

Approaches to the Development of Effective Strategies for the Adoption of Emerging Technologies in Healthcare Institutions: Overcoming Organizational Barriers

Keywords: tecnologías emergentes, instituciones de salud, resistencia al cambio.

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ABSTRACT

The implementation of emerging technologies in the healthcare sector has significantly transformed service delivery, improving operational efficiency, quality of patient care, and clinical decision-making. This study aims to explore the barriers in the adoption of emerging technologies, such as Mobile Health (mHealth) applications, Big Data Analytics, Cloud Computing, Internet of Medical Things (IoMT), Virtual Reality and Augmented Reality, telemedicine, artificial intelligence (AI) and Machine Learning (ML), to propose effective strategies to overcome them. The main barriers were identified through a literature review, including organizational resistance, power dynamics, and the lack of an integrated approach. The study is based on the Diffusion of Innovations Theory, the Unified Theory of Acceptance and Use of Technology (UTAUT), and the Distributed Cognition Theory. The analysis indicates that successfully adopting these technologies requires effective change management, visible and committed leadership, and ongoing training programs. The findings of this study provide a comprehensive framework that guides the effective and sustainable implementation of emerging technologies in health institutions, suggesting future lines of research to evaluate the impact of these technologies and develop specific theoretical models for the health context.

Keywords: emerging technologies, health institutions, resistance to change.



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INTRODUCTION

Healthcare in the 21st century faces increasing complexity that traditional approaches can no longer adequately handle. Linear and reductionist models of medicine and organizational management are no longer sufficient to address the contemporary challenges arising from the emergence of emerging technologies in healthcare organizations (Plsek & Greenhalgh, 2001).

Understanding the structure, behavior, and dynamics of a health institution's operation is a complex challenge due to its high institutionalization, hierarchical governance systems, multidisciplinary work teams, and particular idiosyncrasies. These rigid structural characteristics are opposed, to a greater or lesser extent, when implementing emerging technologies. Therefore, resistance to change, as they indicate, is influenced by individuals' predispositions towards change, perceptions of threats, benefits and trust in management Erwin & Garman (2010).

On the other hand, studies on multidisciplinary teams in healthcare settings highlight how power dynamics and interpersonal relationships affect the acceptance of new technologies, highlighting the importance of an integrative and collaborative approach to overcoming barriers to change (L. Rogers et al., 2023).

Health institutions face several challenges when incorporating emerging technologies into their operations. These challenges can be influenced by affective, cognitive, and behavioral factors, as well as resistance triggered by uncertainty or distrust towards technological changes and their implications in daily work. Similarly, multidisciplinary teams, power dynamics, and interpersonal relationships can make it difficult to accept emerging technologies. These dynamics can influence the perception and adoption of emerging technologies, generating additional trade-offs and barriers (Erwin & Garman, 2010. L. Rogers et al., 2023).

This is why the lack of an integrated approach that considers both technical and social aspects hinders the effective implementation of emerging technologies. Without proper integration, these may not be used optimally, thus reducing their potential to improve the efficiency and quality of healthcare (Pasmore et al., 2019).

Consequently, this study sets out to address the following research question: What strategies are most appropriate for overcoming organizational barriers and adopting emerging technologies in healthcare organizations? To answer this question, a theoretical approach based on organizational theory will be adopted, considering scientific evidence related to emerging technologies, resistance to change, power dynamics, and approaches such as sociotechnical. Specific objectives include identifying the main technologies related to health institutions, distinguishing the impact of power dynamics and interpersonal relationships on the adoption of emerging technologies, including organizational resistance phenomena, and proposing effective strategies to mitigate organizational resistance.

The structure of this article begins with a theoretical framework, which allows us to analyze health organizations from a perspective of institutional theory, followed by the irruption of digital transformation with emerging technologies (ET). Continuing with the barriers involved in the implementation of ET and how to overcome them. Then describe the methodology, literature review and selection criteria. Finally, the discussions, most

relevant conclusions, and implications for future research are established.

METHODOLOGY

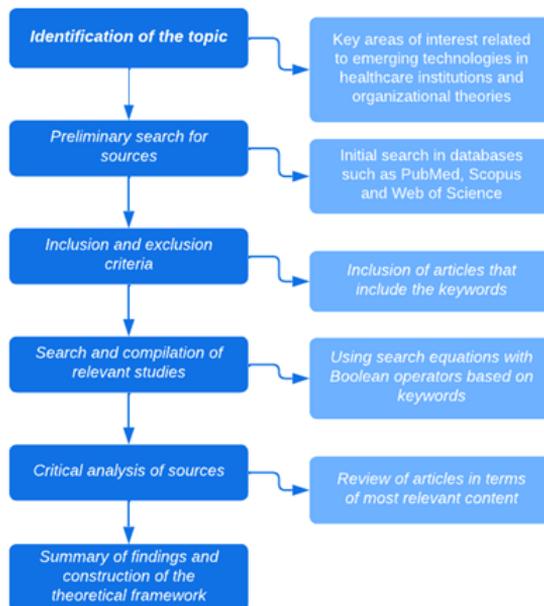
The methodology of this study is based on a systematic review of the existing literature on the adoption of emerging technologies in healthcare institutions, organizational theory, and resistance to change. For these purposes, relevant academic sources were selected using databases such as PubMed, Scopus, and Web of Science.

The inclusion criteria were limited to studies that developed research with keywords that can be visualized in the search equation with Boolean operators, as well as the best-rated journals according to the Journal Impact Factor (JIF) indicator, see **Diagram 1**.

Search Equation:

(“emerging technologies” OR “technological innovation” OR mHealth OR “mobile health” OR “Big Data” OR “Cloud Computing” OR IoMT OR “Internet of Medical Things” OR “Virtual Reality” OR “Augmented Reality” OR telemedicine OR “telehealth” OR “artificial intelligence” OR AI OR “machine learning”) AND (“health sector” OR “healthcare” OR “health institutions” OR hospitals OR clinics) AND (“technology adoption” OR “technology implementation” OR “digital transformation” OR “innovation in health”) AND (“organizational barriers” OR “resistance to change” OR “change management” OR leadership) AND (“operational efficiency” OR “patient care quality” OR “clinical decision making” OR “health services”).

Diagram 1, Search process.



Source: Authors.

The literature review was carried out in two phases: first, a preliminary review was carried out to identify key themes and areas of interest, through the identification of the titles, abstracts, and keywords of each article; then, a search was carried out focused on delving

mainly into the introduction, result, discussion and conclusion. Finally, the most relevant concepts were included that would allow us to broaden our understanding of the dynamics of organizations in the health sector when implementing emerging technologies.

THEORETICAL FRAMEWORK

HEALTH INSTITUTIONS

Health institutions are formal organizational structures, such as hospitals, clinics, and care centers, that respond not only to technical and production demands but also to the institutionalized rules that prevail in society and that function as myths. These institutionalized rules confer legitimacy, stability, and resources on organizations (Meyer & Rowan, 1977).

These formal structures can take on isomorphism resulting from formal and informal pressures exerted on organizations by other organizations and by cultural expectations in society. Thus, institutional isomorphism helps explain why and how health institutions tend to adopt similar structures and practices. Coercive regulations, imitation of successful models under conditions of uncertainty, and professional standards contribute to homogenization in this critical sector (Dimaggio & Powell, 1983).

Consequently, the evolution of organizations and specifically the new institutionalism, is of vital relevance to understanding the current dynamics of institutions in the health sector, in terms of how they operate and adapt to the demands of their environment (Selznick, 1996).

These organizations operate in a complex way due to the interaction of multiple factors and elements. These include the diversity of services and specialties, the interdependence of departments, human resource management, the use of medical technology and information systems, compliance with regulations and standards, financial management, patient-centered care, innovation, and continuous improvement (Ginter et al., 2018).

In short, healthcare organizations, such as hospitals, clinics, and care centers, operate in complex ways due to interactions with internal and external stakeholders. These interactions reflect the technical demands and institutionalized rules that confer legitimacy and resources, and that lead organizations to adopt similar structures and practices. The evolution and adaptation to the demands of the environment are based on factors such as the diversity of services, the interdependence of departments, the management of human and financial resources, the use of technology, compliance with regulations, and patient-centered care.

DIGITAL TRANSFORMATION

In that vein, the healthcare industry has witnessed a profound digital transformation driven by rapid advances in emerging technologies. Digital transformation refers to changes in digital technology used to benefit society and the healthcare industry. Health systems need to use digital technology to find innovative solutions that improve health service delivery and achieve improvements in medical problems (Stoumpos et al., 2023).

In recent decades, emerging technologies have emerged as powerful catalysts for innovation in healthcare. Telemedicine, wearable devices, electronic medical records, the Internet of Things (IoMT) in healthcare, artificial intelligence (AI), and blockchain technology are just a few examples of the technologies that have rapidly transformed the industry.

EMERGING TECHNOLOGIES

Emerging technologies, protagonists of digital transformation, are defined as those that present a radical novelty, characterized by introducing completely new principles or applications. These technologies experience relatively rapid growth in terms of stakeholder involvement, publications, patents, and product development (Roll et al., 2015).

There are several emerging technologies that are having an impact on healthcare. These technologies use digital platforms, connectivity, and data to transform various aspects of healthcare delivery, patient engagement, and research. Regardless of technology, they are all primarily aimed at connecting healthcare workers and patients to enable a seamless flow of medical information between healthcare settings to make informed decisions (Mariano, 2020).

Below are 8 emerging technologies, summarized in Figure 1, that have been strengthened in recent years and have taken a relevant role in the dynamics of organizations in the health sector.

1. Mobile Health Applications (mHealth Apps):

mHealth apps are apps designed for mobile devices, such as smartphones, smartwatches, or tablets, that aim to support healthcare delivery and promote wellness. They vary widely in terms of content, accessibility, interactivity, connectivity, and security. Within the various functionalities they offer, they can be classified into several types according to their uses. Some applications focus on health tracking, allowing the monitoring of data related to physical activity, sleep patterns, nutrition and vital signs; others are medication-oriented, sending dose reminders, tracking compliance, and providing information on drug interactions, as well as allowing users to maintain a medication schedule. There are also telemedicine and telehealth applications, which facilitate the connection with health care providers through video calls, text messages or voice calls, allowing remote diagnosis, monitoring and treatment. On the other hand, fitness apps offer workout tracking, personalized plans, and step counting, while those dedicated to mental health provide resources for stress management, mental health support, and mindfulness practices. In addition, health record apps allow users to store, access, and manage their personal health information, including their history, test results, immunizations, and appointments. Finally, health education apps provide health-related information and resources, with the goal of keeping users informed (Nouri et al., 2018;Nouri et al., 2018).

This wide variety of mHealth applications are essential for healthcare delivery and wellness, offering different functionalities that improve connectivity and accessibility in healthcare (Id et al., 2022; Lu et al., 2020; Nouri et al., 2018; Smuck et al., 2021).

2. Big Data Analytics:

Big Data analysis refers to the process and analysis of a large amount of data that is essential for the proper functioning of health institutions. Processing can vary in terms of data volume, speed of generation, heterogeneity, inconsistency, quality, and value. Big data analytics has increasingly been used to improve clinical decision-making, identify trends, contribute to drug development, and improve public health management (Batko & Ślęzak, 2022)(Batko & Ślęzak, 2022; Cozzoli et al., 2022; Do Nascimento et al., 2021).

Big data flows include various types of data, such as clinical (electronic medical records, hospital information systems, imaging centers, laboratories and pharmacies), biometric (from medical devices that monitor vital signs and body composition), financial (records of relevant financial transactions), from scientific research (information provided from

academia), and those of patients (including treatment preferences, satisfaction levels, self-administered information about their lifestyle, and sociodemographic factors), (Batko & Ślęzak, 2022).

Thus, big data analysis transforms clinical decision-making, improves public health management, and optimizes drug development, benefiting the efficiency and quality of medical care.

3. Cloud Computing:

Cloud computing offers scalable and cost-effective storage and processing capabilities for healthcare organizations. This enables secure access to medical records, facilitates data sharing and collaboration, and supports telemedicine and remote monitoring. The implications of cloud computing in healthcare can be summarized in several key aspects, such as trust in software (especially in models such as software as a service - SaaS, platform as a service - PaaS, and infrastructure as a service - IaaS), security and interoperability, support for clinical tasks, patient-centric approach, the facilitation of collaboration, and the increase in mobility and flexibility of the service (Mehrtak et al., 2021).

However, lack of regulations, system outages, lack of control, and security issues remain potential challenges. Thus, cloud computing improves operational efficiency, facilitates collaboration and ensures secure access to medical data, driving innovation in healthcare (K. Cresswell et al., 2022; Gao et al., 2018; Gu et al., 2020; Mehrtak et al., 2021).

4. Internet of Medical Things (IoMT):

The Internet of Medical Things (IoMT) refers to the interconnected network of medical devices, sensors, and wearable technologies, such as smartwatches, fitness trackers, and monitors, such as glucose monitors. These devices collect and transmit instant health data, enabling remote patient monitoring, early detection of disease, and personalized care (Dwivedi et al., 2022; Sadhu et al., 2022).

Digital healthcare based on the IoMT framework includes several stages. First, patient data is collected using wearable or implanted smart devices that are connected by a network of wearable or wireless sensors, which are then analyzed to make predictions. Also, healthcare providers, patients, or other medical devices can be automatically contacted to be informed of the current medical condition. Finally, the IoMT provides real-time recommendations on what should be done to manage the current medical condition and prevent future complications. However, the IoMT faces challenges such as privacy, a potential lack of accuracy, especially when processing big data, and the high cost of installing and maintaining the devices (Dwivedi et al., 2022; Sadhu et al., 2022).

5. Virtual Reality (VR) and Augmented Reality (AR):

Virtual reality (VR) and augmented reality (AR) technologies create interactive experiences for medical education, surgical planning, and patient education. While VR can simulate realistic medical scenarios for healthcare professional training, AR overlays digital information on the real world, aiding in surgical navigation and medical imaging (Bhugaonkar et al., 2022; Kan Yeung et al., 2021; Kassutto et al., 2021).

VR and AR technologies improve medical training, surgical planning, and patient education, providing advanced tools for healthcare improvement.

6. Telemedicine:

Telemedicine is considered one of the most important innovations in health services, not only from a technological point of view, but also from a cultural and social point of view, as it benefits accessibility to health services and organizational efficiency (Gochhait et al., 2020).

Telemedicine refers to the remote delivery of healthcare services, including medical consultations, diagnoses, and treatments. This presents several advantages, such as providing alternative access to healthcare, especially for those in remote areas, and eliminating travel times (Al- Hazmi et al., 2021; Gajarawala & Pelkowski , 2021; Ibrahim et al., 2021; Kichloo et al., 2020).

The terminology has also been expanded with the concept of Telehealth, which encompasses a broader area of healthcare services and activities, beyond the consultation provided by physicians, including other healthcare professionals (Al- Hazmi et al., 2021; Gajarawala & Pelkowski , 2021; Ibrahim et al., 2021; Kichloo et al., 2020).

Thus, telemedicine improves the accessibility and efficiency of healthcare services, especially benefiting patients in remote areas and facilitating continuity of care.

7. Artificial Intelligence (AI) and Machine Learning (ML):

AI refers to the ability of machines to mimic human behavior by learning from data using self-learning technologies (such as data mining, pattern recognition, and natural language processing) to understand the way the human brain works. On the other hand, ML is a subset of AI that can also improve with experience. With these techniques, AI and machine learning have the potential to revolutionize healthcare. It can analyze large amounts of medical data, including medical images, lab results, and patient registration, to aid in the diagnosis of diseases. By analyzing individual patient data, AI and ML can develop personalized treatment plans based on factors such as medical history, genetics, and lifestyle (Bajwa et al., 2021; Brigands & The Monk, 2020; Habehh & Gohel, 2021).

As a result, AI and ML revolutionize healthcare by improving diagnoses, personalizing treatments, and analyzing large volumes of medical data, increasing accuracy and efficiency in healthcare.

Undoubtedly, the wide variety of emerging technologies is transforming the institutional dynamics of health organizations and their ways of offering services. The degree of adjustment required to absorb emerging technologies poses challenges for any organization. Some of the main difficulties in incorporating emerging technologies become barriers that, in some cases, are insurmountable. Some identified barriers are highlighted below.

Figure 1. Main Emerging Technologies in the Health Sector.



Source: Authors.

BARRIERS WHEN IMPLEMENTING EMERGING TECHNOLOGIES

The implementation of emerging technologies in healthcare institutions offers significant opportunities to improve the quality of patient care, operational efficiency, and medical data management. However, this process is not without its challenges, and various barriers can emerge from different perspectives, making it difficult to adopt and fully exploit these innovations. Among the main barriers are organizational resistance due to cultural and psychological factors, structural obstacles related to systems compatibility and bureaucracy, lack of financial resources and adequate training, the need for effective communication and strong leadership, and the complex ethical and legal aspects surrounding data privacy and security (Ash, 1997):

Addressing these challenges requires a deep understanding of the internal dynamics of healthcare organizations and a comprehensive strategy that considers each of these barriers. The main barriers identified are described below, see **Figure 2**:

CULTURAL AND PSYCHOLOGICAL

Change Management:

Healthcare institutions are no strangers to the concepts of organizational change and resilience; consequently, change management is defined as the process of continuously renewing the direction, structure, and capabilities of an organization to meet the ever-changing needs of internal and external customers. Mastering strategies to manage change is more important because the market is changing dramatically with the emergence of emerging technologies (Moran & Brightman, 2000; Vial, 2019).

Organizational Resistance:

On the other hand, resistance to organizational change can be understood as a three-

dimensional negative attitude towards change, where an affective component is first recognized, which refers to the negative feelings that a person has regarding change, such as anger, anxiety, or fear. Second, a cognitive component involves negative evaluations and thoughts about change, for example, questioning its necessity or benefits. Finally, a behavioral component that includes actions or intentions to act in response to the change, such as complaining, actively opposing, or trying to convince others that the change is harmful (Erwin & Garman, 2010).

Resistance to change can also be understood from the psychological point of view, as “the action taken by individuals and groups when they perceive that a change that is occurring is a threat to them”. The threat does not have to be real (or great) for resistance to occur. In their usual description, threat refers to change within organizations, although it is also found in other forms elsewhere. “Resistance can take many forms, including active or passive, overt or covert, individual or organized, aggressive or timid.” Another definition from management psychology states that resistance to change is “any behavior that serves to maintain the status quo in the face of pressures to alter the status quo” (Mares, 2018; Mares, 2018).

Therefore, we consider that the definition that best fits to understand resistance to change is: “a form of organizational dissidence to a process (or practice) of change that the individual considers unpleasant or inconvenient based on personal and/or group evaluations. Resistance to change intends to benefit the interests of the participant or group (to which they belong) without broadly undermining the needs of the organization. Resistance to change manifests itself in non-institutionalized individual or collective actions and can take the form of non-violent, indifferent, passive, or active behavior.” (Mares, 2018).

Therefore, implementing change within a healthcare organization involves great complexities. For example, researcher Block (2010) has described that only a small number of medical workers are willing to change; that is, they are willing to participate in changes, or their personality tends to adjust or accept changes. Also, psychologists who work in management warn that resistance to change is a natural part of the entire change process, and those who make the change must consider this. Seen in another way, the difficulties of change imply that workers must exchange something they know for something unknown (Block et al., 1998; Di Fabio & Gori, 2016; Bovey & Hede, 2001).

HEALTH INSTITUTIONS

Structure of Health Institutions:

In general, organized activities within an institution require both a division of labor into specific tasks and the coordination of those tasks and activities. An organizational structure refers to how the assignment and coordination of tasks within an organization are designed. Most health services, such as hospitals, are structured around medical specialties, with organizational units that are based on specific knowledge and skills that are needed to perform certain complex tasks, i.e., by functions. Therefore, health services usually have a functional design: an organizational structure based on specialized skills (Mintzberg, 1989; Chairwinder, 1990).

Hospital organizational structures have been repeatedly criticized for impeding coordination, hindering efficiency, and providing suboptimal patient care. Moreover, much of this criticism is empirically supported (Cook et al., 2017; Porter & Lee, 2021; Vera & Kuntz, 2007; Hartnick et al., 2020; Ludwig et al., 2010; Steinmann et al., 2021). However, although health organizations can adopt different operating structures, the main or most recurrent ones are:

Hierarchical Structure: The traditional model used in many large institutions such as

hospitals. Where the hierarchy is organized from the Board of Directors and the Medical Director, through various levels of management, to medical, non-medical, and support staff. This clear structure facilitates decision-making and monitoring, although it may be less flexible in the face of rapid changes in the healthcare environment (McLean et al., 2020).

Matrix Structure: This approach combines functional and project-based teams to improve collaboration and efficiency. Although it can complicate reporting lines and roles, it promotes greater flexibility and responsiveness to various patients.

Flat Structure: Frequently used by smaller organizations or digital health startups, this structure reduces management levels and grants greater autonomy to employees. This encourages innovation and quick decisions, although it can present challenges in scalability and clarity in decision-making as the organization grows (Palepu et al., 2020). These antecedents denote the variability of forms of structure that health institutions can adopt and that are intrinsically related to human capital. Both structure and human capital will face challenges in adjusting to the changes driven by emerging technologies.

Resources & Training

It is inherent to any organization to consider the available resources as an essential variable in any innovation process. Lack of financial resources is a significant barrier to the implementation of emerging technologies in healthcare institutions. These technologies, which include patient data management systems, advanced diagnostic tools, and telemedicine solutions, often require substantial upfront investments. Not only is a budget needed for the acquisition of equipment and software, but also for the infrastructure needed to support these technologies, such as high-speed networks and secure servers. In addition, the costs of maintenance and technological upgrades can be high, and budget-constrained institutions may find it difficult to justify or raise the necessary funds. This lack of adequate funding can delay technology adoption or even prevent it altogether (K. M. Cresswell et al., 2013; Lapointe & Rivard, 2005).

On the other hand, insufficient staff training is another critical obstacle to the adoption of new technologies that require employees who are adequately trained to use and maintain these systems efficiently. That is, without effective and ongoing training programs, employees can feel overwhelmed, insecure, and resistant to change. Training should not only focus on technical skills, but also on integrating new technologies into daily workflows and understanding the benefits these technologies can bring to both patients and staff. Also, a lack of proper training programs can lead to operational errors, decreased efficiency, and a negative perception of technology, which reinforces organizational resilience (Bhattacharjee & Wisdom, 2007; Lapointe & Rivard, 2005).

Communication and leadership:

Effective communication is an essential element for the successful implementation of emerging technologies in the field of health. Without clear and transparent communication about the benefits and expected impact of new technologies, employees can fall into misinformation, rumors, and resistance. It is critical for organizational leaders to clearly articulate the reasons behind technology adoption and how this transformation will affect the various roles within the organization. A lack of proper communication can result in

misunderstandings and fear, which can amplify resistance to change (K. M. Cresswell et al., 2013; Lapointe & Rivard, 2005).

In addition, leadership plays a crucial role in promoting and supporting the adoption of new technologies. Leaders must demonstrate a visible commitment to technological change and provide the necessary resources to facilitate this transition. This includes not only financial support, but also emotional and motivational support, creating an environment where employees feel safe and supported during the change process. Without this active support from senior management, employees may perceive technology adoption as a low-priority initiative and may therefore show a lack of commitment and resistance to adopting new technologies. Effective leadership also involves the ability to manage change strategically, addressing concerns and resistances proactively and constructively (Bhattacharjee & Wisdom, 2007; Joke & Grimshaw, 2003; Weiner, 2020).

Ethical and Legal Aspects:

Ethical and legal aspects are primary concerns when implementing emerging technologies in healthcare institutions. The management of sensitive data, such as patients' medical information, poses significant challenges in terms of privacy and confidentiality. Concerns about who has access to this data, how it is protected, and how it is used can lead to resistance among both employees and patients. Healthcare institutions must establish robust policies and procedures to ensure data security and privacy while complying with current regulations. However, these measures can be complex and expensive to implement, adding another layer of difficulty to technology adoption (Beef, 1997; Westbrook et al., 2009).

In addition, healthcare institutions must comply with a series of strict regulations governing the handling of data and the implementation of new technologies. These regulations are designed to protect patient privacy and ensure the security of medical information, but they can also pose a significant obstacle. Aligning new technologies with these regulations may require additional time and resources, which can delay their implementation. Institutions must ensure that any new technology complies with local and international laws and regulations, which may involve audits, compliance reviews, and modifications to technology systems. The complexity and cost of this regulatory process may discourage organizations from adopting emerging technologies, despite the potential benefits they could offer in terms of operational efficiency and quality of patient care (Garg et al., 2005; Beef, 1997).

Figure 2. Main Barriers to Implementing Emerging Technologies



Source: Authors.

FINDINGS:

STRATEGIES FOR ADOPTING EMERGING TECHNOLOGIES

A constant challenge for the design, development, implementation, and evaluation of emerging technologies in health services is to their use within the complex field of health care. Below, we describe 5 approaches identified from the literature review that we believe are relevant to looking for fit models between emerging technology and health institutions, see **Figure 3:**

THEORY OF INNOVATION DIFFUSION

The innovation diffusion model will provide an essential theoretical framework for understanding how new ideas and technologies spread within a society or social system, and as a beneficiary in the adoption of emerging technologies. This theory identifies key factors such as innovation, communication channels, time, and the social system in which the innovation spreads. When incorporating emerging technologies into healthcare institutions, this model helps break down the process by which such technologies are adopted by different categories of healthcare professionals, from innovators to laggards. In addition, studies such as those highlight how organizational factors, the structure and functionality of the clinical team, influence the adoption and use of these technologies. In this context, the successful diffusion of technological innovations in the health sector depends not only on the technology itself, but also on the organization's ability to support and promote its adoption through an appropriate organizational culture, committed leadership, and sufficient resources (E. M. Rogers et al., 2014; Ash, 1997; Gosling et al., 2003).

UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY (UTAUT)

It is a theoretical model developed whose purpose is to consolidate and simplify the understanding of the factors that determine the acceptance and use of technology, based on the TAM technology acceptance model. The UTAUT is built based on eight previous theories and models of technology acceptance, offering a unified approach to predict the intention of use and the actual use of information technologies by users (Venkateshet al.,

2003)(Davis, 1989a)

The UTAUT identifies four key constructs that directly influence use intent and use behavior:

- **Performance Expectancy:** Reflects the degree to which an individual believes that the use of a technology will improve their performance at work.
- **Effort Expectancy:** This refers to the degree of ease associated with the use of technology.
- **Social Influence:** Represents the degree to which an individual perceives that the people important to them believe they should use the new technology.
- **Facilitating Conditions:** These are the individual's beliefs about the existence of a technical and organizational infrastructure that supports the use of technology.

In addition to these main constructs, the UTAUT incorporates four moderators that affect the relationship between these constructs and the intention to use, as well as the actual use of technology, which are gender, age, experience, and voluntariness of use.

The implementation of UTAUT has proven to be effective in various contexts, including the health sector. For example, they highlight the importance of the model to understand the acceptance of information technologies in the health field (Holden & Karsh , 2010)

DISTRIBUTED COGNITION THEORY

The theory of distributed cognition, developed by Edwin Hutchins in his book “Cognition in the Wild” (1996), argues that cognition is not a process that occurs exclusively within an individual's brain but is distributed through a system of interactions that includes people, artifacts, and the environment. Hutchins studied how navigators on a U.S. Navy ship coordinate their actions and use tools and procedures to perform complex navigational tasks. He found that cognition emerges from collaboration between crew and navigational instruments, demonstrating that cognition is a property of the system as a whole and not just of individual minds. In other words, making an analogy between technologies and organizations, for Hutchins, technologies would be the navigation instruments, and the crew would be health professionals. Therefore, the contributions of the theory of distributed cognition allow us to comprehensively understand how the different actors are linked in the processes of adoption of emerging technologies (Hutchins, 1995)

HUMAN-COMPUTER INTERACTION MODEL

The Human-Computer Interaction Model provides a comprehensive framework for understanding how people interact with technological systems, highlighting the importance of designing interfaces that facilitate user cognition and actions. In the context of the health sector, this model is particularly relevant due to the growing adoption of emerging technologies such as decision support systems and artificial intelligence. These technologies have the potential to significantly improve the quality of healthcare, but they also present challenges in terms of usability and workflow. The application of Norman's model in critical care settings, such as those described by and (Norman, 1988)(Malhotra et al., 2007)(Sheehan et al., 2009), demonstrates how proper design can improve decision-making and operational efficiency. By following the seven steps of the model, designers can create systems that are not only technologically advanced but also intuitive and effective, thus facilitating the integration of these technologies into daily clinical practice.

SOCIOTECHNICAL APPROACH:

Finally, sociotechnical systems (STS) design, as conceived by Trist, Emery, and others, aimed to improve the performance of work systems by recognizing how human behaviors affect the functioning of technology. More specifically, better operational performance could be achieved when workers’ knowledge and capabilities were harnessed to help address technological uncertainty, variation, and adaptation (Pasmoremar et al., 2019). Thus, the sociotechnical approach is defined as a perspective that considers both the social and technical aspects of a working system to achieve a joint optimization that benefits both workers and the organization. This approach promotes the active participation of workers in the design and control of technical processes, thus improving performance and job satisfaction (Pasmore et al., 2019).

Evidence of technological advancements has shown exponential growth in recent decades, while advances in organizational design are almost non-existent, resulting in a widening gap between the promise of technical solutions and our ability to leverage them (Pasmore et al., 2019).

Sociotechnical Models:

An integrative approach, such as sociotechnical models in the field of health, provides essential frameworks for understanding and optimizing the interaction between human, technical, and organizational components. Table 1 describes the most recognized models together with their authors and the most representative key elements.

Table 1. Sociotechnical Models in Health

MODEL	AUTHORS	KEY ELEMENTS
Henriksen et al. Model	Henriksen, Kaye, Morisseau (1993)	1. Individual characteristics of providers: personal skills and competencies. 2. Work complexity: task specificity. 3. Physical environment: design and ergonomics. 4. Human-system interfaces: interaction between providers and technologies. 5. Organizational characteristics: social and managerial aspects.
Vincent et al. Framework	Vincent, Taylor-Adams, Stanhope (1998)	Hierarchy of factors influencing clinical practice: a structure for identifying and analyzing factors that affect safety and risk, facilitating a causes and solutions assessment.
SEIPS Model by Carayon et al.	Carayon, Schoofs Hundt, Karsh, Gurses, Alvarado, Smith, Flatley Brennan (2006)	1. Characteristics of providers, tools, and physical/organizational environment: elements affecting medical care. 2. Interpersonal and technical aspects: human interactions and procedures. 3. Change in patient condition: impact on the patient and the healthcare system.
ISTA Framework by Harrison et al.	Harrison, Koppel, Bar-Lev (2007)	Interrelations between health information technologies (HIT), physicians, and workflows: analysis of mutual influence and unintended consequences of technology implementation.

Source: Authors.

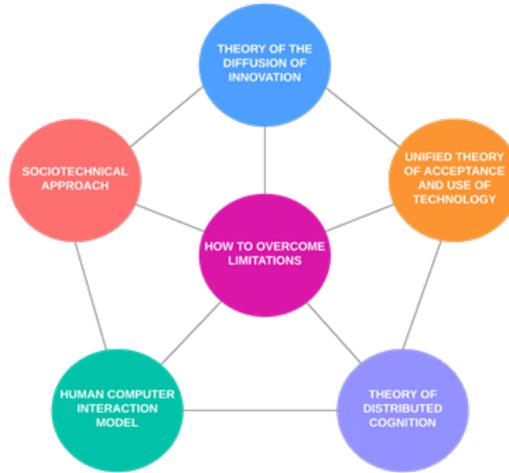
For example, the model of Henriksen et al. (1993) focuses on supplier skills, task complexity, environment design, interaction with technologies, and organizational characteristics. The framework of Vincent et al. (1998) proposes a structure for analyzing factors that affect safety and risk in clinical practice. The SEIPS model by Carayon et al. (2006) assesses provider characteristics, tools, and environment, human and technical interactions, and the impact on patient health status. The ISTA framework by Harrison et al. (2007) analyzes the interrelationships between health information technologies, physicians, and workflows, addressing the unintended consequences of technological implementation. These models promote patient safety and operational efficiency in healthcare systems. (Damn it et al., 2006; Harrison et al., 2007; Henriksen, 1993; Vincent et al., 1998)

Building on the models above, Sittig and Singh have developed an eight-dimensional sociotechnical model to study health information technology (TIS) in complex and adaptive health systems that addresses the challenges of designing, developing, implementing, using, and evaluating TIS, considering the interdependence and relationship between various dimensions. The eight dimensions are:

1. **Hardware and software infrastructure:** Equipment and software needed to run clinical applications and medical devices.
2. **Clinical content:** Textual, numerical, and image data that constitute the “language” of clinical applications.
3. **Human-computer interface:** Aspects of the system that users interact with, including what they see, touch, or hear.
4. **People:** All individuals who interact with the system, from developers to end users to patients.
5. **Workflow and Communication:** Processes and steps necessary to ensure that patient care tasks are performed effectively.
6. **Internal organizational characteristics:** Policies, procedures, and culture of the organization that can facilitate or restrict various aspects of the TIS.
7. **External rules and regulations:** External rules and pressures that influence the design, development, implementation, use and evaluation of TIS.
8. **System Measurement and Monitoring:** Processes for measuring and evaluating both intended and unintended consequences of TIS implementation and use.

This multidimensional model allows for a comprehensive understanding of the complexities associated with the implementation and use of TIS in real clinical settings, highlighting the importance of considering all dimensions in an interrelated manner to improve patient safety and operational efficiency (Sittig et al., 2015).

Figure 3. How to overcome barriers.



Source: Authors.

About what has been described above, a combination of theoretical approaches and practical strategies is presented. These approaches, adapted to the needs and dynamics of each specific barrier, not only provide a solid structure for understanding internal resistances and constraints but also allow for the outlining of strategies to facilitate the transition to technological integration (see **Table 2**).

Table 2. Strategies to overcome barriers

ORGANIZATIONAL BARRIERS	THEORETICAL APPROACHES	PROPOSED STRATEGIES
Organizational Resistance	Theory of the Diffusion of Innovation	Identify and train "innovation champions" within the organization to lead change, leveraging their influence to reduce organizational resistance.
Resources and Training	Unified Theory of Technology Acceptance and Use	Implement communication campaigns that demonstrate the specific benefits of technology and ease of use, focusing on performance and effort expectations.
Power Dynamics and Interpersonal Relationships	Distributed Cognition Theory	Encourage the creation of interdisciplinary working groups that integrate end users, so that the technology is adapted to the needs of each team and consensus is generated.
Ethical and Legal Challenges	Human-Computer Interaction Model	Conduct pilots that adjust the user interface and collect feedback from staff to ensure that the technology respects ethics and privacy.
Technical and Infrastructure Compatibility	Sociotechnical Approach	Develop a technology integration plan that includes technical infrastructure upgrades and collaborative training for all levels of the organization.

Source: Own elaboration

To overcome organizational resistance, it is proposed to identify “innovation champions” in the institution. These individuals, who may include formal or informal leaders, will be trained to understand and value the benefits of emerging technology. These champions will then have the responsibility of positively influencing their colleagues, helping to dispel doubts and build trust in technology. The diffusion of innovation is facilitated when key people model change, which can significantly reduce organizational resistance.

The implementation of technology often fails due to a perceived lack of utility or complexity. To combat this, it is proposed to develop internal communication campaigns that clearly explain the benefits of technology in terms of individual performance and efficiency at work, addressing the expectation of performance and effort. These campaigns should include testimonials from users in similar roles to reduce the perception of difficulty and offer concrete examples of improvements they can achieve with the new technology.

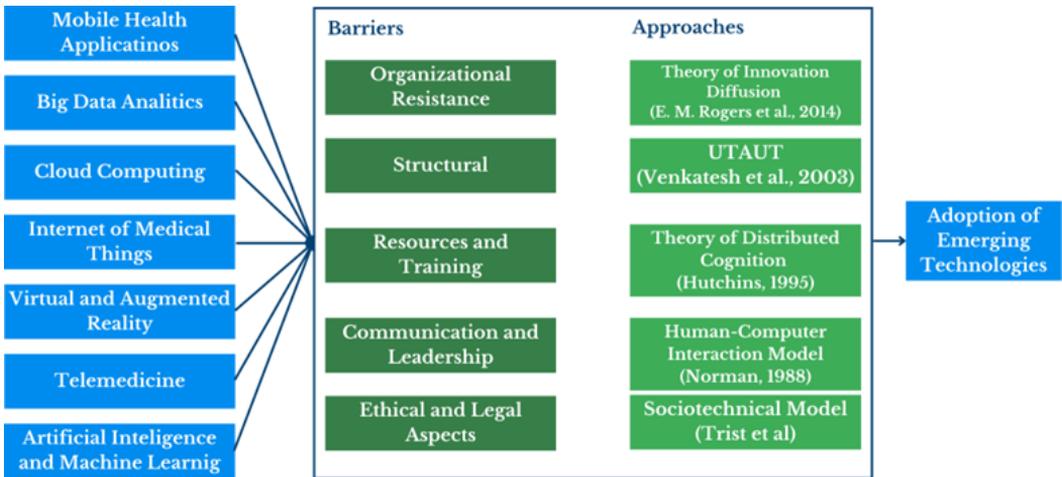
To address power dynamics, the creation of interdisciplinary teams where all members have an active participation in the adaptation and personalization of technology is suggested. By involving end users in the implementation process, these teams can modify the technology according to the specific needs of each group. Not only does this strengthen the sense of belonging and acceptance of technology, but it also allows power dynamics to be overcome, as each member contributes to a common goal.

Data privacy and security are major barriers in the healthcare sector. Conducting pilot tests, in which staff feedback is collected, will allow the technology to be adjusted to comply with ethical and legal standards. These tests will also help ensure that the user interface is intuitive and secure, minimizing the risk of misuse or errors. With the right fit, technology can be integrated in a way that respects the fundamental ethical values and principles of industry.

To integrate the technology into the existing system, a socio-technical approach is required that coordinates infrastructure improvements with continuous staff training. This includes conducting infrastructure audits to identify areas that require upgrades and, in parallel, developing collaborative training programs. This strategy ensures that the technology is operational and functional in the specific context of the institution, facilitating efficient and long-term adoption.

Finally, the visualization of the barriers, approaches, and strategies allows for clarification of the path towards an effective implementation of emerging technologies in the field of health. Each identified barrier finds its answer in a theoretical approach that, in turn, facilitates the formulation of practical strategies, aligning human, technical, and organizational resources. This structured approach not only supports organizational adaptation but also lays the foundation for an innovation-responsive organizational culture, allowing healthcare institutions to adopt and optimize these technologies sustainably and effectively, see **Figure 4**.

Figure 4. Emerging Technologies Integration Framework and Approaches



Source: Own elaboration

DISCUSSION

The implementation of emerging technologies in healthcare institutions represents both significant opportunities and considerable challenges. Throughout this study, it has been shown that the adoption of technologies such as mHealth, Big Data Analytics, Cloud Computing, IoMT, Virtual and Augmented Reality, Telemedicine, and Artificial Intelligence and Machine Learning can radically transform operational efficiency, quality of patient care, and clinical decision-making.

However, each emerging technology presents its advantages and challenges. mHealth apps, for example, have proven essential in improving connectivity and accessibility in healthcare. However, its effectiveness depends largely on acceptance and appropriate use by patients and health professionals. Similarly, Big Data Analytics has the potential to transform clinical decision-making and public health management, but it requires robust infrastructure and adequate training to handle and analyze large volumes of data.

On the other hand, the barriers identified for the implementation of these technologies include organizational resistance, power dynamics and interpersonal relationships, and the lack of an integrated approach that considers both technical and social aspects. Resistance to change is a significant obstacle, influenced by affective, cognitive, and behavioral factors. Power dynamics within multidisciplinary teams can also make it difficult to accept new technologies, while a lack of financial resources and adequate training programs can delay or impede technology adoption.

Therefore, to overcome these barriers, it is crucial to adopt a comprehensive approach that can handle the different variables, such as the socio-technical approach that would integrate both the technical and social aspects of health systems. Thus, change management could be a priority, with clear strategies for communicating the benefits of emerging technologies and addressing staff concerns. Engaged, visible leadership would

also be essential to promote and support emerging technology adoption. In addition, it is important to develop ongoing training programs that not only address technical skills but also the integration of new technologies into daily workflows.

Finally, theoretical models such as Rogers' Diffusion of Innovation Theory and the Unified Theory of Technology Acceptance and Use (UTAUT) provide valuable frameworks for understanding and facilitating the adoption of emerging technologies. These models highlight the importance of factors such as innovation, communication channels, time, and the social system in technology adoption. In addition, Trist and Emery's sociotechnical approach and Norman's human-computer interaction model underscore the need for systems design that facilitates interaction between users and technology.

CONCLUSION

In conclusion, the adoption of emerging technologies in healthcare institutions has the potential to revolutionize healthcare, improving operational efficiency, quality of patient care, and clinical decision-making. However, its implementation is not without significant challenges. Organizational resistance, power dynamics, and the lack of an integrated approach are barriers that must be addressed through effective change management strategies, engaged leadership, and appropriate training programs.

Adopting a socio-technical approach and using theoretical models such as the Innovation Diffusion Theory and UTAUT can facilitate the successful adoption of these technologies. Healthcare institutions need to develop a deep understanding of internal dynamics and staff needs to ensure effective and sustainable integration of emerging technologies.

The successful implementation of these technologies requires not only investments in infrastructure and training but also a cultural change within organizations. With a strategic and collaborative approach, healthcare institutions can overcome barriers to technology adoption and fully harness the potential of emerging technologies to improve healthcare and public health in general.

LIMITATIONS:

One of the main limitations of this study lies in the theoretical approaches and conceptual frameworks proposed to develop strategies for the adoption of emerging technologies, which, although solid, could benefit from the inclusion of other complementary approaches that allow the creation of more specific frameworks adjusted to the particularities of the health sector. This raises the need to expand the analysis through additional theories that could enrich the understanding of the factors that influence the adoption of these technologies.

Second, the literature-based methodological approach has inherent limitations, as it focuses on theoretical aspects that, in practice, may not respond uniformly in various institutional and organizational contexts. The lack of empirical studies or specific case studies in different types of health institutions limits the capacity for generalization and direct applicability of the strategies proposed in real scenarios.

Finally, the study does not explore the possibility of proposing multiple strategies that address barriers on different fronts simultaneously. A multifaceted approach, which allows solutions to be implemented at different organizational levels in a coordinated manner, could significantly improve the effectiveness of adoption strategies and facilitate the transition to a more integrated technological environment in health institutions.

FUTURE LINES OF RESEARCH:

As emerging technologies continue to transform the healthcare sector, the need for further research into various aspects to ensure the successful adoption of emerging technologies is becoming apparent. That is why it is proposed as lines of research, first to carry out a global impact assessment of emerging technologies using a longitudinal research design that would allow capturing the long-term impact of specific technologies such as mHealth, Big Data analytics, cloud computing, IoMT, virtual and augmented reality, telemedicine, and AI and ML on operational efficiency and quality of patient care. These studies should include both quantitative and qualitative measurements to provide a comprehensive understanding of the associated benefits and challenges.

Second, although there are models that explain the acceptance of technology, such as the famous technology acceptance model (TAM) and the unified theory of acceptance and use of technology (UTAUT), the development of new theoretical models specific to the health context is required. These models must consider the particularities of the healthcare environment, including power dynamics, organizational resistance, and sociotechnical aspects. Because the usual focus of these constructs is positional at the person level and not at the organizational level, studies should be adapted considering multilevel theory and evaluated in individual, group, and organizational terms (Davis, 1989; Venkatesh et al., 2003).

Third, since change management and leadership are critical to the successful adoption of new technologies, studies are needed to explore best practices in these areas. Future research could focus on identifying effective leadership strategies and training programs that foster an organizational culture that is open to change and technological innovation. Fourth, it is critical to further investigate the specific organizational barriers that impede the adoption of emerging technologies and develop effective strategies to overcome them. This includes studying how power dynamics and interpersonal relationships affect technology implementation and how a sociotechnical approach can facilitate an optimal fit between technologies and organizational structures.

Fifth, collecting and analyzing successful case studies in the implementation of emerging technologies can provide valuable lessons and best practices for other institutions. These studies should document the processes, challenges, and solutions applied, offering practical guidelines for technological adoption in various health contexts.

Finally, investigating how emerging technologies are transforming the education and training of health professionals is essential to ensure that staff are adequately prepared to use these tools. This includes the development of educational programs that integrate digital technologies into the medical and continuing education curriculum.

By addressing these lines of research, it will be possible to make significant progress in the effective and sustainable integration of emerging technologies in the health sector, thus improving operational efficiency, quality of patient care, and clinical decision-making.

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