DERLEME REVIEW

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Systematic Review on Reengineering Digital Processes of Healthcare Institutions

Sağlık Kurumlarının Dijital Süreçlerin Yeniden Yapılandırılması Üzerine Sistematik Derleme

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ABSTRACT Objective: Organizations make changes on their processes in order to keep their costs under control while continuing their activities effectively and efficiently. This research has been carried out to evaluate the results of reengineering practices carried out within hospitals, based on cost and benefit themes. **Material and Methods:** Systematic review is an important method for revealing best practices and implementation results. The systematic review method was used to analyze and interpret the data of the research and to present the findings. The systematic review was made using the PRISMA flow chart. As a result of the first examination, 1931 studies were found and 13 studies that were suitable for the inclusion criteria were evaluated within the scope of the study. **Results:** Reengineering practices carried out in hospitals were examined under the themes of benefit and cost and it was seen that results were obtained from various perspectives. When considered in terms of benefit; while there are studies that have shown positive results such as ease of use, health output, increase in satisfaction and productivity, it is also seen that there are studies that have not shown any benefit. In terms of cost perspective, it has been observed that there are studies showing positive results in efficiency increase and saving. **Conclusion:** Although the investigated studies indicate efficiency, user-friendliness, increasing satisfaction, saving or increasing income as the main objective, multiple outputs have been obtained in one study. The systematic compile review study has revealed the best practice results, and it also provides suggestive for the reengineering studies to be carried out. With the studies examined, it can be said that the reengineering studies performed in technological processes yielded positive results.

Keywords: Reengineering; hospital; change; business process redesign

ÖZET Amaç: Organizasyonlar, faaliyetlerini etkili ve verimli şekilde sürdürürken aynı zamanda maliyetlerini de kontrol altına almak için süreçleri üzerinde değişiklik yapmaktadır. Bu araştırma, hastanelerde gerçekleştirilen değişim mühendisliği uygulamalarının sonuçlarını maliyet ve fayda temalarına göre değerlendirmek amacıyla yapılmıştır. **Gereç ve Yöntemler:** Sistematik derleme, en iyi uygulamaların ve uygulama sonuçlarının ortaya koyulması için önemli bir yöntemdir. Araştırmanın verilerini analiz etmek, yorumlamak ve bulguları sunmak için sistematik derleme yöntemi kullanılmıştır. Sistematik derleme yapılırken PRISMA akış şemasından faydalanılmıştır. İlk inceleme sonucunda 1931 araştırma bulunmuş ve dâhil edilme kriterlerine uygun 13 çalışma değerlendirilmiştir. **Bulgular:** Hastanelerde yürütülen değişim mühendisliği uygulamaları fayda ve maliyet temaları altında incelenmiş ve çeşitli perspektiflerde sonuçlar elde edildiği görülmüştür. Fayda teması açısından bakıldığında; kullanım kolaylığı, sağlık çıktısı, memnuniyet ve verimlilik artışı gibi olumlu sonuçlar veren çalışmalar bulunmasına karşın fayda üretemeyen değişim mühendisliği çalışmaları olduğu da görülmektedir. Maliyet açısından bakıldığında ise verimlilik artışı ve tasarruf konusunda olumlu sonuçlar veren çalışmalar olduğu görülmüştür. **Sonuç:** İncelenen çalışmalar, ana hedef olarak verimlilik, kullanıcı dostu olma, memnuniyet artışı, tasarruf veya gelir artışı göstermesine rağmen bir çalışmada birden çok çıktı elde edilmiştir. Sistematik derleme çalışması, en iyi uygulama sonuçlarını ortaya koymakta ve aynı zamanda yürütülecek değişim mühendisliği çalışmaları için de fikir vermektedir. İncelenen çalışmalar ile birlikte, teknolojik süreçlerde yapılan değişim mühendisliği çalışmalarının olumlu sonuçlar verdiği söylenebilir.

Anahtar Kelimeler: Değişim mühendisliği; hastane; değişim; iş sürecinin yeniden tasarımı

In today's business world, organizations are redesigning their processes to achieve competitive advantage, increase efficiency and keep costs under constant control.[1] Different researchers have made different definitions for reengineering in the literature. Hammer and Champy, who also introduced the

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concept, define reengineering in their book called reengineering, published in 1993 as: *"Reengineering is the fundamental rethinking and radical redesign of business processes in order to make striking improvements in the most important performance measures of our time such as cost, quality, service and speed"*. According to this definition, reorganization and restructuring of business processes are emphasized for reengineering. In other words, the concept of reengineering is expressed as a process-oriented redesign activity.[2,3] In another study, Hammer and Stanton defined the concept as "Reengineering is fundamentally rethinking and radically redesigning business processes in order to make dramatic improvements in performance".[3] In the studies carried out by Davenport and Short, the concept of "Business Process Redesign" was used and this concept was later used as an equivalent definition with the same meaning as reengineering.[2,4] It is possible to express this process carried out on behalf of institutions as a management technique. Also, it is possible to express it as a new set of activities aiming to increase performance by carrying out redesign activities as a result of radical changes in the process, system, structure and applied policies. In addition, it is possible to express it as a new set of activities aiming to increase performance by carrying out redesign activities as a result of radical changes in the process, system, structure and applied policies.

It is important to realize the processes by adapting to the changes in the environment instead of the practices and management styles that correspond to the traditional management understanding or the early stages of modern management understanding. For this, it is necessary to realize the system and management approach by making an improvement from the root. Reconstruction allows big improvements to be made at one time. While restructuring is an expensive way to improve quality and processes, it is seen as an important practice in today's rapidly changing markets.[5] It can be said that as in many sectors, reducing costs and increasing efficiency in the health sector is possible with reengineering, which helps to redesign business processes.[1]

MATERIAL AND METHODS

"Systematic review", also known as "research synthesis", aims to provide a comprehensive and unbiased synthesis of many related studies in a single document.[6] In this study, the effectiveness of the reengineering management technique that occurs in the technological processes of hospital enterprises, which has a very important place in the execution of health services, will be systematically investigated. The research will reveal the areas, practices and practice results where the change is most required in hospitals. This systematic review was conducted in accordance with the PRISMA directive. PRISMA is a guide that specifies standards for reporting the results of systematic reviews, providing transparency in the presentation of results and affiliation between reviews.[7] The study was conducted as a retrospective review of publications on the subject. Due to the fact that reengineering studies have been done intensively in recent years and Leggat, Bartram, Stanton, Bamber and Sohal publihed a systematic review in 2015, the year 2015 was taken as the beginning for the literature review.[8] The literature review was carried out on the Web of Science, Scopus, Pubmed and Science Direct electronic databases over the Ankara University internet access network. A keyword search was made according to Medical Subject Headings, and since its equivalent could not be found, the keywords reengineering, redesign, process redesign, which are commonly used in the literature, were searched between April and May 2020. The keywords were scanned in the abstract, keyword and the subject of the study as combinations of each other in the relevant databases.

Inclusion criteria in the study have been defined as: Conducting reengineering research in hospitals, being a research article, being in technological processes, being an implementation, being in English and full text; whereas exclusion criteria has been defined as reviews, qualitative and descriptive studies. Titles and summaries of the studies obtained from electronic databases were examined; studies in English, which include reengineering practice in health institutions and whose full text can be accessed, were included in the study (Figure 1). As a result of the re-

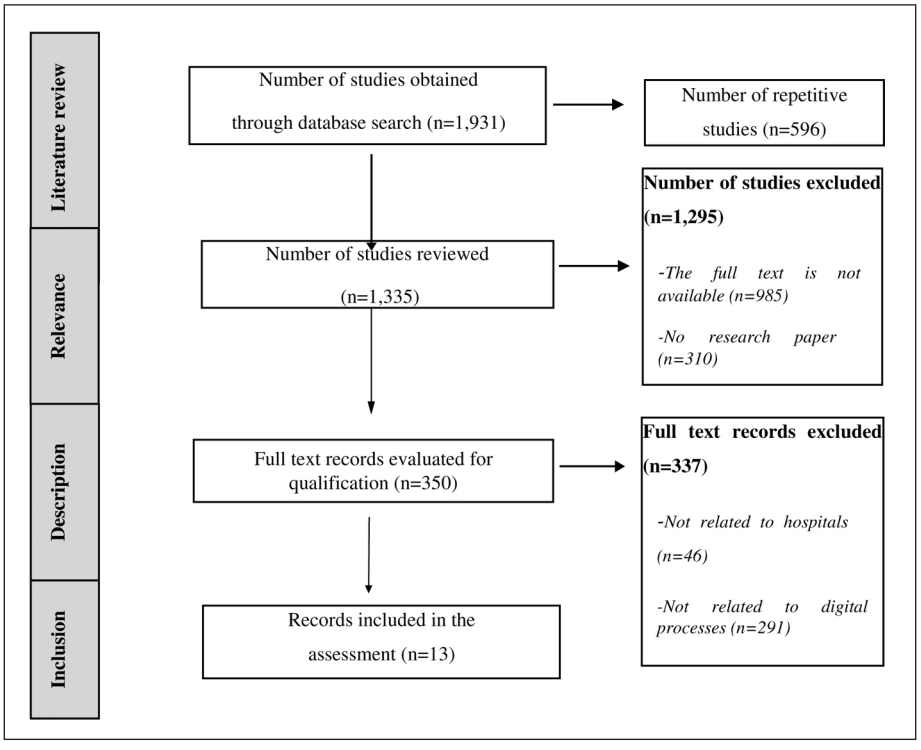

FIGURE 1: Selection flow of studies.

view, 13 studies that were determined to comply with the relevant criteria were included in the study.

In the research, "Quality Criteria for Assessing Research" in Table 1 suggested by Polit and Beck were used for quality assessment of studies. The criteria allow a general assessment based on the objective, method, sample characteristics, analysis of findings, results and discussion.[9] The criteria consisted of 12 items, each with a score of 1 and text readings were carried out by the researchers. Each study was evaluated separately by the researchers over all criteria; a score of "1 point" was given if the criteria met each item completely, and "0 point" if not.

TABLE 1: Quality criteria for assessing research.

1. Are the objective of the research and research questions given appropriately?
2. Were the research questions answered appropriately?
3. Are the concepts used in the study clearly defined?
4. Are the characteristics of the sample adequately explained?
5. Is the sample size sufficient?
6. Are the materials and methods used suitable for the subject?
7. Is the equipment used valid and reliable?
8. Are the findings clear and properly organized?
9. Have all important conclusions been discussed?
10. Is the discussion consistent with the findings?
11. Are the results reported as a summary?
12. Have limitations been reported?

Source:[9]

The quality evaluations of the studies selected for evaluation were carried out by the researchers independently from each other, with the highest score being 12 and the lowest score being 7. For reliability among raters, the "kappa coefficient" value was calculated in SPSS-23 program. With the kappa coefficient, the consistence between the two researchers was demonstrated. The kappa value for the total of all items was 0.704, and the consistence between raters was found to be adequate.

STUDY PROBLEM AND PURPOSE OF STUDY

Rapid globalization has accelerated the use of technology and has forced organizations to adapt to this change. With the coronavirus pandemic, the service sector has started to be realized more contactless than

ever with technology support. In this way, the redesign of processes has become an important field of activity.

In this context, research questions have been defined as:

- What are the usage frequency and usage results of reengineering studies in health services?
- What are the methods used in reengineering practices and what is their effectiveness?
- In terms of reengineering, does every transition from traditional to modern method benefit healthcare institutions?

Reengineering is an important and potentially efficient approach to increase the efficiency and effectiveness of hospitals and to address the broader challenges faced by public administration in difficult economic times.[8] With this point of view, the main purpose of the study is to determine the areas where reengineering studies occurring in technological processes are concentrated, revealing the best practices in the specified areas and bringing useful reengineering methods to the forefront. While the systematic review study conducted by Leggat et al. in the field of reengineering in hospitals focuses on quality and lean organization, the study focuses on the restructuring of technological processes.[8]

The study has the feature of systematic review. These studies include research and processes previously carried out in institutions.

However, although these studies were previously conducted research studies, they also carry a collective evaluation feature in order to understand the benefit and cost aspects and sub-perspectives of the process in terms of benefit and saving, on behalf of the institutions that will go to process renewal in technological processes. On behalf of the researchers, it is important to give an idea about which perspectives do the studies on the subject mostly cover and which ones can be studied.

RESULTS

When the studies included in the research were examined, reengineering practices in technological fields of hospitals as of 2015 were examined, among the studies obtained as a result of the screening. Considering that 2020 has not yet been completed during the screening period, it has been observed that reengineering studies have increased over the years. Among the studies examined within the scope of the research, it was seen that the most publications were made in 2019 (n=4).

While the 13 studies examined were conducted in 6 different countries with different geographical, economic, cultural and health system characteristics, it was determined that most of the studies were conducted in the USA (n=7). This is followed by Australia (n=2), Spain (n=2) Argentina (n=1) and England (n=1). When the units where reengineering practices are carried out were examined, most of the practices were carried out in the units related to medication tracking systems (n=5). In addition, studies were conducted in the areas of decision support systems (n=4), electronic health record systems, and patient follow-up (3) and laboratory (n=1).

Due to the nature of reengineering practices, reengineering, analysis and qualitative data analysis were used in all studies included in the study. Data of healthcare professionals, patients and related units were used as the sample group in the studies examined.

Table 2 contains information about the methods used in the studies included in the study.

OUTPUTS OF REENGINEERING STUDIES

The findings regarding the aims and results of the studies examined are included in Table 3, focused on cost and benefit. These main themes and sub-perspectives were obtained by grouping the benefit outcomes included in the findings of the investigated studies on reengineering.

BENEFIT OUTCOMES

Ease of Use: The study conducted by Huynh et al. is about medication management processes of nurses.[13] A typical medication management system includes a) evaluating the patient to obtain relevant data, b) collecting drugs, c) administering drugs, d) documentation of administration, and e) observing therapeutic and adverse effects. Clinical observations

TABLE 2: Methods used in the studies.

Studies	Used methods
De Ramón Fernández, Ruiz Fernández, Marcos-Jorquera, Gilart Iglesias[10]	Fishbone diagram
Rungvivatjarus, Kuelbs, Miller, Perham, Sanderson, Billman, et al.[11]	Error mode and effects analysis, key drivers diagram, statistical process control graphs, PUKO cycle
Menon, Fatehi, Bird, Darssan, Karunanithi, Russell et al.[12]	User and patient observations, statistical data analysis
Huynh, Snyder, Vidal, Sharif, Cai, Parsons et al.[13]	Clinical observation, user suggestions and requests, computerized simulation tracking
Melton, Zillich, Russell, Weiner, McManus, Spina et al.[14]	Fictional scenarios, principles of human factors
Venkatesh, Hajdasz, Rothenberg, Dashevsky, Parwani, Sevilla, et al.[15]	Autoregressive integrated moving average (ARIMA) model, PUKO cycle
Fisher, Mtonga, Espino, Jonkman, Connor, Cappella et al.[16]	Agile process models, user suggestions and requests
Pérez-Benito, Sáez, Conejero, Tortajada, Valdivieso, García-Gómez[17]	Information geometry temporal plot, probabilistic statistical process control algorithm, temporal heat maps
Baysari, Del Gigante, Moran, Sandaradura, Li, Richardson, et al.[18]	User suggestions and requests and pre/post study
Federman, Sarzynski, Brach, Francaviglia, Jacques, Jandorf, et al.[19]	Patient feedback, clinical observation, user recommendations
Jafar and Fletcher[20]	Clinical observation, user suggestions and requests, simulation
Liu and Walsh[21]	PUKO cycle, simulation
Luna, Lede, Otero, Risk and González Bernaldo de Quirós[22]	Inquiry, participatory design, usability testing, experimental testing of interfaces

TABLE 3: Thematic analysis of reengineering.

Theme	Perspective	Article
Benefit		
	Ease of use	Huynh et al.[13], Fisher et al.[16]
	Health output	De Ramón Fernández et al.[10], Melton et al.[14], Venkatesh et al.[15]
	Increase in satisfaction	De Ramón Fernández et al.[10], Rungvivatjarus et al.[11], Menon et al.[12], Fisher et al.[16], Liu and Walsh[21], Luna et al.[22]
	Failure to reveal benefit	Baysari et al.[18], Federman et al.[19], Luna et al.[22]
	Productivity increase	De Ramón Fernández et al.[10], Rungvivatjarus et al.[11], Huynh et al.[13], Venkatesh et al.[15], Fisher et al.[16], Pérez-Benito et al.[17], Jafar and Fletcher[20], Liu and Walsh[21]
Cost		
	Income increase	Menon et al.[12], Liu and Walsh[21]
	Saving	Menon et al.[12], Melton et al.[14], Fisher et al.[16]

verify the variability of nurse roles in the medication management system resulting in practices that deviate from standard practice protocols and is subject to environmental disruptions. For this, nurses are divided into two groups. While the first group acts according to the segregated work flow program, the second group acts according to the batch program. The task tracking of the nurses is monitored and their productivity is measured with the mobile application "iMed Tracker" developed by the researchers. The downtime caused by the patient for the segregated workflow tends to be lower than the batch work-flow. The reason for this is stated as non-pharmaceutical duties included in the batch workflow.

In a web-based study developed by Fisher et al. to improve the recipe management process and the general inventory control system, user suggestions and requests regarding system requirements and facilities have been taken into consideration.[16] For this, standardization is carried out so that different programs used in different departments of the institution can function in harmony with each other, and implementation is carried out in order to configure computers in the management office of the institution, to provide a physical inventory of all medications in the clinic and data entry process, and to establish both inventory and distribution modules in the clinic. Recipe management and general inventory control is a phar-

macist-oriented application that provides electronic distribution, automatic inventory management and increases process efficiency and transparency in all aspects of healthcare.

Health Output: In the study by De Ramón Fernández et al., a support system for a new early diagnosis has been developed to promote early diagnosis for chronic obstructive pulmonary disease (COPD) and to improve diagnostic accuracy and the quality of care provided.[10] First, weaknesses in the current diagnostic process were determined using the fishbone method and redesigned. As system weaknesses, it is stated that the diagnosis of COPD has inefficiencies and weaknesses that directly affect the quality of life of patients and increase the economic costs borne by public health systems. The current system contains weaknesses in the standardization of pulmonary function tests to ensure early detection and secondary prevention of the disease, hospital referral criteria of patients related to clinicians or lack of recommended information in relevant reports. This causes each specialist to process different tests and procedures for the patient. All these inefficiencies lead to increased costs associated with the diagnosis of COPD, as it results in patients returning to several consultations until an accurate diagnosis is provided or due to overuse of hospital resources (diagnostic tests). The newly developed system was evaluated qualitatively by specialists (n=12) and patients (n=36) and the applicability of the study has been proven with the findings such as the increase in efficiency in the quantitative results and the decrease in the number of patient applications. In the study conducted by Melton et al., which aimed to apply human factors principles to the creatinine clearance alert design and to increase the usability of the redesigned alert compared to the original alert and to reduce the prescribing errors, two prototypes were developed in a fake electronic health record.[14] New alert windows have been added in addition to the existing (original design) electronic system for reengineering. The scenarios included three drugs that must be adjusted or discontinued due to kidney failure. Two creatinine clearance alerts were generated for the original design, each close the start of the respective scenario. These alerts provide a general alert about estimated creatinine clearance and other lab results when the prescriber first enters the prompt entry system. On the other hand, redesigned alerts appear immediately after entering the order details for each drug, and the drugs to be prescribed and administered are determined in line with these alerts. Throughout the scenarios, participants appear to make significantly (43%) fewer prescription errors when using the original and redesigned creatinine clearance alerts.

Increase in Satisfaction*:* In the study by Liu and Walsh to completely redesign and standardize the documentation process building, there was a positive provider perception of the new documentation process based on a survey of the provider group.[21] A study was conducted by Luna et al. in two different stages: the first stage included the development of a new alarm interface, the iterative user-centered design process, and the second stage included an experimental approach to test the new user-centered design interface according to the standard version carried out in a controlled environment.[22] However, in the study between two designs, average user satisfaction was 87.4% for traditional design, compared to 92% for user-centered design methodology. Nineteen (59.3%) of 30 participants in the study felt that they were more satisfied with the use of the standard interface while using the user-centered design interface. However, in the study between two designs, the average user satisfaction for traditional design was 87.4%, while it was 92% for the user-centered design methodology. Nineteen (59.3%) of 30 participants in the study felt that they were more satisfied with the use of the standard interface while using the user-centered design interface. In the study by De Ramón Fernández et al., 10/12 (83%) of the specialists positively rated our tool in terms of helping speed-up diagnosis, helping to interpret results, as well as pioneering in promoting diagnosis and recommending its use in health centers, and with 4.29 out of 5 a general evaluation of the system was made.[10] In general, "patients" had a positive opinion for the use of the system. Patients provided a global rating of 4.53 out of 5. 27/36 (75%) of the patients emphasized that the system was very useful in alert of possible COPD cases. In the study conducted by Rungvivatjarus et al. using process maps, fishbone

diagrams, failure mode and impact analysis to identify drug reconciliation process errors, providers were enabled to improve the quality of care by clarifying our drug reconciliation policies and clearly defining provider roles.[11] In the study conducted by Fisher et al., users have reported that the program is as easy to access to the gmail box and saves a lot of time, as well as increased satisfaction levels.[16]

With the study of Venkatesh et al. aiming to reduce the number of dual chemistry tests, as these tests applied in emergency rooms cause excessive resource use and increase workload, it is provided that alerts regarding the test and the smart management of the process show up, when certain panels are entered on the automation screens of the clinicians.[15] In the evaluations made, a decrease was observed in the number of tests applied in 100 emergency service visits. These reductions are seen as evidence of success both in factors affecting the intensity when the emergency service is busy and in factors related to unnecessary resource use.

***Failure to Reveal Benefit*:** In the study of Baysari et al. aiming to redesign and reduce the number of decision support for prescribed antimicrobial drugs although it is not appropriate, it is seen that the redesigned new ordering process has no effect on the appropriateness of antimicrobial prescribing.[18] It is stated that this situation is caused by the deficiencies of the users besides the designed system. For example, it is understood that prescribers do not consider documenting an indication for antimicrobial use a priority, and prescribers state that when selecting a prewritten order from the available list, they seek the dose and frequency of an appropriate antibiotic instead of the indication. One of the weaknesses in terms of the system is that it allows to proceed to the next step even if a suitable indication is not given. In the comparison of traditional and new designs by Luna et al., it is seen that there is no significant difference between 'click count' and 'word count' when using computerized system.[22] In the study conducted by Federman et al., a three-stage process was used to redesign and implement the summary after the visit, collected through semi-structured interviews: 1) Defining the content, formatting and organization preferred by patients and clinicians; 2) Drafting a post-visit summary model in Microsoft Word; 3) Improving the post-visit summary with patient feedback, etc.[19] Many difficulties were expressed by physicians in the implementation of the summary redesign after the visit. Most notable one was that the effort was extremely time consuming and required many meetings on the topic. In addition, the participants reported that they had difficulties in achieving the design features they wanted most. In particular, they reported limitations of the system in its ability to format text and images, create charts for medications, and include patient-friendly text during clinical encounters without creating additional work for clinicians. For this reason, most of the participants stated that the visit summary that was redesigned in their institution was "not optimal".

Productivity Increase: A 2-phase study was conducted by Jafar and Fletcher, specifically on UK emergency medical team documentation standards and to focus on this aspect of emergency response.[20] With the improvements made on the documentation, it is seen that the 'results' data in May 2018 approached 90%, which is more than 4 times improvement compared to the first test in January 2017. Although it is less impressive numerically, it is stated that the improvement in diagnostic coding has also increased from 44% to 73%. In Liu and Walsh's study, a significant improvement was observed in the disease severity, mortality risk and case mix index originating from the Diagnosis Related Group, compared with the pre-intervention and post-intervention periods.[21] In the study conducted by Pérez-Benito et al., restructuring interventions were determined in four processes, including hospital relocation, restructuring of services, distribution of care services, changes in the pre-operative admission protocol due to taking patients from another hospital, within 7 years with measurable effects on electronic health records.[17] In the study of electronic health records, it was seen that the redesigns were made on the acceptance protocol whichh provided a significant reduction in the hospitalization time of the patients. The study by De Ramón Fernández et al. has shown that "healthcare staff" can avoid unnecessary visits by COPD patients.[10] In the study by Rungvivatjarus et al., it was stated that continued gains throughout the

institution significantly improved the completion of the drug settlement process, and those caused by deficiencies in all 13 therapeutic classes addressing the most frequently reported type of error improved the percentage of reconciled drugs.[11] In the study conducted by Huynh et al., it was seen that Intervention 2 reduced the percentage of interruption of the patient-focused process in the drug management process.[13] This result indicates that the system will be more efficient if nurses avoid situations that lead to disruption. The study conducted by Venkatesh et al. was initiated in the emergency services of two urban emergency departments in July 2015, and a system consisting of provider training, electronic health record redesign, audit and feedback was established.[15] In the institution where the study was conducted, emergency service providers identified repetitive chemistry tests as a high priority target to reduce overuse. The use of a multimodal quality improvement intervention has resulted in significant reductions in overuse of blood chemistry testing in the emergency service. The study by Fisher et al. concluded that the distribution and management of both paper-based systems and multiple inventory sources used instead of Recipe Management and General Inventory Control is among the most inefficient and error-prone processes.[16]

COST OUTPUT

Income Increase: Liu and Walsh significantly increased hospital average expected payments: when comparing pre-intervention and post-intervention working hours, the average expected payment for hospital fees increased by $ 14,020 per patient per month.[21] In the study conducted by Menon et al., 22 patients who received mobile diabetes management system and 22 patients who received usual care were compared as the experimental and control group.[12] In clinical results, various eHealth strategies have been studied as a multi-modal package (pragmatic approach) in order to better understand their impact on stakeholder satisfaction, healthcare provider and participant costs, and improvements have been observed. *(Positive effect on costs for healthcare providers).*

Saving: In the study conducted by Menon et al., it was seen that the participants saved their costs.[12] With a Drug Management Process simulation model, it was aimed to evaluate two hypothetical interventions. The study by Melton et al. found that 43% fewer prescription errors were made, and it was highlighted that if alerts reduced medication errors by 43%, as in the study, this could harm about 3 million patients and save about $ 8 million per year.[14] Venkatesh et al. believe that the intervention probably contributes to the synergistic effect of combining several evidence-based interventions, including electronic patient record redesign, supervision, and feedback, is likely to contribute to the intervention.[15] Annually, this intervention means savings of more than $ 126,000, avoiding over 11 units of patient phlebotomy, and countless unmeasured indirect costs and time savings in the emergency department.

DISCUSSION AND CONCLUSION

Health services are in the highly sensitive group of services with no substitution or postponement. These services require a quality provision without delay in case of need. Planning and implementation of such an important service and carrying out the necessary control of the processes should be carried out with great care. Today, the benefit of technology cannot be ignored in the realization of these processes, including management activities. Especially in the last 20 years, significant progress has been made in terms of technology in the health sector, as in other service and production sectors. Institutions providing health services are now becoming technological, starting from the processes such as appointments, etc. required before the patient comes to the institution, and processes such as test and inspection follow-up required after the patient leaves the institution. In this century, where technology is an important strategic step in terms of competition, it is seen that there has been a significant increase in the number of academic studies on technological perception and change steps in the process of transition to technology, especially in the last 20 years. In this study, the restructuring of health institutions in the technologicalization process and the evaluation of the reflection of this structuring on the institutions from different angles were systematically evaluated in terms of certain perspectives.

In the general analysis of the included and excluded studies, it was concluded that reengineering is a frequently preferred method, especially in terms of increasing efficiency in technological processes and measuring outputs and making comparisons with the old system. In this sense, the first question of our research has been supported.

In the studies examined, it is seen that methods such as fishbone diagram, error mode effects analysis, key drivers diagram and user suggestions-requests are used to determine the weaknesses of the previous system and the aspects that need improvement. However, the application of the fishbone diagram is seen as one of the methods frequently encountered in the literature in order to determine the main problems and to make improvements by determining the sub-problems related to this. In addition, the usability of this method is one step ahead in terms of both user suggestions and requests, and in terms of analyzing the information to be obtained in clinical observations on a regular basis regardless of whether it is important or not. However, it is possible to state that different situations require different methods and this diagram makes it possible to only identify errors and to be sorted according to their importance. In the studies, the PUKO cycle was used to check and audit the validity in terms of practice. It is also possible to state that some studies have increased the control phase to five with double control. When the studies are examined in general, it is seen that the most used step in determining the errors and deficiencies of a restructuring stage in technological processes in institutions is to apply to user requests and criticisms. In this respect, the second research question, the methods used and their effectiveness can be evaluated in this way.

In the included studies, it is observed that the improvement processes are especially carried out in practices such as developing decision support systems, performing electronic patient registration in a healthy way and reducing the rate of applying the wrong prescription.

While these improvements made in terms of benefit in technological processes sometimes aimed at providing a user-friendly interface, improving health outcomes, increasing satisfaction and efficiency, in terms of benefit, sometimes it is seen that savings and income increase are aimed by getting rid of unnecessary steps on behalf of the institution, in terms of costs.

When the outputs of the studies are examined, it is seen that productivity increase is mostly targeted in the restructuring process. In the study of De Ramón Fernández et al. on the improvement of the early diagnosis system for COPD patients, it is stated that the system arrangement carried out reduces the unnecessary applications of the patients to the institution, thus reducing the workload of the staff and performing a more efficient work.[10] In the study of Huynh et al., which is another study aiming at process-oriented improvement in the activities carried out, it is observed that with the improvement performed, there has been a decrease in cases such as the interruption of the patient-induced process and efficiency has been achieved, in terms of the outputs related to the work flow and drug management processes of nurses.[13]

In the study conducted, two different collective and segregated work flow simulations were determined for nurses, and the efficiency of the drug management process was measured in the steps from entering the patient's room until leaving this room for the other patient's room. While it was observed that the patient-oriented medication management process was interrupted in the process of nurses with collective work flow chart; it is stated that this situation is less in nurses with segregated work flow charts. In the study by Jafar and Fletcher on the improvement process in the documentation standards regarding the emergency response, it is revealed that the change made on the system has achieved an efficiency of 29% in diagnosis coding within one year.[20] In the study conducted by Pérez-Benito et al., it was seen that the re-designs performed on electronic health records have been the acceptance protocol which provided a significant reduction in the hospitalization time of the patients.[17] According to the results of the studies, it is possible to state that the improvements in technological systems provide benefits starting from the unnecessary referral of the patients, the execution

of the processes without any interruption and even the reduction of the patient stay.

Although efficiency is important for institutions, the user-friendliness of the new systems to be installed or the improvements to be made is seen among the factors that increase efficiency. The study conducted by Melton et al. supports this hypothesis.[14] This study aims to provide benefit by modifying the alert modification of the creatine clearance test, which is a renal function control test, by changing the alerts about the three drugs that need to be adjusted or discontinued in patients suffering from renal failure, and by making the interface user-friendly. Thanks to the redesigned alerts in the change made in the interface, it is seen that 3.5 times more access to this information is achieved due to an additional convenience developed for both less prescription errors and access to laboratory information. This application, which also reduces recipe errors, shows the importance of systems making information easily accessible to users without any difficulty. In another study concerning the recipe management and general inventory control process, similar results support the usefulness of user-friendly systems. Fisher et al. state that, with a user-friendly web-based system (Rx-magic), both automated inventory management is carried out effectively and process efficiency and transparency provide convenience for pharmacists.[16]

Reducing prescribing errors, which is one of the results of Melton et al.'s user-friendly system, can also be considered as a health outcome. In this study, it is stated that prescription errors decreased by 43%.[14] This is seen as an important health outcome in terms of patients and wrong drug administration. Similarly, Venkatesh et al. realized that applying the chemistry test, which is one of the tests applied to patients in emergency departments, to the same patient both as rapid-bedside tests and in laboratory tests was unnecessary workload and resource loss, and made certain improvements in the automation system.[15] In addition to being an application that increases efficiency in terms of quality, these improvements are also seen as an important health outcome for the service and emergency patients by preventing unnecessary applications in the crowded emergency service environment.

In these studies, which are evaluated with different perspectives such as efficiency, user-friendliness and health output, it is seen that there are significant increases in satisfaction in terms of patients, institutions and users. The addressees of the improvements in most of the mentioned studies state that there is a significant increase in the level of satisfaction. In the study conducted by Liu and Walsh to redesign and standardize the documentation process, it is stated that the process provided a positive perception.[21] Likewise, in the study conducted by De Ramón Fernández et al. to improve the early diagnosis system in COPD patients, the addresses of the system stated a satisfaction level of 4.29 out of 5, and patients also stated that they were satisfied with the new system with a rate of 4.53 out of 5.[10]

However, it is not possible to say that all the studies carried out achieved the determined goals. The configurations carried out in some studies either did not show any effect compared to the previous ones and caused unnecessary loss of resources or caused a waste of time due to complexity. This caused them to be considered useless by their addresses. In the study of redesigning prescribed antimicrobial drug decision support by Baysari et al., it is seen that the design has no effect on indication accuracy.[18] In a study conducted by Federman et al., a redesign was developed for physicians in order to create a summary of the patient visit in electronic environment.[19] However, as a result of the study, this design was criticized by physicians as being extremely time-consuming, lacking some drug and patient-oriented benefits, and as a result it was decided that it was not optimal. In this respect, it can be considered as a finding that every transition from traditional to modern method is not beneficial for health institutions in terms of reengineering.

In some of the studies examined, it is seen that process renewal provides serious income or savings on behalf of institutions. With the diabetes application developed by Menon et al. to provide physician and patient self-control for type 2 diabetes patients, it was concluded that the application provided a significant increase in income for healthcare providers and savings on participant costs.[12] The developed appli-

cation allowed easy follow-up of the patient from the clinical panel and specific situations such as automatic message sending, and also enabled the patient to receive these notifications through the mobile application and control their vital situations such as flexpen and blood glucose monitoring. In a study conducted by Venkatesh et al. to reduce double chemistry testing in emergency services, it is stated that there is net savings of more than $ 126,000 per year, as well as unmeasured indirect cost savings, due to the reduced double chemistry test.[15]

Digitalization carried out in the technologies and processes used is one of the important steps of our age. In this research, studies related to process renewal in digitalization and technology adaptation practices in health institutions were examined. It is seen that the studies benefit organizations, employees and patients not only for the purpose of efficiency, user-friendliness, increase in satisfaction, saving or increasing income, but also in other dimensions. Although it is seen as beneficial, it should not be forgotten that if the process renewal is not fully understood and planned correctly before it is implemented and this change is not managed correctly, it will mean a great waste of resources and time loss for the institutions. In this respect, before taking a step towards change, great importance should be given to taking the right step at the right time.

The study is limited to research articles whose full text can be accessed in databases specified between April 2020 and May 2020. Books, book chapters, theses, papers and compilation articles written on the subject of reengineering are excluded from the scope of the study.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

All authors contributed equally while this study preparing.

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