Journal of Social Sciences of Mus Alparslan University

anemon

Derginin ana sayfası: http://dergipark.gov.tr/anemon

Araştırma Makalesi ● Research Article

Economic Effects of Digitalization: Health Sector Example

Dijitalleşmenin Ekonomik Etkileri: Sağlık Sektörü Örneği

Nazan Torun*

Öz: Dijitaleşme sağlık hizmetlerinde verimliliği artırma, hasta sonuçlarını iyileştirme, kalite iyileştirme, bilgiye erişim kolaylığı, güvenlik sağlama gibi birçok avantajının yanında maliyetleri azaltmada katkısı bulunmaktadır. Dijital uygulamaların bu kadar fazla avantajları bulunması ve yaygın kullanılmasına başlanmasına rağmen sağlık sektöründe dijital uygulamaların ekonomik etkileri hakkında çok az çalışma mevcuttur. Bu doğrultuda bu çalışma ile Türkiye'de giderek yaygınlaşan dijital hastane uygulamaların birincil ekonomik yönünden kazanımları incelenmesi amaçlanmıştır. Çalışmada birincil maliyetler olarak kağıt giderleri ve işçilik giderler alınmıştır. Çalışma için bir üniversitenin etik kurulundan onay (19.12.2024 tarihli ve 34 sayılı) alınmıştır. Çalışma sonucunda dijitalleşmenin hastaneler üzerinde ekonomik etkilerinin olumlu yönde olduğu tespit edilmiştir. Dijitalleşmenin hastanelere kâğıt tasarruf maliyetinin 48.494 ₺, iş gücü maliyetlerinin ise 7.779,474 ₺ toplamda ise ortalama olarak yıllık 7.827,968 ₺'lik katkısı olduğu belirlenmiştir. Çalışmada iş gücü maliyetlerinde 24 saat hizmet verme durumu, hasta giriş ve çıkış durumu, birimde çalışan personel sayısı ve bu personelin bir dakikalık ücretlerinin belirleyici olduğu belirlenmiştir.

Keywords: Dijitalleşme, Ekonomik Kazanım, Hastane, Maliyet, Sağlık hizmetleri.

Abstract: Digitalization contributes to reducing costs, as well as many advantages, such as increasing efficiency in healthcare services, improving patient outcomes, quality improvement, ease of access to information, and security. Although digitalization has so many advantages and has become widely used, there are very few studies on the economic effects of digital applications in the healthcare sector. In this regard, this study aims to examine the primary economic benefits of digital hospital applications, which are becoming increasingly widespread in Turkey. In the study, paper and labor costs were taken as primary costs. Approval for the study was obtained from the ethics committee of a university (dated 19.12.2024 and numbered 34). As a result of the study, it was determined that the economic effects of digitalization on hospitals were positive. It has been determined that digitalization contributes 48.494 ₺ to hospitals in paper saving costs and 7.779,474 ₺ in labor costs, with an average annual contribution of 7.827,968 ₺. The study determined that 24-hour service availability, patient entry and exit status, the number of personnel working in the unit and the one-minute wages of these personnel are determining factors in labor costs.

Anahtar Kelimeler: Digitalization, Economic Benefits, Hospital, Cost, Health Service

*Doç.Dr., Ankara Yıldırım Beyazıt Üniversitesi, Sağlık Bilimleri Fakültesi, Sağlık Yönetimi Bölümü
ORCID: 0000-0003-1793-3248, nazantorun@aybu.edu.tr
Cite as/ Atıf:.Torun, N.(2024). Economic effects of digitalization: Health sector example. *Anemon Muş Alparslan Üniversitesi Sosyal Bilimler Dergisi*, *12*(2), 717-724 http://dx.doi.org/10.18506/anemon. 1507704
Received/Geliş: 30 Jun/Haziran 2024
Accepted/Kabul: 26 August/Ağustos 2024
Published/Yayın: 30 August/Ağustos 2024

Introduction

The adoption and implementation of digitalization are considered an important step towards the modernization of healthcare, as they allow for improving patient outcomes worldwide, increasing the efficiency of the healthcare system, and enabling comprehensive research in healthcare (WHO, 2017).

There are many advantages provided by digitalization. In particular, these advantages are more important for the healthcare industry due to quality improvement, security, information integrity and accuracy (Nguyen et al., 2022). In this study, the economic benefits of digitalization are mentioned. Electronic medical records have long been promoted as a way to reduce costs, provide better patient service, and significantly improve outcomes. The advantage of the electronic medical record lies in its ability to integrate and streamline the healthcare delivery process, thereby increasing efficiency, reducing the costs of healthcare delivery, improving the overall quality of care, and reducing overall costs associated with the practice of medicine (Salehinajad et al., 2014; Vishwanath et al., 2010). Thanks to decision support systems in digital hospitals, fast and accurate decisions can be made, staff may have less workload, and the possibility of making mistakes may be less (Kılıç, 2016). At the same time, the e-Health system provides 50% benefits in healthcare costs and 35% benefits in efficiency (Kılıç, 2017). The most important reason for using PACS, which allows images obtained by imaging systems in different units to be archived in one place and made available to users at different points when necessary, is to reduce the loss of time and space by eliminating the necessity of printing the images on film, as well as saving costs (Onbay & Kantarcı, 2009).

The unstoppable rise in healthcare costs worldwide necessitates healthcare institutions to create a cost-effective system to control operational costs without changing the quality of care and service they offer. For this purpose, digitalization in health manages information, reduces costs, facilitates total quality management, and ensures the continuity of continuous quality improvement programs (Salehinajad et al ., 2014). These benefits are precisely measurable and quantifiable through the use of digital technology. For example, electronic data exchange technology saves time and labor costs by transmitting patient surveillance data in real-time, and electronically (Al- Shorbaji, 2001:18). Despite this, most healthcare organizations still use paper charts and manual processes (Schmitt & David, 2002).

Digitalization is a significant initiative that should only be undertaken after a careful analysis of the costs and benefits involved. Unfortunately, demonstrating the financial return of digitalization is often viewed as an inexact science at best, leading many healthcare executives not to adopt this technology. However, with the right approach, it is possible to convincingly demonstrate that the financial benefits will far outweigh the costs (Schmitt & David, 2002).

Rather than perceiving digital health as a cost that needs to be compensated, healthcare systems have begun to see it as a quality improvement tool that can positively transform healthcare services. This is because the digitalization of large-scale digital health, such as electronic medical records, provides significant quality, and safety benefits, including reducing undue variation in care, reducing preventable harm, improving patient focus, and enhancing opportunities for monitoring, risk management, and quality improvement (Shaw et al. al 2018).

Although digitalization has many advantages and has become widely used, there are very few studies on the economic effects of digitalization in the healthcare sector. In this regard, this study aims to examine the primary economic benefits of digital hospital applications, which are becoming increasingly widespread in Türkiye. It is thought that the study results will increase awareness in terms of the economic benefits of digitalization and contribute to the use of digitalization.

Literature Review

Information technologies and many digitalization are used in the health sector to survive, reduce production costs, ensure quality, and produce reliable, and accessible information (Long et al., 2018). Using mobile technology to centralize business processes helps prevent unnecessary referrals and reduces costs for patients. Solving problems in the functioning of the health system by using digital health technologies does not require

expensive or additional technologies. Using existing SMS or mobile internet technologies is simple, cost-effective, and successful (Buntin et al 2011). This section of the study includes studies examining the economic effects of digitalization in the healthcare sector.

Nguyen and his colleagues examined studies that conducted cost-benefit analyses of digital applications in healthcare institutions. In their study, they examined 28 studies out of 1184 in the literature, 20 of which were US-based studies. They found that only three studies conducted a cost-benefit analysis. Although studies have shown that digital implementation has a positive impact, measured effects have varied widely. As a result of the study, they concluded that the existing literature shows a lack of appropriate and comprehensive economic frameworks to understand the value of digital hospital applications (Nguyen et al., 2022)

Similarly, Salehinajad and colleagues systematically reviewed studies investigating the effects of digitalization in healthcare institutions in Iran. As a result of the compilation, more than half of the studies determined that these systems had positive effects on costs, and less than half had negative effects on costs. At the same time, studies have stated that these systems have other important effects such as reducing medication errors, increasing the accessibility of information, and improving quality (Salehinajad et al., 2014).

Menachemi and Brooks reviewed the general advantages and potential costs of various health computed tomography applications, including digital applications, electronic physician orders, and clinical decision support systems. In most of their studies in the literature, they have found that the returns obtained from digitalization are greater than the investments made for digitalization (Menachemi & Brooks, 2006).

Barlow et al. examined the economic impact of implementing electronic records in a polyclinic with 59 physicians. In the study, a positive return on investment was obtained by examining the data before and after the installation of the electronic recording system. The electronic records system was associated with direct reductions in expenditures and increases in revenues throughout the study period. Specifically, they reported that the direct electronic records system provided attributable savings of approximately $1 million in the first year (Barlow et al., 2004). King and his colleagues stated that digitalization reduces paper and document costs to zero, and reduces the costs resulting from errors by eliminating human-made errors (King et al., 2003).

Bayer et al. in their studies reported that digital hospital applications have many advantages, such as increasing the prestige and reliability of the hospital, contributing to increasing patient safety by preventing medication errors, providing fast, systematic, and reliable accessibility of data, preventing drug waste, and reducing general management costs. (Bayer et al ., 2019).

As can be seen from the studies, digitalization in the healthcare sector reduces errors, improves quality, saves time by shortening processes, reduces costs and provides economic benefits by reducing the use of paper and documents.

Method

This study was conducted with the aim of determining the primary economic benefits of digital hospital applications. The study was conducted in a hospital operating in Ankara and implemented HIMSS (Healthcare Information and Management Systems Society). In order to determine the economic benefits items in the study, semi-structured interviews were conducted with the personnel working in the hospital, and the literature was examined. As a result of the interviews and literature review, it was determined that the primary costs of economic benefits in the digital hospital are paper expenses, printing device depreciation expenses, toner fees, archive depreciation costs, and labor expenses. Since the age of the hospital is 40 years, the

building depreciation cost, printing device depreciation expenses, and toner charges could not be calculated because information was not available.

To calculate paper expenses, the amount of paper used in the three-year periods before and after becoming a digital hospital was calculated. Since paper prices increase every year, the calculation will result in a lower price in previous years and it will not be an accurate result to compare between years. Paper prices were calculated based on current prices with the replacement cost approach.

As for labor costs, the average time savings resulting from digital application for each unit were determined as a result of interviews with employees. Labor costs were first calculated per person and then multiplied by the number of personnel working in the relevant unit per day. In calculating labor expenses; first, the annual wage of each staff member was calculated and the one-minute wage of a staff member was calculated by converting the year to day, the day to hour, and the hour to minute. Salaries in March 2024 were taken into account in personnel salaries. Salaries of employees vary depending on the units they work in and their seniority. The average of employees' salaries was taken to keep salaries uniform. One-day labor saving costs were determined by multiplying the number of personnel in each title who performed the most digital transactions in the units, the relevant personnel's one-minute labor wage and the time savings minute. These calculations were made for all units, and a yearly savings cost was calculated by taking into account whether the units provide 24-hour uninterrupted service and the annual leaves of the employees.

Approval for the study was obtained from the ethics committee of a university (dated 19.12.2024 and numbered 34).

Results

In the study, first of all, in order to calculate paper expenses, the number of A4 paper (as 1 roll) usage was learned from the relevant unit of the hospital by year. In determining the price of A4 paper, the price received by the hospital through tender in March 2024 was taken into account. The hospital switched to a digital application in 2012. Therefore, no calculations were made for this year. To calculate the cost of savings in paper fees, the total paper costs for the years before and after 2012 were compared. While the amount of paper used before 2012 was 1500 pieces, it was observed that it decreased by almost half to 800 pieces in the years after 2012. The decrease in paper quantities is naturally reflected in its costs. While the total paper cost was 359.879 ₺ before 2012, it became 214.396 ₺ in the following years. In other words, an average of 145.483 ₺ was saved in paper expenses in the three years after switching to digitalization (Table 1).

Table 1. Number and Cost of Paper Used by the Hospital by Years

Year	Number of A4 Paper Rolls Used	Cost of a Roll of Paper (₺)	Total cost (₺)
2009	1500	76.57	114855
2010	1500	76.57	114855
2011	1700	76.57	130169
2012	1740	76.57	133231
2013	1000	76.57	76570
2014	1000	76.57	76570
2015	800	76.57	61256

Labor saving costs are shown in Table 2. The emergency unit, clinics, operating room, intensive care unit, diagnostic, and imaging units are open 24 hours a day, and 365 days a week, and the outpatient clinic, and administrative unit are open 8 hours a day on weekdays. These were taken into account when calculating the 1-day labor savings costs of the units. It is assumed that employees use their annual leave for an average of 20 days. Total annual costs were calculated based on 345 days by subtracting the annual leave days of the employees in units that provide 24-hour service, and based on 241 days by subtracting the annual leave days, and weekends of the employees in units that do not provide 24-hour service.

In terms of the units worked, the first three units that saved the most time were the emergency department (240 minutes), clinics (200 minutes), and intensive care unit (180 minutes). In comparison, the first three units that saved the least time were the administrative unit (60 minutes) and operating room, respectively. It is designated as an outpatient clinic and diagnostic and imaging unit (120 minutes).

Since emergency services provide 24-hour uninterrupted service and are the units with the highest number of patient entries and exits in the hospital, it is an expected finding that they are the units where the most time is saved. Similarly, it is an expected finding that administrative units, which serve only 8 hours a day on weekdays and are not affected by the number of patients, are the units where the least time is saved. According to these findings, we can say that the factors that determine time saving are the 24-hour service availability of the units and the units with a high number of patient entries and exits.

Among the units, the first three units with the most cost savings are outpatient clinics (2.984,544 ₺), clinics (1.897,500 ₺), and emergency unit (1.092,960 ₺), while the first three units with the least time savings are the diagnosis and imaging units (117.990 ₺), respectively, administrative unit (274.740 ₺), and operating room (455.400 ₺). It is an expected finding that the outpatient clinic is the unit where the most cost savings are achieved, as the highest number of personnel working in a day is in the polyclinic, and the hourly wage of these personnel is the highest. Similarly, it is an expected finding that the unit with the least cost savings is the diagnosis and imaging unit, as the minimum number of personnel working per day is in the diagnosis, and imaging unit, and the minute wage of these personnel is the least. According to these findings, we can say that the factors that determine cost savings are the number of personnel working in the unit, and the minute wage of this personnel. It has been determined that digitalization provides a total annual workforce savings of 7.779,474 ₺ to a medium-sized hospital.

Table 2 . Labor Savings Costs

Unit of Study	Saving time (In 1 Day)	Minute Rate (₺)	Number of Employees (in 1 day)	1 Day Saving Cost (₺)	1 Year Savings Cost (₺)
Operating room	120 min	1.1	10 Nurses	1.320	455.400
Clinic	200 min	1.1	25 Nurses	5.500	1.897,500
Intensive Care Unit	180 min	1.1	14 Nurses	2.772	956.340
Outpatient clinic	120 min	2.4	43 Doctors	12.384	2.984,544
Emergency room	240 min	1.1	12 Nurses	3.168	1.092,960
Administrative units	60 min	095	20 Administrative staff	1.140	274.740
Diagnostic and Imaging Unit	120 min	0.95	3 Medical secretary	342	117.990
Total Labor Saving Cost					7.779,474

The one-year cost of paper savings calculated over three years is 48.494 ₺. Labor costs are 7.779 474 ₺. As a result, the average annual savings cost of digital applications on hospitals was determined as 7.827,968 ₺.

Table 3. Total Savings Cost of Using Digital Applications

	1 Year Savings Cost
Labor Savings Costs	7.779,474 ₺
Paper Saving cost	48.494 ₺
Total Cost of Savings	7.827,968 ₺

Conclusion

With the development of technology, digitalization has started to be used in all sectors. Since the health sector has its own characteristics, the services provided have a direct effect on human health, and health resources are scarce, it is vital that resources are provided efficiently (Volkan, 2019). Since digitalization allows transactions to be carried out quickly and without errors, they are widely used in the health sector (Biçer & Yurtsal, 2021:752). In addition, developments in communication and information theologies has changed the demand for health services and made digitalization in health services inevitable (Gökkaya & İzgüden, 2022). Digitalization in the field of health has accelerated during the Covid-19 pandemic (Tunçsiper, 2023). Economic and social changes are observed as a result of digitalization. Many positive effects of these changes are observed. Studies has shown that digitalization increases accessibility to information, improves quality, leads to direct reductions in expenses and increases in revenues, reduces paper and document costs to zero, reduces costs arising from errors by eliminating errors, increases the prestige and reliability of the hospital, contributes to the prevention of medication errors and increases patient safety, and provides fast, systematic and reliable access to data (Barlow et al., 2004; Bayer et al., 2019; King et al., 2003; Salehinajad et al., 2014). As can be seen, digitalization has many positive effects on the health sector.

In addition to the numerous benefits of digitalization in healthcare, there are also some risky aspects that need to be considered. Despite the risks of not everyone having equal access to technology, the security of information in the electronic environment, and the fact that digitalization reduces patient-doctor communication and interaction, businesses need to be ready for change and flexible, and they need qualified and educated employees in this regard (Demir & Özcan, 2023).

This study was conducted to determine the economic effects of digitalization on the health sector. As a result of the study, it was determined that the economic effects of digitalization on hospitals were positive. It has been determined that digitalization contributes 48.494 ₺ to hospitals in paper saving costs, and 7.779,474 ₺ in labor costs, with an average annual contribution of 7.827,968 ₺. In the study, it was determined that 24-hour service availability, patient entry and exit status, the number of personnel working in the unit, and the one-minute wages of these personnel are determining factors in labor costs.

Although this study is an important study in terms of determining the economic effects of digitalization in hospitals for the first time, it has some limitations. Firstly, determining the time savings achieved due to digitalization is limited to the opinions of the interviewees. In future studies, time savings can be determined through observational studies such as keeping a stopwatch. Secondly, it is assumed that the same number of patients came to the hospital in the years used in the calculation of paper fees. Thirdly, the time saving period has not been determined for each employee working in the units, but only for the personnel in each title who perform the most digital transactions. Fourth, it is assumed that all employees take an average of 20 days of leave a year. Fifthly, there are differences in salaries between employees with the same title (especially for doctors) due to reasons such as seniority, branch of work, and unit. Therefore, in order to ensure uniformity, the average salary for each title was calculated in the study. Finally, in this study, economic factors are limited to paper, and labor costs in a hospital only. It is thought that future studies will contribute to the literature by conducting studies in many hospitals of different scales and calculating the economic contributions from different perspectives such as clinical decision support systems, quality improvement, and error prevention.

Reference

Al-Shorbaji, N. (2001). Health and medical informatics. Technical paper. World Health Organization, RA/HIS, Regional Office for the Eastern Mediterranean.

Barlow, S., Johnson, J., & Steck, J. (2004). The economic effect of implementing an EMR in an outpatient clinical setting. Journal of Healthcare Information Management: JHIM, 18(1), 46-51.

Bayer, E., Kuyrukçu, A. N., & Akbaş, S. (2019). Evaluation of Digital Hospital Applications from the Perspective of Hospital Employees and Managers: A State Hospital Example. Journal of Academic Research and Studies, 11(21), 335-360.

Biçer, E. B., & Yurtsal, K. (2021). Service quality and customer satisfaction perception in hospitals. Atatürk University Social Sciences Institute Journal, 25(2), 751-773

Buntin, M. B., Burke, M. F., Hoaglin, M. C., & Blumenthal, D. (2011). The benefits of health information technology: a review of the recent literature shows predominantly positive results. Health Affairs, 30(3), 464-471.

Demir, T., & Özcan, A. (2023). Systematic review of published research on digitalization in health in turkey between 2014-2023. Eurasian Academy of Sciences Social Sciences Journal, (51), 1-25.

Gökkaya, D., & İzgüden, D. (2022). Digital hospital applications: a study on city hospital employees. Gümüşhane University Journal of Health Sciences, 11(3), 848-859.

Kılıç, T. (2016). Digital hospital; an example of best practice. International Journal of Health Services Research and Policy, 1(2), 52-58.

Kılıç, T. (2017). E-Health, Good Practice Example; Holland. Gümüşhane University Journal of Health Sciences, 6(3), 203-217.

King, L. A., Fisher, J. E., Jacquin, L. A. U. R. A., & Zeltwanger, P. E. (2003). The digital hospital: opportunities and challenges. Journal of Healthcare Information Management: JHIM, 17(1), 37-45.

Long, L. A., Pariyo, G., & Kallander, K. (2018). Digital technologies for health workforce development in low-and middle-income countries: a scoping review. Global Health: Science and Practice, 6(Supplement 1), S41-S48.

Menachemi, N., & Brooks, R. G. (2006). Reviewing the benefits and costs of electronic health records and associated patient safety technologies. Journal Of Medical Systems, 30, 159-168.

Nguyen, K. H., Wright, C., Simpson, D., Woods, L., Comans, T., & Sullivan, C. (2022). Economic evaluation and analyses of hospital-based electronic medical records (EMRs): a scoping review of international literature. Digital Medicine, 5(1), 29.

Onbay, T. U. & Kantarcı, A. (2009). Distributed Interhospital PACS Network. Paper presented at the In EFMI STC VI. National Medical Informatics Congress, Antalya, Abstract retrieved from: https://turkmia.net/kongre2009/cd/pdf-format/Onbay.pdf

Salehi Nejad, S., Ahmadian, L., & Khajouei, R. (2014). Effects of Health Information Systems in Iran: a Systematic Review. Health Information Management, 11(2), 282-296.

Schmitt, K. F., & Wofford, D. A. (2002). Financial analysis projects clear returns from Electronic Medical Records: Demonstrating the economic benefits of an electronic medical record is possible with the input of staff who can identify the technology's benefits. Healthcare Financial Management, 56(1), 52-58.

Shaw, T., Hines, M., & Kielly-Carroll, C. (2018). Impact of digital health on the safety and quality of health care. ACSQHC (date of access: 24.04.2024), https://apo.org.au/node/245811

Tunçsiper, Ç. (2023). Digital transformation and health economics: a bibliometric analysis on digital health. Gümüşhane University Journal of Health Sciences, 12(1), 21-31.

World Health Organization. (2017). Global diffusion of eHealth: making universal health coverage achievable: report of the third global survey on eHealth. World Health Organization.

Vishwanath, A., Singh, S. R., & Winkelstein, P. (2010). The impact of electronic medical record systems on outpatient workflows: a longitudinal evaluation of its workflow effects. International Journal of Medical Informatics, 79(11), 778-791.

Volkan, E. (2019). Analysis of the Effect of Digital Hospital Studies on Paper Savings in Inpatient Procedures and the Duration of Nursing Care Services. Master's Thesis, Istanbul Medipol University Institute of Health Sciences, Istanbul