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HOSPITAL MANAGEMENT BASED ON DIGITAL TECHNOLOGIES: EV- IDENCE ON CARE QUALITY, PATIENT SAFETY, AND OPERATIONAL EFFICIENCY

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ABSTRACT

Digital transformation in healthcare has promoted significant advances in operational efficiency and in the quality of care provided by hospital services. This study aimed to analyze the applications of digital technologies, with an emphasis on Big Data and predictive analytics, in hospital management, considering their impacts on processes, patient safety, and clinical decision-making. This is an integrative literature review with a qualitative and descriptive approach, based on recent scientific evidence. The results indicate that incorporating digital systems, such as electronic health records, artificial intelligence, and analytical tools, contributes to optimizing care pathways, reducing medical errors, improving resource management, and increasing the predictability of clinical events. It was also observed that, although the benefits are significant, challenges related to interoperability, professional training, and technological infrastructure persist as barriers to the full implementation of these solutions.It is concluded that the strategic use of digital technologies represents a fundamental axis for the modernization of health services, making it essential to align technological innovation, institutional governance, and the qualification of professionals to maximize their positive impacts.

Keywords:digital health; hospital management; big data; predictive analytics.

INTRODUCTION

Digital transformation has consolidated itself as one of the main drivers of change in hospital management contemporary, promoting profound reconfigurations in care, administrative, and decision-making processes. The incorporation of digital technologies, such as electronic health records, clinical decision support systems, artificial intelligence, and analysis of large volumes of data, has been widely associated with improved quality of care, strengthened patient safety, and optimized operational efficiency in health services (12, 13). In this context, hospital management based on digital technologies emerges as a strategic model capable of responding to the growing demands for safe, efficient, patient-centered care.

Patient safety, considered one of the pillars of quality in healthcare, remains a global challenge, especially in the face of the complexity of hospital systems and the high incidence of preventable adverse events.

Evidence indicates that the use of digital technologies, particularly computerized prescribing systems and clinical decision support, contributes significantly to the reduction of medication errors and improvement in clinical decision-making (4, 11, 16). Studies show that the transition to digitized hospital environments is associated with a significant reduction in prescribing errors and care-related incidents, highlighting the potential of these technologies in mitigating care risks (4).

In addition to safety, the quality of care is also directly affected by the digitization of health services. The implementation of electronic health records has been associated with improved adherence to clinical protocols, greater continuity of care, and better coordination among multidisciplinary teams (6,8). Systematic reviews indicate that health information technologies promote consistent gains in care quality, including better clinical monitoring, greater diagnostic accuracy, and increased service delivery efficiency (12, 13). However, these benefits strongly depend on the usability of the systems and their proper integration into the clinical workflow, since poorly designed interfaces can compromise the safety and effectiveness of digital interventions (3).

In the context of operational efficiency, the adoption of digital technologies has been associated with process automation, cost reduction, and improved management of hospital resources. Tools such as electronic prescription systems, pharmaceutical robotics, and integrated management platforms have shown a positive impact on reducing operational times and optimizing logistics flows, especially in highly complex environments (2, 18). The analysis of large volumes of data (Big Data) also enables more accurate, evidence-based decision-making, contributing to strategic planning and improving organizational performance (18).

Despite advances, the implementation of digital technologies in hospital management does not occur without challenges. Barriers such as high costs, resistance from healthcare professionals, the need for specialized training, and difficulties with interoperability between systems still represent significant obstacles to the full adoption of these tools (7, 14). In addition, simply introducing technology does not automatically guarantee improvements in clinical outcomes; it is essential to adopt systemic approaches that integrate human, organizational, and technological factors to maximize the benefits of digital transformation (15,20).

In this scenario, it becomes essential to understand, in an integrated way, the available evidence regarding the impact of digital technologies on hospital management, especially with regard to the quality of care, patient safety, and operational efficiency. Thus, the present study aims to conduct an integrative review of the literature, critically analyzing the main scientific findings related to hospital management based on digital technologies, with a focus on their effects on care and organizational outcomes in healthcare services.

METHODOLOGY

The present study is characterized as an integrative literature review, conducted with the objective of critically analyzing the scientific evidence regarding the impact of digital technologies on patient

patient and the efficiency of hospital management. This method was chosen because it allows a broad synthesis of different methodological approaches, including observational studies, systematic reviews, and applied research, providing a comprehensive understanding of the phenomenon under investigation.

The search strategy was structured systematically, covering databases recognized in the health field, such as PubMed, Scopus, and Web of Science. Controlled descriptors and English keywords were used, combined with Boolean operators, including terms such as **"**digital health**"**, **"**hospital management**"**, **"**patient safety**"**, **"**electronic health records**"**, and **"**clinical decision support systems**"**. The search considered publications from 2014 to 2025, aiming to ensure scientific timeliness and relevance.

The inclusion criteria covered original articles and systematic reviews published in scientific journals, with full text available, that directly addressed the application of digital technologies in the hospital context and their impacts on patient safety, operational efficiency, or quality of care. Duplicate studies, opinion articles, editorials, gray literature, and publications with no clearly identified authorship, according to a previously established criterion to ensure academic rigor and traceability of sources.

The study selection process took place in stages. Initially, titles and abstracts were read for preliminary screening, followed by a full-text review of articles potentially eligible. Data extraction was conducted in a standardized manner, including information such as authors, year of publication, study objective, type of methodology, main technologies analyzed, and results related to hospital safety and efficiency.

For the data analysis, a qualitative approach was adopted, with a thematic synthesis of the findings. The results were organized into analytical categories, allowing patterns, benefits, limitations, and challenges associated with the implementation of digital technologies in hospital settings to be identified. This step made it possible to build an integrated view of the evidence, highlighting both advances and gaps present in the literature.

Finally, we sought to ensure transparency and reproducibility of the

study by means of a detailed description of the methodological steps, aligning with international recommendations for literature reviews, such as the PRISMA guidelines, even though this is not a strict systematic review.

RESULTS

The analysis of the 20 included studies made it possible to organize the findings into three central thematic axes: (1) quality of care, (2) patient safety, and (3) operational efficiency, all directly related to the incorporation of digital technologies into hospital management.

In the quality of care axis, the studies show that the implementation of digital systems, such as electronic health records, clinical decision support systems, and fully digitized hospitals, contributes to improved continuity of care, greater availability of clinical information, and support for decision-making. Systematic reviews have shown that digital hospitals improve the experience of patients and professionals, with greater accessibility and integration of clinical data, although challenges related to usability and work overload persist [3,4, 7]. In addition, digital technologies applied to specific contexts, such as the management of diabetes within the hospital setting, have shown a positive impact on the standardization of care and clinical control [8].

In the patient safety area, the results are robust in showing a significant reduction in care errors, especially medication errors. Nearly experimental studies and interrupted time-series studies evidenced substantial reductions after the transition to digital environments, with decreased prescribing errors and adverse events [5, 9]. Systematic reviews also indicated that systems such as electronic prescribing, automated dispensing, and clinical decision support reduce error rates and improve the traceability of care processes [1,3]. However, some studies warn of risks associated with poor implementation or low usability of the systems, which may generate new types of error [3,4].

With regard to operational efficiency, the studies indicate that hospital digitization promotes significant gains in process optimization, reduced time for service, and

better resource management. Technologies such as automation in hospital pharmacies, artificial intelligence, and integrated management systems have shown an increase in workflow efficiency, reduced waste, and better inventory control [1,7]. Case studies using tools strategic, such as the Balanced Scorecard adapted to the digital context showed improvements in governance and organizational performance [11]. However, challenges persist, including implementation costs, the need for professional training, and interoperability issues [1,4].

The synthesis of the main findings is presented in Table 1.

Table 1 – Synthesis of the results of the included studies according to thematic axes

Study	Type of technology	Quality Care	Patient safety patient	Efficiency operational
[1]	Pharmaceutical automation / CPOE	Improvement in dispensing	Reduction of medication errors	Inventory optimization
[3]	Electronic health record (EHR)	Access and data integration	Fewer errors, but usability risks	Reduction of rework
[4]	Complete digital hospital	Improving the clinical experience	Variable impact	Partial improvement of processes
[5]	Transition to a digital hospital	—	Significant reduction in errors	—
[7]	AI, ML, and intelligent systems	Improving continuity of care	Reduction in adverse events	Reduction of cost
[8]	Digital interventions (diabetes)	Standardization of care	Improvement in clinical control	—
[9]	Prescription electronic	—	Reduction of prescription errors	—
[11]	Digital strategic management (BSC)	Organizational improvement	—	Increase in the efficiency

In an integrated manner, the findings show that digital transformation in hospital management has a consistent positive impact, especially when there is alignment between technology, organizational processes and training professional. However, the methodological heterogeneity of the studies and the contextual differences between health systems indicate the

need for caution when generalizing the results.

DISCUSSION

The findings of this integrative review show that the incorporation of digital technologies in hospital management is a strategic driver for transforming health systems, with significant impacts on care quality, patient safety, and operational efficiency. However, the critical analysis of the studies reveals that these benefits do not occur automatically, being strongly dependent on organizational, technological, and human factors.

With regard to care quality, the results indicate that digitization favors the integration of clinical information, continuity of care, and decision support—essential elements for evidence-based practices. Studies show that systems such as electronic health records and digital hospitals expand access to real-time data and reduce information gaps [3,4]. However, the literature also points to important limitations, such as usability problems, increased cognitive load for professionals, and negative impacts on the clinical-patient interaction [4]. These findings suggest that care quality does not depend only on the technology itself, but on how well it fits the workflow and the clinical context.

With regard to patient safety, there is consistent evidence that digital technologies reduce errors, especially in the medication process. The significant reduction in prescribing errors after the implementation of digital hospitals reinforces the role of these tools as system-wide safety barriers [5,9]. Systematic reviews support these findings by showing that computerized systems increase a traceability and standardization of processes [1,3]. However, contemporary discussion highlights a relevant paradox: the introduction of new technologies may also generate new types of error, related to interface failures, excessive alerts (alert fatigue), and technological dependence [3]. Thus, digital safety should be understood as a sociotechnical construct, which requires governance, continuous monitoring, and clinical validation.

In the axis of operational efficiency, studies indicate significant gains related to process automation, resource optimization, and improved organizational performance. Technologies such as pharmacy automation, artificial intelligence, and integrated systems help reduce waiting times, operational costs, and waste [1,7]. In addition, digital strategic management models, such as the adapted Balanced Scorecard, demonstrate potential to align care, financial, and operational indicators [11]. However, implementing these technologies involves substantial challenges, including high initial costs, the need for robust infrastructure, and ongoing training for professionals [1,4].

Another critical point identified in the literature concerns interoperability and digital maturity of healthcare systems. Fragmentation of information systems and the absence of interoperable standards limit the potential of digital technologies, compromising both efficiency and safety [1,10]. Additionally, human factors, such as resistance to change, low digital literacy, and inadequate training, emerge as significant barriers to effective digital transformation.

From a methodological point of view, it is observed that most studies present observational designs, systematic reviews, and case studies, with a relative scarcity of robust clinical trials or long-term economic evaluations. This limitation affects the strength of the available evidence, especially with regard to measuring clinical outcomes and the cost-effectiveness of digital interventions.

Finally, the integrated analysis of the results allows us to infer that digital transformation in hospital management should be carried out using a systemic, user-centered approach, considering technological, organizational, and human aspects. The isolated adoption of technologies, without strategic alignment and without adequate governance, tends to produce limited or even adverse results. In this sense, institutional policies, frameworks of

implementation and continuous evaluation become fundamental elements to ensure that the potential benefits of digital technologies are effectively translated into sustainable improvements in healthcare delivery.

CONCLUSION

This integrative review shows that hospital management based on digital technologies represents a fundamental strategy for modernizing health systems, with relevant positive impacts in the three axes analyzed: quality of care, patient safety, and operational efficiency.

The results demonstrate that hospital digitalization, through tools such as electronic health records, clinical decision support systems, process automation, and artificial intelligence, contributes to improved continuity of care, greater accuracy in clinical decisions, and a reduction in care failures. In particular, there is a consistent reduction in medication errors and an increase in process traceability, representing significant advances in patient safety [1,5,9].

With regard to operational efficiency, digital technologies proved capable of optimizing workflows, reducing waste, and improving resource management, promoting measurable organizational gains. However, these benefits depend on the existence of adequate infrastructure, interoperability between systems and ongoing training of healthcare professionals [1,4].

Despite the advances identified, the review also highlights important challenges, such as limitations in system usability, risks associated with poor implementation, high costs, and barriers related to the human factor. These aspects reinforce that digital transformation in healthcare must be understood as a complex sociotechnical process, which requires strategic planning, effective governance, and continuous evaluation.

Additionally, there is a need to expand studies with greater methodological rigor, especially those that assess clinical outcomes, cost-effectiveness, and impact at scale, in order to consolidate the scientific evidence base in this field.

It is therefore concluded that incorporating digital technologies into hospital management has significant potential to promote safer, more efficient, patient-centered health systems. However, its effectiveness depends on the integration between technology, organizational processes, and human capital, making a structured approach and one guided by

evidence to maximize its benefits and mitigate risks.

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