



Incorporation of information systems in healthcare centers in the peruvian context: An exploratory systematic review

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ABSTRACT

The article presents an exploratory systematic review on the incorporation of Information Systems (IS) in healthcare centers in the Peruvian context, highlighting the importance of these technologies in the management of clinical and hospital data. The objective was to analyze the current state of IS implementation in healthcare centers in Peru, identifying the types of integrated systems, the development methodologies adopted, the purpose of the systems, and their impact on medical care. The methodology employed was an exploratory systematic review, in which studies were searched in academic databases such as Scopus. Inclusion criteria were applied, encompassing articles published between 2015 and 2023, in English or Spanish, focused on the implementation of IS in Peruvian healthcare centers. A total of 14 relevant articles were selected. The main findings reveal that the implemented IS include point-of-care medical information systems, electronic health records, and machine learning models. These systems have improved the quality of medical care, optimized hospital processes, and facilitated clinical data management. However, their adoption faces barriers such as a lack of technological infrastructure and resistance to change. In conclusion, the integration of IS in Peruvian healthcare centers has had a positive impact, but challenges remain that require further research and technological adaptation.

Keywords: digitalization, clinical management, public health, healthcare technology, technological innovation

INTRODUCTION

The implementation of Information Systems (IS) in healthcare centers are technological tools that manage and process data related to patient care, hospital administration, and resource management [1]. Their implementation improves decision-making, the quality of healthcare services, and offers other benefits [2]. Additionally, they optimize workflows and reduce errors, contributing to better clinical outcomes [3].

In Latin America, the adoption of IS in healthcare centers has progressed, driven by the need to modernize the health sector through digitalization [4,5]. However, barriers still exist that hinder their integration into various processes; for example, the lack of technological infrastructure, insufficient staff training, and limited financial resources are common obstacles in the region [6].

Among the main causes of the problem are low investment in healthcare technology by public health entities, resistance to change in traditional institutions, and the fragmentation of health systems [7]. These difficulties create inequalities in the access and use of IS between public and private healthcare centers, limiting their impact on improving patient care [8].

The consequences of poor IS implementation include a lack of continuity in patient care, delays in administrative processes, and a higher risk of medical errors [9]. Furthermore, the lack of system integration prevents a comprehensive view of patients' health status, affecting service quality [10].

Despite progress in other regions, research on IS in Peruvian healthcare centers remains scarce. This gap limits the identification of strategies that could optimize their use. Therefore, it is essential to explore and systematize studies to provide a clear overview and encourage future research. The objective of this systematic review is to analyze the current state of IS incorporation in Peruvian healthcare centers, identifying the main types of IS implemented, the development methodologies, their purpose, and the impact generated.

LITERATUREREVIEW

Information systems

IS are integrated sets of interrelated components that collect, process, store, and distribute data to support decision-making, coordination, and control within an organization. These systems combine technology, people, and processes to manage the flow of information and optimize resource use [11]. Their purpose is to transform data into useful information, enabling organizations to improve their efficiency, competitiveness, and ability to adapt to environmental changes. IS are essential in areas such as business management, healthcare, education, and public administration [12].

IS efficiently manage clinical, administrative, and financial data, improving decision-making and service quality. They provide quick access to medical information, optimize patient care, and promote coordination among healthcare professionals. Additionally, they contribute to resource management, treatment monitoring, and public health policy planning, collectively enhancing the effectiveness and equity of healthcare services [13].

Digitalization

Digitalization involves transforming physical documents, data, or manual activities into electronic representations that can be stored, processed, and transmitted more efficiently. Digitalization enables greater accessibility, faster information handling, and process automation, driving innovation and facilitating the integration of systems and technological tools across various sectors such as education, industry, healthcare, and commerce [14].

METHODOLOGY

We conducted an exploratory systematic review, a type of literature review that seeks to broadly analyze a specific area of knowledge. Unlike traditional systematic reviews, which respond to specific research questions, the exploratory review has a more flexible approach, aiming to identify knowledge gaps, trends, and key characteristics within a field [16]. In this context, we posed four research questions: Q1: What types of IS have been implemented or integrated into healthcare centers in the Peruvian context? Q2: What software development methodologies were adopted for the implementation of IS in healthcare centers in the Peruvian context? Q3: What was the purpose of the IS implemented in healthcare centers in the Peruvian context? and Q4: What impact has the incorporation of IS generated in healthcare centers in the Peruvian context? To answer these questions, we followed the recommendations set forth by [17] according to the following phases:

Phase 1. Search strategy

We utilized the Scopus database due to its extensive regional coverage and its ability to ensure access to high-quality scientific studies. Additionally, we employed the following search string (stage 1) in titles, abstracts, and keywords: ("Information Systems" OR "Software" OR "Computer Systems" OR "Digital Platforms") AND ("Healthcare Center" OR "Health Facility" OR "Health Institution" OR "Clinic" OR "Hospital" OR "Medical Facility" OR "Healthcare Service" OR "Primary Care Network"). This search string integrated various alternatives for each term, increasing the likelihood of finding relevant studies across different contexts.

Phase 2. Inclusion and exclusion criteria

Applying inclusion and exclusion criteria in a systematic review is crucial to ensure the relevance and quality of the selected studies, as it helps filter information and focus only on research that aligns with the study's objectives, ensuring more accurate and representative results (stage 2). Table 1 presents the criteria applied using the Scopus manual filtering tool.

Table 1. Inclusion and exclusion criteria

| Inclusion criteria | Exclusion criteria |
|---|---|
| Original research articles | Review articles, conference papers, books, and book chapters. |
| Articles in English or Spanish | Duplicate articles |
| Articles published between 2015 and 2023 | |
| Full-access articles without payment restrictions | |
| Studies focused on the implementation of IS in healthcare centers in Peru | |

Phase 3. Study analysis

We selected a total of 14 primary research studies, which were thoroughly analyzed to confirm their focus on the implementation of IS in healthcare centers within the Peruvian context (stage 3). This analysis allowed us to answer the research questions posed. Table 2 illustrates the number of articles obtained at each stage of the search and selection process.

Table 2. Number of articles obtained by search stage

| Database | Stage 1 | Stage 2 | Stage 3 |
|----------|---------|---------|---------|
| Scopus | 131,508 | 66 | 14 |

RESULTS AND DISCUSSION

Below are the results of the review according to the research questions posed (Table 3):

Table 3. Systematic review results

| Article | Q1: Type of IS implemented or integrated | Q2: Software development methodologies adopted | Q3: Purpose of IS implemented | Q4: Impact generated |
|---------|---|--|---|---|
| [18] | Point-of-Care Medical Information System (POCMIS) | Consolidated Framework for Implementation Research (CFIR) and Dynamic Adaptation Process (DAP) | Strengthen the health system and improve continuous medical education | Identification of barriers and suggestions for improving implementation in Peruvian hospitals |
| [19] | Electronic Health Record System (SIHCE) | Software circuit: phased implementation plan (testing, training, Go Live) | Migration of paper medical records to electronic formats | Improved management and process changes at the San Pablo Hospital Complex |
| [20] | Information and Communication Technologies (ICT) | Not specified | Evaluate physicians' access, use, and preferences for ICT | Increased ICT usage by physicians, improvement in medical education |
| [21] | Web-based Critical Results Application | Retrospective cohort study, implementation and evaluation phases | Support diagnosis and therapy in chronic patients | Reduction in mortality and optimization of patient follow-up |
| [22] | Online Service for Health Technology Management | Development of a database with online technical assistance | Advisory service for the evaluation and acquisition of biomedical equipment | Improved planning and acquisition of technology in Peruvian hospitals |
| [23] | Machine Learning Model for Pneumonia Mortality Prediction | Validation of probabilistic causal network | Predict mortality in patients with community-acquired pneumonia | Improved mortality prediction capacity compared to other clinical scoring systems |
| [24] | Access to Point-of-Care Medical Information (UpToDate) | Didactic sessions and application support | Improve evidence-based practice | Reduction in clinical knowledge, barriers to using information systems |
| [25] | Public Health Laboratory Information System (NETLAB) | Web application development by the National Institute of Health | Improve quality and reduce wait times for laboratory results | Contribution to disease prevention and control in Peru |
| [26] | Epidemiological Information Systems for HIV/AIDS, Hepatitis B, Syphilis | Qualitative-quantitative methodology | Identify barriers to information quality | Multidimensional issues related to human resources and system weaknesses |
| [27] | Parametric 3D Models for Hospital Ventilation | Computational analysis of ventilation patterns | Evaluate the circulation of the SARS-CoV-2 virus in | Identification of areas at risk of viral contamination inside |

| | | | hospitals | and outside hospitals |
|------|--|---|---|---|
| [28] | VLAN Network Proposal for Information Security | "Top-down" methodology | Increase information security in hospitals | Improved data security in hospital systems |
| [29] | E-health Programs for Pregnant Women | Mixed methods (focus groups and surveys) | Improve equity in access to health information during pregnancy | Improved access to reliable and personalized information for pregnant women |
| [30] | Home Incubator with Telemetry System | Software development based on Arduino | Provide affordable incubators for premature babies | Improved monitoring and care for premature babies in low-income families |
| [31] | Telemedicine in Mental Health | Implementation of digital platforms (videocalls, teleconsultations) | Provide mental health care during the pandemic | Reduction in the gap of access to specialized psychiatric care |

In the Peruvian context, the integration of information systems (IS) in healthcare centers has proven to be a developing process that is transforming the management and delivery of healthcare services, particularly in hospitals. One of the earliest implementations has been the use of Point-of-Care Medical Information Systems (POCMIS), which provide immediate access to updated medical information. These systems have been used in public and military hospitals with the goal of improving clinical decision-making and promoting continuous medical education. However, their implementation faces challenges, including a lack of committed leadership, individual user preferences, and cultural barriers related to resistance to technological change. These factors highlight the need to adapt IS to local contexts and the specificities of each hospital environment.

Additionally, the development and implementation of Electronic Health Record Systems (SIHCE) have marked a significant advancement in the digitalization of healthcare centers in Peru. A representative example is the San Pablo Hospital Complex, where a migration from paper-based to electronic medical records has been successfully carried out. This process followed a planned approach that included testing phases, staff training, and system replication in various locations. The implementation of SIHCE has not only optimized the management of clinical information but also driven changes in administrative and hospital management processes, reflecting the structural impact that adopting these technologies can have on healthcare systems.

In terms of advanced technologies, machine learning models have been integrated to improve clinical prognoses in critical cases, such as predicting mortality in patients with community-acquired pneumonia. These models have demonstrated greater accuracy compared to traditional scoring systems, such as the Pneumonia Severity Index. The incorporation of artificial intelligence in Peruvian hospitals has shown the potential of these tools to optimize clinical outcomes, though they are still in validation and development phases, limiting their widespread use.

The NETLAB system, implemented by the National Institute of Health, is another significant example of IS in public health. This information system has improved the management of laboratory results by facilitating communication among various healthcare actors, including epidemiologists, physicians, and laboratory staff. Its implementation has reduced wait times for obtaining results, significantly contributing to the prevention and control of infectious diseases across the country. This demonstrates the value of IS in strengthening the public health system.

Likewise, the use of telemedicine has gained relevance in Peru, particularly during the COVID-19 pandemic. The implementation of teleconsultations, telemonitoring, and educational sessions at the Hermilio Valdizán Specialized Hospital has enabled the continuation of mental health care amidst the restrictions imposed by the health emergency. This mode of care has been essential in reducing gaps in access to specialized services, particularly in areas with geographical or logistical limitations, and has proven to be a key tool in ensuring the continuity of medical care.

Finally, the development of home-based incubators with telemetry systems has provided an innovative solution for the care of premature infants in low-resource settings. These incubators, designed to monitor vital parameters such as temperature and humidity, offer an affordable and accessible alternative for families who cannot access hospital incubators. The use of cost-effective technologies like Arduino and mobile connectivity has allowed parents to monitor their babies from anywhere, contributing to improved neonatal care in the home setting. This development represents an example of how IS can be adapted to meet specific needs in vulnerable populations.

CONCLUSION

The integration of IS in Peruvian healthcare centers has demonstrated a positive impact on improving clinical information management, optimizing hospital processes, and enhancing access to specialized health services. Advances such as the implementation of electronic health records, telemedicine, and the use of machine learning models highlight the potential of these technologies to transform the healthcare system, improving both the quality and efficiency of services. However, the success of these initiatives depends not only on the technology itself but also on cultural and organizational adaptation, as well as committed leadership and proper training of healthcare personnel.

The limited number of studies found for the period 2015-2023 underscores the need for increased research on the integration of IS in Peruvian healthcare centers. While the existing studies show positive impacts, the scarcity of research limits a generalizable understanding of the challenges, benefits, and opportunities these technologies may offer to the healthcare system. Expanding research in this area is essential to evaluate IS performance in different healthcare contexts, identify persistent barriers, and develop strategies that optimize their implementation and long-term sustainability. Furthermore, additional research could contribute to better policy planning and informed decision-making, maximizing the impact of technology on the quality of healthcare in the country.

ETHICAL DECLARATION

Conflict of interest: No declaration required. **Financing:** No reporting required. **Peer review:** Double anonymous peer review.

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