayraktar, Ş., and Kağan, G. (2014). Development of a Six Sigma infrastructure for trabeculectomy process. American Journal of Operations Research, 4, 246.

Özveri, O., and Çakır, E. (2012). Yalın Altı Sigma ve Bir Uygulama. Afyon Kocatepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 14, 17-36.

Papadopoulos, T. (2011). Continuous improvement and dynamic actor associations: A study of lean thinking implementation in the UK National Health Service. Leadership in Health Services, 24, 207-227.

Parlak, S. (2017). Toplam Kalite Yönetimi ve Kalite Yönetim Sistemi Standartları. Ekin Basım Yayın Dağıtım.

Pekgör, S., Eryılmaz, M. A., Solak, İ., Pekgör, A., Yaka, H., Kaya, İ. F. K., ... and Koç, M. (2017). Evaluation of Factors Affecting the Use of the Central Physician Appointment System. Southern Clinics of Istanbul Eurasia, 28, 204-211.

Poyraz N. (2015) Hastanelerde Süreç Yönetimi ve Süreç İyileştirme Konusunda Bir Uygulama Örneği, İstanbul Arel University. (Unpublished Master's Thesis)

Rauch, E., Damian, A., Holzner, P., and Matt, D. T. (2016). Lean Hospitality-Application of Lean Management methods in the hotel sector. Procedia CIRP, 41, 614-619.

Rexhepi, L., and Shrestha, P. (2011). Lean Service Implementation in Hospital: A Case study conducted in "University Clinical Centre of Kosovo, Rheumatology department", Umeå School of Business. (Unpublished Master's Thesis)

Rosemann, M., and Brocke, J. V. (2015). The six core elements of business process management. In Handbook on business process management 1 (pp. 105-122). Berlin, Heidelberg: Springer Berlin Heidelberg.

Ryan, A., Hunter, K., Cunningham, K., Williams, J., O'Shea, H., Rooney, P., and Hickey, F. (2013). STEPS: lean thinking, theory of constraints and identifying bottlenecks in an emergency department. Ir Med J, 106, 105-7.

Samadbeik, M., Saremian, M., Garavand, A., Hasanvandi, N., Sanaeinasab, S., and Tahmasebi, H. (2018). Assessing the online outpatient booking system. Shiraz E-Medical Journal, 19, 27-33.

Senger, Ö. and Cengiz, Ö. (2018). Hizmet sektöründe altı sigma kalite felsefesinin uygulanması: bir turizm işletmesi örneği. Alphanumeric Journal, 6, 151-176.

Soylu, A. (2017). Sağlık Bilişim Sistemleri ve Merkezi Hastane Randevu Sistemi, Beykent Üniversitesi (Unpublished Master's Thesis)

Şahin, B. (2010). Hastane yönetim süreçleri ve sağlık yönetim bilgi sistemleri. Kadir Has Üniversitesi. (Unpublished Master's Thesis)

Tagge, E.P., Thirumoorthi, A.S., Lenart, J., Garberoglio, C. and Mitchell, K.W. (2017). Improving Operating Room Efficiency in Academic Children's Hospital Using Lean Six Sigma methodology. Journal of Pediatric Surgery 52, 1040-1044.

Tanık, M. (2013). Kalıp ayar sürelerinin smed metodolojisi ile iyileştirilmesi: bir yalın altı sigma uygulaması. Muğla Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 25, 117-140.

Tatham, P., and Worrell, D. (2010). Lean Thinking in an Uncertain Environment: The Implications for UK Defence Acquisition. International Journal of Defense Acquisition Management, 3, 1-22.

Tekin, P., and Erol, R. (2016, April). Modelling and Analysis of Operation and Patient Appointment Systems: A Case Study At a Dental Hospital in Turkey. In 2016 UKSim-AMSS 18th International Conference on Computer Modelling and Simulation (UKSim) (pp. 203-208). IEEE.

Thomassey, S. (2014). A simulation based comparison: Manual and automatic distribution setup in a textile yarn rewinding unit of a yarn dyeing factory. Simulation modelling practice and theory, 45, 80-90.

Toda, E., and Ginj, M. (2019). The effect of utilizing lean tools in a hospital radiopharmacy. The Journal of Nuclear Medicine, 60, 3020.

Toussaint, J. S., and Berry, L. L. (2013). Leadership lessons from lean. Trustee, 66, 21-24.

TSE, (2015). TS EN ISO 9001:2015 Kalite Yönetim Sistemi- Şartlar, Türk Standartları Enstitüsü: Ankara.

Türkan, T., and Görener, A. (2017). Süreç iyileştirme: Vasıflı çelik üretim sektöründe bir uygulama. Optimum Ekonomi ve Yönetim Bilimleri Dergisi, 4, 23-40.

Unsal, Ç. Sağlık sektöründe hizmet kalite standartları ve acil serviste hasta memnuniyetine yönelik bir araştırma, Beykent Üniversitesi (Unpublished Master's Thesis)

Vinodh, S., Ben Ruben, R., and Asokan, P. (2016). Life cycle assessment integrated value stream mapping framework to ensure sustainable manufacturing: a case study. Clean Technologies and Environmental Policy, 18, 279-295.

Yalçındağ, Y. (2021). Gıda işletmelerinde Taguchi yöntemi ile süreç iyileştirme ve bir uygulama. Pamukkale Üniversitesi, Fen Bilimleri Enstitüsü. (Unpublished Master's Thesis)

Yalçınkaya, S. A. (1997). Sapdöver harman makinası üretiminde iş akış diyagramına göre iş etüdü. Journal of Agricultural Sciences, 7(02), 78-83.

Yamamoto, J., Abraham, D., and Malatestinic, B. (2010). Improving insulin distribution and administration safety using lean six sigma methodologies. Hospital Pharmacy, 45, 212-224.

Yazgan, M. (2009). Sağlık işletmelerinde hizmet kalitesinin sağlık hizmeti sunan ve sağlık hizmeti alan taraflarca değerlendirilmesi. Dokuz Eylül Üniversitesi, Sağlık Bilimleri Enstitüsü. (Unpublished Master's Thesis)

Yeh, C. W., Shyu, C. S., Hsu, C. H., and Cheng, K. M. (2011). Applying six sigma to promote self-management ability in health clubs. African Journal of Business Management, 5, 1365.

Yıldırım, A. (2014). Sağlık kurumlarında üretim ve süreç yönetimi üzerine bir değerlendirme: Malatya Turgut Özal Tıp Merkezi örneği. The Journal of Academic Social Science Studies, 29, 457-474.

Yıldız, S., and Yalman, A. G. F. (2015). Sağlık işletmelerinde yalın uygulamalar üzerine genel bir literatür taraması. Uluslararası Sağlık Yönetimi ve Stratejileri Araştırma Dergisi, 1, 5-20.

Yılmaz, M. (2019). Üç yazılım firmasında yazılım süreç değişimlerinin gözlenen etkileri: Endüstriyel keşif vaka çalışması. Pamukkale Üniversitesi Mühendislik Bilimleri Dergisi, 25, 240-246.

Yılmaz, M., Alıcı, H., and Karaman, M. (2017). Sağlık kurumlarında israf giderme yöntemleriyle yalın düşünce. İnönü Üniversitesi Sağlık Hizmetleri Meslek Yüksek Okulu Dergisi, 5, 54-70.

Yılmaz, S., Arslan, N., and Oturakci, M. (2021). Process improvement applications for a cargo company. Niğde Ömer Halisdemir Üniversitesi Mühendislik Bilimleri Dergisi, 10, 576-581.

Yükçü, S., and Yüksel, İ. (2015). Hastane işletmelerinde kısıtlar teorisi yaklaşımı ve örnek bir uygulama. Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi, 29, 557-578.

Zhao, P., Yoo, I., Lavoie, J., Lavoie, B. J., and Simoes, E. (2017). Web-based medical appointment systems: a systematic review. Journal of medical Internet research, 19, e6747.