



# Digitization and Operational Efficiency in the Health Sector: A Study in Chota, Peru

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## Abstract

**Purpose:** Digitized resource management in hospitals is essential for improving operational efficiency, especially in regions with limited resources. This study evaluates the impact of resource digitization on operational efficiency in a hospital in Chota, Peru, with a focus on understanding its role in enhancing hospital operations in a regional context. **Research design, data, and methodology:** The research employs a quantitative, non-experimental, and transactional approach. Data were collected from 114 hospital workers using structured surveys, which focused on their experiences and perspectives regarding the implementation of digitized resource management systems in the hospital. **Results:** Digitization has a moderate but significant impact on operational efficiency, explaining 28.1% of its variability ( $R^2 = 0.281$ ). The study highlights the importance of integrating document management systems and emphasizes the critical need for preserving data privacy and security. These factors were found to be significant in improving workflow and decision-making. The findings are consistent with prior research, which suggests that digitization can be an effective strategy for enhancing operational efficiency in healthcare settings. **Conclusion:** The implementation of advanced technologies, combined with continuous staff training, is crucial for optimizing resource management and improving healthcare delivery in resource-constrained regions. Future research should explore longitudinal studies to assess the long-term impact of digitization on operational efficiency in diverse healthcare contexts.

**Keywords :** Resource Management, Digitization, Operational Efficiency, Digital Transformation, Hospital Administration

**JEL Classification Code:** M10, I10, L20

## 1. Introduction

The management of digitized resources in the hospital setting has emerged as a crucial tool for improving operational efficiency in various healthcare systems around the world; however, this digital transformation also presents significant challenges that vary depending on the regional context. The research contributes significantly to SDG 8, as

by improving the operational efficiency of hospitals through optimized management of digitized resources, it fosters higher productivity in the healthcare sector, which is essential for sustainable economic development of the community and the country.

In the international context, the digitization of medical records and the implementation of OCR for document conversion face problems related to uniformity in training

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and resistance to change among healthcare personnel; this situation limits the effectiveness of digitization, affecting the accessibility and accuracy of documentation, as well as the reduction of errors in medical records (Arora et al., 2024; Batra et al., 2023).

In North America, specifically in the United States, reliance on advanced technologies has revealed inequalities in technological accessibility between urban and rural centers, leading to variations in operational efficiency (Palozzi et al., 2020). In South America, countries such as Brazil and Chile, the lack of adequate infrastructure and poor training in new technologies hinder the optimization of digitized resource management; in addition, inconsistency in the implementation of digital systems leads to problems in time management and administrative efficiency, negatively impacting patient care and continuous improvement (Cheng et al., 2020; Ijeh et al., 2024).

In the Peruvian context, pseudonymization and data privacy preservation are particularly problematic areas due to insufficient investment in secure technologies and a legal framework that has not yet kept pace with digitization; this situation raises concerns about the protection of personal data and may undermine patients' trust in the healthcare system (Romero et al., 2023).

Moreover, many hospitals in Peru still depend on physical filing systems or fragmented digital platforms that lack full integration, resulting in inefficiencies in document management and, at times, the loss of critical information. (Caballero-Pérez et al., 2024). Similarly, the lack of full integration of electronic health records (EHRs) also poses a major challenge, as the heterogeneity of the systems used in different health centers prevents seamless integration, making it difficult to access complete and timely patient information (Vilcahuaman et al., 2020). In tandem, SCM suffers from the lack of an integrated and digitized system, leading to delays, inventory errors and shortages of essential medical supplies (Bressan et al., 2022).

The hospital under study located in the province of Chota in Peru, the lack of an effective optical character recognition (OCR) system means that medical records remain in physical format, making them difficult to access and update, consuming a lot of time and resources, increasing the risk of human error and reducing the accuracy of documentation; even insufficient staff training in OCR technologies limits the effective application of these tools, affecting accessibility and time savings in the management of crucial information.

In addition, the lack of clear policies and robust data protection processes exposes sensitive information to potential security breaches and non-compliance with legal regulations, compromising the trust of citizens; simultaneously, the lack of effective integration limits the hospital's ability to operate digitally efficiently, affecting the

quality of care and coordination between departments, negatively impacting biomedical research and leading to unnecessary duplication of medical tests, which increases costs and time; moreover, the absence of digitized resources and their poor management results in low hospital operational efficiency, making it difficult to evaluate and improve its technical and scale efficiency.

From a theoretical perspective, the research is based on models and theories related to information management, systems theory and operations management; these theoretical frameworks underline the relevance of having adequate information systems to improve operational and administrative processes. In practice, the research directly addresses the problems of data management and operational efficiency in a hospital context, providing solutions that can be applied to improve the operation of the hospital under study; digitization of records and effective integration can decrease time and errors, improve resource management and internal coordination, as this not only improves the hospital's ability to serve the community, but also establishes a replicable model for other hospitals in similar regions, broadening its practical impact.

Socially, the research has the potential to significantly improve the quality of health services available to the local community, given that, by optimizing the operational efficiency of hospitals, faster and more reliable access to critical health services can be guaranteed, because it is especially important in areas such as Chota, where health resources are limited. The methodological justification is based on the specific and quantifiable nature of the variables under study, since it allows obtaining precise and objective data, essential for assessing the effectiveness of digitized resource management in terms of operational efficiency.

The objective is to determine the impact of digitized resource management on the operational efficiency of a hospital in Chota, Peru. The hypothesis is that there is a direct impact of digitized resource management on the operational efficiency of a hospital in Chota, Peru.

For accuracy purposes, the software used for the OCR technologies and EHR system corresponds to the Pakamuros Soft platform, an open-source software developed by the regional government and based on Open MRS among other open-source sources.

## **1.1. Literature Review**

Buddhev et al. (2024) found that ad hoc repair path digitization reduced the number of steps by 18 and saved 74 minutes of total staff time per repair, with an annual savings of £21,721.48; MES path digitization reduced the number of steps by 13 and saved 56 minutes of total staff time per repair, with an annual savings of £3469.44; elective operations cancelled due to equipment problems decreased

by 44%; staff satisfaction with the repair path improved from 12% to 96%. Gupta et al. (2024) indicated that ArogyaSetu had a positive impact on the digital transformation of the Indian healthcare industry, improving governance and positively affecting stakeholders.

Begkos et al. (2024) showed that organizational change manifested itself in evolutionary and revolutionary ways, indicating that datification practices centralize control, empower diverse actors, and create interorganizational tensions. Gallab et al. (2024) revealed that the structured and simplified implementation of DPM in the pneumatic tube system was able to introduce significant benefits in predictive maintenance in the healthcare sector. Secundo et al. (2021) coordination of multiple actors within the healthcare ecosystem can effectively address pandemic-specific management challenges; the study also introduces policy implications through a unique decision support system (DSS) for assigning IoT devices to a wider group of patients, balancing the needs of improving the conditions of the most severe patients and maximizing the efficiency of device use.

Hameed et al. (2020) indicate that robots were mainly used to minimize person-to-person contact and ensure cleanliness, sterilization, and support in hospitals and quarantine facilities, thus minimizing the threat to the lives of medical personnel. Curioso et al. (2024) highlight the crucial role of these programs and related policies in the development of digital health competencies during the pandemic, as well as the importance of collaborations between institutions and countries to improve human resource capacity in digital health.

Pachas et al. (2024) indicate that the progressive implementation of digital technologies in public hospitals in Peru has improved the accessibility of health services, although challenges related to infrastructure, systems integration and data security persist. Mauricio et al. (2024) demonstrated a very high level of adoption and usability for both patients and physicians. Ruiz-Llontop et al. (2023) indicated that internal users reported a low level of 46.6% for the "Tele-education" dimension, while the "Tele-assistance" dimension obtained a high level of 47.9%; external users found that the "Responsiveness" dimension obtained a low level of 43.3%, and the "Security" dimension obtained a low level of 39.3%.

De La Cruz-Ramírez et al. (2023) indicated that most obstetricians made occasional use of smart health-based services during their professional activities (45.7%); limited access to computing devices (50.3%), medical applications (56.9%) and Internet connection (50.4%) was observed; in addition, most obstetricians lacked digital health education training in the use of digital health tools (76.1%), information management (79.0%), digital content creation (77.5%) and collaborative networking (73.2%). All these

aspects had a statistically significant relationship with the use of smart healthcare ( $p < 0.05$ ).

With regard to the theoretical basis of digitized resource management, the systems theory, proposed by Ludwig Von Bertalanffy, has been taken into account, as it allows a holistic approach to resource management, considering all parts of the healthcare system, such as medical equipment, management software and databases, and their interrelationships, ensuring better coordination and optimization of resources (Cambon & Alla, 2021). In addition, it fosters interconnection between different systems and subsystems, such as hospital information systems, electronic medical records and patient monitoring systems; this interconnection creates synergies that operationally improve the entity (Katrakazas et al., 2020).

Systems theory also facilitates adaptation to technological changes and the needs of the healthcare sector, enabling the incorporation of new technologies and management practices in an agile and efficient manner; it also helps to identify and eliminate redundancies and bottlenecks, improving resource management processes and reducing operating costs; it provides a structured framework for data analysis and decision making, improving the accuracy and effectiveness of strategic and operational decisions (Javanmardi et al., 2020).

Digitized resource management is the practice of using digital technologies to optimize and manage the resources needed in the delivery of health services, encompassing the implementation of technological tools and platforms that facilitate the collection, storage, analysis, and utilization of data to improve the efficiency and quality of health services (Kraus et al., 2021).

Optical Character Recognition and Identification (OCR) is the electronic conversion of images of typed, handwritten text into machine-coded text; this technology allows printed text to be digitized for compact editing, searching and storage, facilitating its manipulation by computer programs; OCR systems scan documents and convert the character images into machine-readable formats using pattern processing, artificial intelligence and computer vision techniques (Nahar et al., 2023).

Pseudonymization and privacy preservation; Pseudonymization is a data processing technique that replaces identifiable information in a data set with artificial identifiers or pseudonyms; this technique is used to protect the privacy of individuals by anonymizing sensitive data while maintaining the usefulness of the data for analysis and processing; on the other hand, privacy preservation involves implementing methods and policies that ensure that personal data are treated in a way that does not compromise the identity of individuals, even when data are shared or used for research (Subramanian et al., 2023).

Document management and archiving is the systematic process of managing digital documents, including their creation, storage, organization, preservation and final disposition; this process uses technologies such as OCR to convert physical documents into editable and searchable digital formats, thus improving management efficiency and access to information; the implementation of document management systems allows organizations to maintain effective control over information, ensuring its availability and security (Abbas et al., 2022).

Electronic Medical Record (EMR) integration involves the consolidation of patients' medical data into a centralized digital system that facilitates access to and management of clinical information; this process requires the use of advanced technologies to ensure that data are kept accurate, complete, and up-to-date, leading to improved coordination of patient care and operational efficiency of healthcare institutions; effective integration of EMRs also involves interoperability between different systems and protection of patient data privacy (Jang et al., 2023).

Regarding the theoretical basis of operational efficiency, operations management theory is considered to have been developed by Frederick Winslow Taylor, Henry Ford, and Taiichi Ohno, emphasizing continuous improvement and elimination of waste; it has contributed significantly to operational efficiency in the healthcare sector, focusing on optimizing operational and administrative processes to improve service quality, reduce costs, and increase patient satisfaction (Ali & Kannan, 2022). In the healthcare sector, the application of operations management principles allows for better planning and control of resources, such as personnel, equipment and medical supplies, ensuring that they are used efficiently and effectively (Nartey et al., 2022).

One of the main contributions is the application of continuous improvement techniques, such as Lean and Six Sigma, which help to identify and eliminate waste, reduce process variability and improve the quality of medical services; these techniques enable hospitals and other healthcare institutions to optimize workflow, reduce waiting times and improve resource utilization; in addition, operations management theory promotes the use of information technologies to improve coordination and information exchange between different departments and healthcare professionals, which is crucial for comprehensive and efficient patient care (Hadid et al., 2022).

Operational efficiency, in the words of Pimentel and Mora-Monge (2023) is the ability of institutions to deliver high quality healthcare services in a cost-effective manner without sacrificing quality; optimizing human, financial and material resources to increase productivity and reduce operating costs.

The Lean Performance and Models analysis focuses on supply chain efficiency and effectiveness, using

performance metrics to assess sustainability, responsiveness, flexibility, and operational efficiency; it also proposes a performance management framework that classifies performance metrics into four competitive dimensions and seven perspectives, demonstrating that physical stores are critical components of the omnichannel strategy for many retailers (Adivar et al., 2019).

Technical efficiency and scale assessment uses advanced models such as data envelopment analysis (DEA) to measure the efficiency of hospital supply chains; one study used a DEA model of networks to assess the supply chain efficiency of 19 hospitals in Iran, highlighting the importance of assessing both free and fixed connections within the internal structure of the supply chain (Gerami et al., 2020).

Critical strategies for efficiency include the implementation of Lean Six Sigma (LSS), which combines waste elimination with data-driven continuous improvement (Dion & Evans, 2024). A recent study in a private hospital in Dublin, Ireland, demonstrated how LSS was used to redesign the operating room department supply chain, reducing inventory costs and improving clinical staff efficiency (Renukappa et al., 2022). SCM focuses on the efficient integration and coordination of inventory and distribution activities; they also highlight the importance of internal logistics and reducing operating costs to improve patient service quality (Khorasani et al., 2020)].

## 2. Methods

The research was applied, as it aimed to solve a general problem based on specific needs. It was quantitative, based on the collection and analysis of data to narrate and expose phenomena, which allowed fair and clear conclusions to be drawn.

The design was non-experimental and transactional, i.e., it was carried out without manipulating variables and data were collected at a single point in time. The scope of this research was descriptive and explanatory, as it sought to clearly identify the problem to be solved, collect and analyze relevant quantitative data to understand the phenomenon studied, and formulate conclusions or recommendations that could be applied to improve processes, make decisions or develop practical means. In addition, cooperation was sought from stakeholders outside the sector, such as local and regional institutions, and the findings were evaluated and obtained.

The study population consisted of 159 employees of the hospital under study, including health professionals and appointed and contracted administrative personnel. Medical and administrative personnel who were working at the time the surveys were administered and those who voluntarily

wished to participate were included. Workers on vacation, on leave, and those who did not wish to participate in the research were excluded.

To obtain the sample, the finite proportion calculation was applied, resulting in 114 workers, made up of health professionals and administrative personnel appointed and hired. Simple random sampling was considered, since it guaranteed randomness in the selection, was easy to apply and ensured that each worker had the same possibilities of being included in the sample. A survey was used as the data collection technique, for which a questionnaire with 62 questions was designed and validated by experts. The data were collected through an online survey, sent through a link to the workers selected as a sample, guaranteeing the confidentiality and confidentiality of the names of the participants.

The descriptive statistical method was used to summarize and organize the data in an understandable way, describing the main characteristics of the sample by means of measures such as mean, median, mode, frequencies and percentages. These analyses made it possible to identify trends and patterns in the data collected. On the other hand, the inferential statistical method was applied to make generalizations and predictions about the population from the sample analyzed. Hypothesis tests, confidence intervals and regression analysis were used to determine causal relationships between variables and to evaluate the statistical significance of the results obtained. Respect for intellectual property rights ensured the recognition, valuation and originality of authors, preventing plagiarism and theft of ideas, fostering an environment that valued and protected innovation and creativity.

The data collected were kept secure, allowing the personal data of the participants to be protected, and the

privacy of the information was an important consideration. Transparency was essential, because there was no intention to harm any participant, ensuring honesty throughout the research process. Protecting biodiversity was also taken into account, implementing measures to reduce degradation and protect nature, respecting the living beings and ecosystems involved in the research project. Honesty was fundamental, involving the accurate collection of data, the correct attribution of sources and the transparent presentation of the results, without being adulterated or manipulated.

### 3. Results and Discussion

The results provide an analysis of the impact of various factors, including IOCR, pseudonymization and privacy preservation, document management and archiving, and EMR integration, on operational efficiency within a hospital setting. Table 1 summarizes the regression model, indicating a significant positive relationship between these predictors and operational efficiency, with an R-squared value of 0.287. Further, the ANOVA results in Table 2 reinforce this finding, demonstrating that the regression model significantly accounts for variance in operational efficiency ( $F=11.083$ ,  $p<0.001$ ). Subsequent analyses, including regression coefficients and paired sample t-tests, elucidate specific contributions of each factor, particularly highlighting the critical role of digitized resource management as illustrated in Table 7. These results underscore the necessity for enhanced management strategies to improve operational outcomes in healthcare environments.

**Table 1:** Model summary: impact of identification and optical character recognition (IOCR), pseudonymization and privacy preservation, document management and archiving, and electronic medical record (EMR) integration on operational efficiency

Model	R	R square	Adjusted R-squared	Standard error of the estimate	Statistics of change				
					Change in R-squared	Change in F	gl1	gl2	Sig. change in F
1	,536 <sup>a</sup>	0.287	0.261	0.513	0.287	11.083	4	110	0.000

**Note:** a. Predictors: (Constant), Electronic Medical Record Integration (EMR), Pseudonymization and Privacy Preservation, Document Management and Archiving, Identification and Optical Character Recognition (IOCR).

**Table 2:** Analysis of variance (ANOVA): Significance of model on operating efficiency

Model		SS	gl	MC	F	Sig.
1	Regression	11.655	4	2.914	11.083	,000 <sup>b</sup>
	Residual	28.919	110	0.263		
	Total	40.574	114			

**Note:** a. Dependent variable: operating efficiency; b. Predictors: (Constant), Electronic Medical Record Integration (EMR); Pseudonymization and Privacy Preservation, Document Management and Archiving; Identification and Optical Character Recognition (IOCR); SS, sum of squares; MC, root mean square.

**Table 3:** Regression coefficients: impact of optical character recognition and identification (OCR), pseudonymization and privacy preservation, document management and archiving, and electronic medical record (EMR) integration on operational efficiency

Model	CNE		CE	t	Sig.
	B	Error	Beta		
1 (Constant)	0.510	0.240		2.121	0.036
IOCR	0.002	0.067	0.003	0.033	0.974
PPP	0.193	0.093	0.188	2.070	0.041
GAC	0.224	0.071	0.280	3.173	0.002
IRME	0.224	0.079	0.253	2.832	0.006

Note: a. Dependent variable: EF, operational efficiency; IOCR, Identification and Optical Character Recognition; PPP, Pseudonymization and Privacy Preservation; DAM, Document Management and Archiving; IRME, Integration of Electronic Medical Records; CNE, non-standardized coefficients; CE, standardized coefficients.

**Table 4:** Descriptive statistics for the independent variable "Management of digitized resources" (VARIND DRM) and its comparisons with specific dimensions in the analysis of performance and lean models, technical efficiency and scale, critical strategies for efficiency, and supply chain management in a hospital in Chota, Peru, 2024

		Media	N	Standard deviation	Mean standard error
Par 1	DRM	2.30	115	0.529	0.049
	ADM LEAN	2.00	115	0.662	0.062
Par 2	DRM	2.30	115	0.529	0.049
	TESA	1.65	115	0.701	0.065
Par 3	DRM	2.30	115	0.529	0.049
	ECE	2.06	115	0.764	0.071
Par 4	DRM	2.30	115	0.529	0.049
	GCS	1.76	115	0.721	0.067

Note: DRM, digitized resource management; ADM LEAN performance analysis and modeling; TESA, technical efficiency and scale assessment; CES, critical efficiency strategies; SCM, supply chain management

**Table 5:** Results of the t-test for paired samples examining the differences between the independent variable "Management of digitized resources" (VARIND DRM) and the dimensions assessed in the efficiency and management of the hospital of Chota, Peru, 2024

		Matched differences					t	gl	Sig. (bil.)
		Media	Standard deviation	Mean standard error	95% confidence interval of the difference				
					Inferior	Superior			
Par 1	DRM - ADM LEAN	0.296	0.649	0.060	0.176	0.415	4.889	114	0.000
Par 2	DRM- TESA	0.643	0.716	0.067	0.511	0.776	9.643	114	0.000
Par 3	DRM - ECE	0.235	0.705	0.066	0.105	0.365	3.571	114	0.001
Par 4	DRM- GCS	0.539	0.741	0.069	0.402	0.676	7.804	114	0.000

Note: DRM, digitized resource management; ADM LEAN performance analysis and modeling; TESA, technical efficiency and scale assessment; CES, critical efficiency strategies; SCM, supply chain management

**Table 6:** Estimated effect sizes using Cohen's d and Hedges' correction for the independent variable "Management of digitized resources" (VARIND DRM) compared to the dimensions assessed in the performance of the hospital in Chota, Peru

		Standardizer <sup>a</sup>	Estimated points	95% confidence interval		
				Inferior	Superior	
Par 1	DRM - ADM LEAN	Cohen's d	0.649	0.456	0.263	0.647
		Hedges correction	0.651	0.454	0.262	0.645
Par 2	DRM- TESA	Cohen's d	0.716	0.899	0.681	1.115
		Hedges correction	0.718	0.896	0.679	1.111
Par 3	DRM - ECE	Cohen's d	0.705	0.333	0.145	0.520
		Hedges correction	0.707	0.332	0.144	0.518
Par 4	DRM- GCS	Cohen's d	0.741	0.728	0.521	0.932
		Hedges correction	0.743	0.725	0.519	0.929

Note: DRM, digitized resource management; LEAN ADM, LEAN performance analysis and modeling; TESA, technical efficiency and scale assessment; CES critical efficiency strategies; SCM, supply chain management

**Table 7:** Summary of the regression model evaluating the impact of digitized resource management on the operational efficiency of the hospital in Chota, Peru, 2024

Model	R	R square	Adjusted R-squared	Standard error of the estimate	Statistics of change				
					Change in R-squared	Change in F	gl1	gl2	Sig. Change in F
1	,530 <sup>a</sup>	0.281	0.274	0.508	0.281	44.062	1	113	0.000

Note: a. Predictors: (Constant), management of digitized resources

**Table 8:** Analysis of variance (ANOVA) to determine the statistical significance of the impact of digitized resource management on the operational efficiency of the Chota hospital, Peru, 2024

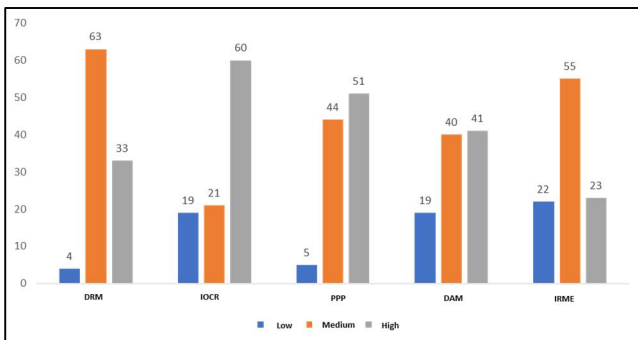
Model		SS	gl	MC	F	Sig.
1	Regression	11.383	1	11.383	44.062	,000 <sup>b</sup>
	Residual	29.191	113	0.258		
	Total	40.574	114			

Note: a. Dependent variable: Operating efficiency. b. Predictors: (Constant), Management of digitized resources.

**Table 9:** Coefficients of the regression model showing the relationship between digitized resource management and operational efficiency of the hospital in Chota, Peru, 2024

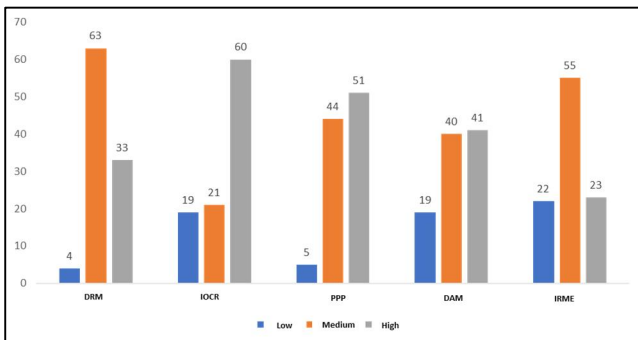
Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Error	Beta		
1	(Constant)	0.569	0.212	2.686	0.008
	DRM	0.597	0.090	0.530	6.638

Note: a. Dependent variable: Operating efficiency.



**Figure 1:** Level of digitized resource management of a hospital in Chota, Peru-2024

**Note:** DRM, digitized resource management; IOCR, identification and optical character recognition; PPP, pseudonymization and privacy preservation; DAM, document archiving and management; IRME, electronic medical record integration<sup>4</sup>



**Figure 2:** Level of operational efficiency of a hospital in Chota, Peru-2024

**Note:** OE, operational efficiency; ADM LEAN, performance analysis and modeling; TESA, technical efficiency and scale assessment; CES, critical efficiency strategies; SCM, supply chain management.

This study evaluates the impact of digitized resource management on the operational efficiency of the Chota hospital (Peru) in 2024. The results indicate that digitization has a moderate but significant impact on operational efficiency, with a coefficient of determination R of 0.530 and an R<sup>2</sup> of 0.281. This suggests that 28.1% of the variability in operational efficiency can be explained by digitized resource management. Regression analysis revealed an adjusted R<sup>2</sup> of 0.274 and a standard error of estimate of 0.508, confirming the accuracy of the model (F=44.062, p=0.000).

The coefficients of the model indicate that digitization of resources is a key strategy to improve operational efficiency (Beta=0.530, t=6.638, p=0.000). These findings are consistent with previous studies by Buddhev et al. (2024), which demonstrated the tangible benefits of digitization in the healthcare sector. In addition, Gupta et al. (2024) and Begkos et al. (2024) highlighted the benefits of digital transformation, improved governance and the creation of interorganizational tensions.

Buddhev et al. (2024) observed a 44% decrease in cancelled operations and an improvement in staff satisfaction from 12% to 96%. Gupta et al. (2024) noted that ArogyaSetu had a positive impact on the Indian healthcare sector, while Begkos et al. (2024) emphasized empowerment of various stakeholders.

Von Bertalanffy's systems theory suggests a holistic approach to resource management, which improves coordination and optimization (Cambon & Alla, 2021).

Taylor, Ford and Ohno's operations management theory emphasizes continuous improvement and waste elimination, applying techniques such as Lean and Six Sigma to optimize processes and improve service quality (Ali & Kannan, 2022; Nartey et al., 2022; Hadid et al., 2022).

In the recent context, an increasing number of digitization experiences are being implemented in the Peruvian public sector (Montenegro Neira et al., 2024). In the national health care system, the results of the literature generally point to technical and operational improvements in terms of efficiency (Romero et al., 2023). Overall, our results are consistent with the expected national and regional trends: Peru's structural heterogeneity leads to a pronounced digital divide, particularly between urban and rural areas; in this context, it is important to highlight that in rural regions, the perception of technological changes and their impacts carries greater significance. (Prieto-Egido et al., 2023).

Our results contribute to the limited evidence in rural Peru's hospital context by demonstrating improved efficiency and operability. In a rural context, the success of a technology should be evaluated based on its social acceptance within the hospital setting. Some studies suggest that factors such as the experience level of the staff can significantly influence this success (Hasebrook et al., 2023). This complementary variable can help shape new research agendas and inform policies for digital health services in rural Peru.

#### 4. Conclusions

The impact of digitized resource management on the operational efficiency of the hospital in Chota, Peru, for the year 2024 was evaluated. Using a regression model, it was determined that the digitization of resources has a moderate but significant impact on operational efficiency, evidenced by a coefficient of determination (R) of 0.530 and an R-squared of 0.281. This suggests that approximately 28.1% of the variability in operational efficiency can be explained by digitized resource management. The results show that the inclusion of the predictors in the model maintains a significant explanation of 27.4% of the variability, with a standard error of the estimate of 0.508, reflecting adequate accuracy in the predictions. The change in R-squared was 0.281, with an F-value of 44.062 and a significance level of 0.000, confirming the statistical significance of the model. These findings validate the importance of digitization as a strategy to improve operational efficiency and are in line with previous studies such as Buddhav et al. (2024).

There are gaps in the literature regarding the specific implementation of digital management systems in rural hospitals and their long-term impact. Future research should focus on longitudinal studies that analyze differences in

operational efficiency between hospitals with different levels of digitization and in different geographic contexts. Limitations of the study include the focus on a single hospital, which may not be representative of other healthcare settings. One way to overcome this limitation is to construct a study that can include hospitals with different institutional characteristics, in order to compare whether the impact is identical in hospitals of different sizes and characteristics or location. In addition, the non-experimental, cross-sectional methodology limits the ability to establish definitive causality between digitization and operational efficiency. Future research should consider larger samples and longitudinal methods to provide more robust results.

In the data analysis, it is revealed that the management of digitized resources is predominantly at a medium level, with a notable implementation of OCR (60%) and a high level of Pseudonymization and preservation of data privacy (51%). The hospital's operational efficiency is mostly at a medium level (64%), with significant areas for improvement in technical and scale efficiency, as well as in SCM. Statistical analysis shows that OCR, Pseudonymization, document management and archiving, and EHR integration have a significant impact on hospital operational efficiency, with a model R-value of 0.536 and an R-squared of 0.287. These results underscore the importance of focusing on these areas to improve operational efficiency.

To improve the operational efficiency of the health sector in Chota, it is suggested to increase the level of digitization of resources by focusing on improving areas with current average levels, such as EHR integration and SCM. This can be achieved by investing in advanced technology and continuous staff training, establishing an implementation plan with clearly defined phases, specific deadlines and allocated resources. It is also crucial to optimize document management and archiving to reduce information access time and improve data accuracy. The adoption of cloud-based document management systems, allowing fast and secure access to documents from any location, could be an effective solution.

It is recommended that Pseudonymization and privacy preservation measures be strengthened to ensure the integrity and confidentiality of patient information. This may include implementing advanced security protocols and conducting regular audits to ensure compliance with data protection regulations. In addition, it is essential to increase the application of LEAN models and critical strategies for efficiency, aligning with Lean Six Sigma best practices. Conducting training workshops for staff and establishing continuous improvement teams to monitor and optimize operational processes can lead to significant improvements.

Consolidating EHR integration to achieve a complete transition to electronic systems is a priority. This can significantly improve the quality of patient care and the

operational efficiency of the hospital. It is crucial to develop a detailed timeline for full EHR implementation, including testing and feedback stages. It is also recommended to implement strategies to improve SCM, such as the adoption of real-time tracking technologies and automated inventory management systems. This can help reduce costs, optimize the flow of materials, and improve the availability of resources needed for healthcare.

Finally, it is suggested that comparative studies be conducted in other rural and urban hospitals to evaluate the effectiveness of digitalization strategies and adapt best practices. These studies should consider different levels of implementation of digital technologies and their impact on operational efficiency and quality of care. These proposals, based on the study findings, provide a solid basis for future interventions and improvements in digitized resource management in hospitals, contributing to greater operational efficiency and improved quality of care

## References

- Abbas, A., Hameed, M., Balakrishnan, S., & Anandh, K. (2022). Intelligent Document Finding using Optical Character Recognition and Tagging. *International Conference on Automation, Computing and Renewable Systems (ICACRS)*, 1165-1168. <https://doi.org/10.1109/ICACRS55517.2022.10029142>
- Adivar, B., Yumurtaci, I., & Christopher, M. (2019). A quantitative performance management framework for assessing omnichannel retail supply chains. *Journal of Retailing and Consumer Services*, 48, 257-269. <https://doi.org/10.1016/j.jretconser.2019.02.024>
- Ali, I., & Kannan, D. (2022). Mapping research on healthcare operations and supply chain management: a topic modelling-based literature review. *Annals of Operations Research*, 315, 29-55. <https://doi.org/10.1007/s10479-022-04596-5>
- Allab, M., Ahidar, I., Zrira, N., & Ngote, N. (2024). Towards a Digital Predictive Maintenance (DPM): Healthcare Case Study. *Procedia Computer Science*, 232, 3183-3194. <https://doi.org/10.1016/j.procs.2024.02.134>
- Arora, S., Pandey, M., Arora, M., Gupta, K., Sharma, V., & Nagpal, L. (2024). Digitization of Health Insurance Documents for The Cashless Claim Settlement Using Intelligent Document Management System. *Procedia Computer Science*, 235, 1319-1331. <https://doi.org/10.1016/j.procs.2024.04.125>
- Batra, P., Phalnikar, N., & Diwan, T. (2023). OCR-MRD: performance analysis of different optical character recognition engines for medical report digitization. *International Journal of Information Technology*, 16, 447-455. <https://doi.org/10.1007/s41870-023-01610-2>
- Begkos, C., Antonopoulou, K., & Ronsani, M. (2024). To datafication and beyond: Digital transformation and accounting technologies in the healthcare sector. *The British Accounting Review*, 56(4), 1-17. <https://doi.org/10.1016/j.bar.2023.101259>
- Bressan, T., Valdivia-Gago, A., & Zavaleta-Cortijo, C. (2022). Challenges of design, implementation, acceptability, and potential for, biomedical technologies in the Peruvian Amazon. *International Journal for Equity in Health*, 21(183), 1-18. <https://doi.org/10.1186/s12939-022-01773-7>
- Buddhdev, P., Tebby, J., Black, P., Harding, D., Kendall, J., & Shah, H. (2024). Improving Theatre Productivity by Digitising Surgical Equipment Repairs. *Cureus*, 16(6), 1-11. <https://doi.org/10.7759/cureus.61802>
- Caballero-Pérez, V., Arias-Cerón, J., & Barrón, D. (2024). Main Factors to Improve the Project Management System with Digitization in the Health Sector. *Management Engineering in Emerging Economies*, 391-408. [https://doi.org/https://doi.org/10.1007/978-3-031-54485-9\\_17](https://doi.org/https://doi.org/10.1007/978-3-031-54485-9_17)
- Cambon, L., & Alla, F. (2021). Understanding the complexity of population health interventions: assessing intervention system theory (ISyT). *Health Research Policy and Systems*, 19(95), 1-13. <https://doi.org/10.1186/s12961-021-00743-9>
- Cheng, L., Yang, M., De Vos, J., & Witlox, F. (2020). Examining geographical accessibility to multi-tier hospital care services for the elderly: A focus on spatial equity. *Journal of Transport & Health*, 19, 1-20. <https://doi.org/10.1016/j.jth.2020.100926>
- Curioso, W., Coronel-Chucos, L., & Oscuivilca-Tapia, E. (2024). Empowering the digital health workforce in Latin America in the context of the COVID-19 pandemic: the Peruvian case. *Informatics for Health and Social Care*, 49(1), 73-82. <https://doi.org/10.1080/17538157.2024.2315266>
- De La Cruz-Ramírez, Y., Cortez-Orellana, S., & De La Cruz-Ramírez, N. (2023). Technological Accessibility and Digital Health Education Associated with the Use of Smart Healthcare by Obstetricians in Peru. *Information and Communication Technologies*, 101-113. <https://doi.org/10.1007/978-3-031-18272-38>
- Dion, H., & Evans, M. (2024). Strategic frameworks for sustainability and corporate governance in healthcare facilities; approaches to energy-efficient hospital management. *Benchmarking: An International Journal*, 31(2), 353-390. <https://doi.org/10.1108/BIJ-04-2022-0219>
- Gerami, J., Mavi, R., Saen, R., & Mavi, N. (2020). A novel network DEA-R model for evaluating hospital services supply chain performance. *Annals of Operations Research*, 324, 1041-1066. <https://doi.org/10.1007/s10479-020-03755-w>
- Gupta, S., Modgil, S., Lopes, A., Lagur, I., & Stekelorum, R. (2024). Towards digital transformation and governance in the healthcare sector. *Information Technology & People*, 6(1), 1-21. <https://doi.org/10.1108/ITP-02-2023-0179>
- Hadid, M., Elomri, A., & Hamad, M. (2022). Bibliometric analysis of cancer care operations management: current status, developments, and future directions. *Health Care Management Science*, 25, 166-185. <https://doi.org/10.1007/s10729-021-09585-x>
- Hammed, Z., Siddique, A., & Won, C. (2020). Robotics Utilization for Healthcare Digitization in Global COVID-19 Management. *Int. J. Environ. Res. Public Health*, 17(11), 1-19. <https://doi.org/10.3390/ijerph17113819>
- Hasebrook, J. P., Michalak, L., Kohnen, D., Metelmann, B., Metelmann, C., Brinkrolf, P., ... & Hahnenkamp, K. (2023). Digital transition in rural emergency medicine: Impact of job satisfaction and workload on communication and technology acceptance. *Plos one*, 18(1), e0280956. <https://doi.org/10.1371/journal.pone.0280956>

- Ijeh, S., Okolo, C., Olawumi, J., & Oyeyemi, A. (2024). Addressing health disparities through IT: A review of initiatives and outcomes. *World Journal of Biology Pharmacy and Health Sciences*, 18(1), 107-114. <https://doi.org/10.30574/wjbphs.2024.18.1.0167>
- Jang, W., Liu, Z., Zhang, S., Yin, Y., & Chen, C. (2023). Optical Character Recognition of Medical Records Based on Deep Learning. *5th International Conference on Robotics and Computer Vision (ICRCV)*, 182-187. DOI:10.1109/ICRCV59470.2023.10328990
- Javanmardi, E., Liu, S., & Xie, N. (2020). Exploring Grey Systems Theory-Based Methods and Applications in Sustainability Studies: A Systematic Review Approach. *Sustainability*, 12(11), 1-15. <https://doi.org/10.3390/su12114437>
- Katrakazas, P., Pasiadis, K., Bibas, A., & Koutsouris, D. (2020). A General Systems Theory Approach in Public Hearing Health: Lessons Learned From a Systematic Review of General Systems Theory in Healthcare. *IEEE Access*, 8, 53018-53033. 10.1109/ACCESS.2020.2981160
- Khorasani, S., Cross, J., & Maghazei, O. (2020). Lean supply chain management in healthcare: a systematic review and meta-study. *International Journal of Lean Six Sigma*, 11, 1-34. <https://doi.org/10.1108/IJLSS-07-2018-0069>
- Kraus, S., Schiavone, F., Pluzhnikova, A., & Invernizzi, A. (2021). Digital transformation in healthcare: Analyzing the current state-of-research. *Journal of Business Research*, 123, 557-567. <https://doi.org/10.1016/j.jbusres.2020.10.030>
- Mauricio, D., Llanos-Colchado, P., Cutipa-Salazar, L., Castañeda, P., Chuquimbalqui-Maslucán, R., Rojas-Mezarina, L., & Castillo-Sequera, J. (2024). Electronic Health Record Interoperability System in Peru Using Blockchain. *International Journal of Online & Biomedical Engineering*, 20(3), 136-153. DOI: 10.3991/ijoe.v20i03.44507
- Montenegro Neira, T. D., Rimapa Navarro, L. R., Camacho Delgado, F. M., Bollet Ramírez, F., Gomez Morales, A. J., & Hernández Hernández, O. (2024). From paper to screen: towards legal certainty with the digitization of public deeds in Peru. *Sapienza: International Journal of Interdisciplinary Studies*, 5(2), e24043. <https://doi.org/10.51798/sijis.v5i2.777>
- Nahar, K., Alsmadi, I., Al Mamlook, R., Nasayreh, A., Gharaibeh, H., Almufih, A., & Alasim, F. (2023). Recognition of Arabic Air-Written Letters: Machine Learning, Convolutional Neural Networks, and Optical Character Recognition (OCR) Techniques. *Sensors*, 23(23), 1-15. <https://doi.org/10.3390/s23239475>
- Nartey, E., Aboagye-Otchere, F., & Simpson, S. (2022). Management control and supply chain operational performance of public health emergency to pandemic control. *Management Research Review*, 45(3), 398-435. <https://doi.org/10.1108/MRR-09-2020-0600>
- Pachas, J., Rosales, G., Ruiz-Balvin, M., Guerrero, F., Diaz, N., Gordillo-Flores, R., ... Tapia-Silguera, R. (2024). Digital Transformation in Public Hospital Management: Improving the Patient Experience. *Revista De Gestão Social E Ambiental*, 18(4), e04571. <https://doi.org/10.24857/rgsa.v18n4-046>
- Palozzi, G., Schettini, I., & Chirico, A. (2020). Enhancing the Sustainable Goal of Access to Healthcare: Findings from a Literature Review on Telemedicine Employment in Rural Areas. *Sustainability*, 12(8), 1-16. <https://doi.org/10.3390/su12083318>
- Pimentel, V., & Mora-Monge, C. (2023). Benchmarking the operational efficiency of Mexican hospitals – a longitudinal study. *Benchmarking: An International Journal*, 31(2), 309-329. <https://doi.org/10.1108/bij-11-2021-0671>
- Prieto-Egido, I., Sanchez-Chaparro, T., & Urquijo-Reguera, J. (2023). Impactos de las tecnologías de la información y la comunicación en los ODS: el caso de Mayu Telecomunicaciones en zonas rurales de Perú. *Tecnologías de la Información para el Desarrollo*, 29(1), 103-127. <https://doi.org/10.1080/02681102.2022.2073581>
- Renukkappa, S., Mudiya, P., Suresh, S., Abdalla, W., & Subbarao, C. (2022). Evaluation of challenges for adoption of smart healthcare strategies. *Smart Health*, 26, 1-17. <https://doi.org/10.1016/j.smhl.2022.100330>
- Romero, W., Gregorini, F., & Copaja, R. (2023). Mobile application to digitize handwritten patient records in peruvian public hospitals. *LACCEI*, 1(8), 17-21. <https://doi.org/10.18687/LACCEI2023.1.1.1114>
- Ruiz-Llontop, M., Reyes-Perez, M., & Padilla, J. (2023). Change Management Model for the Quality of the Telehealth Service in a Regional Hospital in Northern Peru. *HCI International 2023 – Late Breaking Papers*. HCII 2023, 600-609. [https://doi.org/10.1007/978-3-031-48041-6\\_40](https://doi.org/10.1007/978-3-031-48041-6_40)
- Secundo, G., Shams, S., & Nucci, F. (2021). Digital technologies and collective intelligence for healthcare ecosystem: Optimizing Internet of Things adoption for pandemic management. *Journal of Business Research*, 131, 563-572. <https://doi.org/10.1016/j.jbusres.2021.01.034>
- Subramanian, A., Suresh, P., & Santhiappan, S. (2023). A robust section identification method for scanned electronic health records. *Proceedings of the 6th Joint International Conference on Data Science & Management of Data (10th ACM IKDD CODS and 28th COMAD)*, 213-217. <https://doi.org/10.1145/3570991.3571011>
- Vilcahuaman, L., Rivas, R., & Toledo, E. (2020). Chapter 12 - Clinical engineering in Peru: Looking for a healthcare technology management model. *Clinical Engineering Handbook (Second Edition)*, 94-100. <https://doi.org/10.1016/B978-0-12-813467-2.00012-2>