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The Impact of Artificial Intelligence on Healthcare: Perspectives and Approaches for Latin America and the Caribbean.

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1. Presentation

This document, prepared by the Center for Implementation and Innovation in Health Policies (CIIPS) of the Institute for Clinical and Health Effectiveness (IECS), is part of a series of Technical Documents on Artificial Intelligence and Health.

These documents aim to contribute to the knowledge in the region by addressing different relevant axes and perspectives in the analysis of this topic.

Intended for healthcare teams, decision-makers at all levels, and the general population, with a special interest in the digital transformation of the healthcare sector, these documents complement the activities carried out by the Center for Artificial Intelligence in Health for Latin America and the Caribbean (CLIAS), which is developed at CIIPS with the support of the International Development Research Centre (IDRC). For more information about CLIAS, visit <http://clias.iecs.org.ar>

This particular document addresses the situation of Artificial Intelligence (AI) in health in Latin America and the Caribbean (LAC) from a regional perspective. It analyzes the current situation and the challenges in the implementation of AI in the healthcare sector, as well as identifies some opportunities.

To accomplish this, a review of the available literature was conducted, and relevant global experiences were selected, with a focus on regional experiences.

This document does not aim to be an exhaustive bibliographic review of the state of AI in health in LAC but rather an exploratory description to understand the characteristics of AI implementation in this region. The experiences were selectively chosen, and this does not represent a comprehensive review of all existing initiatives, which are mentioned in this text to exemplify the various uses and applications.



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2. Key Messages of the Document

The maturity in the development of Artificial Intelligence (AI) in healthcare in the Latin America and the Caribbean (LAC) region is still in the exploratory phase. This means that the criteria for a truly integrated ecosystem are not yet met, leading to duplication of efforts or efforts not focused on addressing the region's priority health needs.

The lack of governance by governments or ministries of health regarding AI applied to healthcare in the countries of the region, facilitates a context where projects focus on individual or corporate objectives, or on the problems that AI developers consider or evaluate as important for the patient, organization, or end-user. While this situation could contribute to improving the quality of care and patient satisfaction, it may exclude many important national or regional health issues.

However, some more advanced countries have started developing policies, regulatory frameworks, training programs for healthcare personnel in AI, and efforts to integrate all stakeholders under the governance of the government and health authority. Examples include Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Uruguay, which already have national AI strategies, including in the healthcare sector.

Nevertheless, in most countries, regulations are still unclear, allowing isolated AI projects in healthcare to develop without significant regulatory, ethical, and/or legal controls. This poses a risk of inappropriate use of AI, violation of basic bioethical principles that harm the patient or end-user, and even the exacerbation of healthcare inequities. Additionally, the lack of a clear and consistent regulatory framework for the use of AI in the healthcare sector, education, and research can discourage the creation of ventures, limit the adoption of innovative solutions, and create barriers to collaboration among different stakeholders, such as researchers, educational institutions, and emerging companies.

In the macro-management of healthcare systems, the lack of budget and governance has a negative impact, as it limits the capacity of healthcare systems to invest in advanced technologies and training personnel to implement them. Moreover, the lack of financial resources can restrict the ability of healthcare systems to address the health needs of vulnerable populations, resulting in a gap in access to quality healthcare. In this aspect, the COVID-19 pandemic has accelerated the generation of initiatives that enable the management of health data to inform timely decision-making.

While Artificial Intelligence (AI) can play a key role in the macro and meso-management of healthcare by helping process large amounts of clinical and administrative data from patients quickly and accurately, deficiencies in the "data and infrastructure" pillar for health data recording in the region have been identified. For example, there is still manually recorded health information that is not captured by AI, which could result in erroneous or poor-quality health data that is incomplete and not integrated. This not only hinders informed decision-making but also generates biases and inequity. For



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instance, when applying AI to patient selection processes for health interventions or when biases in research arise from using AI to select the target population. Efforts to improve the collection and management of health information in Latin America and the Caribbean (LAC) are crucial first steps towards implementing AI in the healthcare sector.

In this line, with the use and implementation of proper electronic health records, AI can help healthcare providers identify patterns and trends in patient care, leading to better decision-making and more effective resource planning. This, in turn, can improve the management of the supply chain for medications, medical devices, and other healthcare products, resulting in cost reductions and increased efficiency. In Latin America and the Caribbean (LAC), where supply chain management is still being improved, there is a great opportunity to leverage AI.

Another characteristic of the context that could be limiting AI in the region is the underdevelopment of the technology sector, which leads to the reliance on costly technological resources from outside the region. Excessive costs for technology obtained from abroad could discourage the creation of local ventures. Considering that many countries in the region face budgetary constraints, promoting technological development through fiscal incentives, intergovernmental agreements, or public-private partnerships could greatly benefit the advancement of AI in all sectors, including healthcare.

Education and research should also be considered to enhance the implementation of AI in the healthcare sector. Training competent and up-to-date professionals in the latest technologies is essential to ensure proper and effective utilization of AI in healthcare. Currently, most healthcare professionals acquire knowledge and skills in AI through training programs outside the region, and many do not return. The lack of basic AI or even computer science training in undergraduate or postgraduate curricula may have resulted in healthcare professionals, especially those who have graduated several years ago, being unaware of the benefits and risks of AI, not using it, and lacking the capacity to participate in AI projects or conduct related research. Despite this, the growing interest of academic institutions and healthcare personnel in AI education and research is a long-term opportunity to achieve the integration of the AI ecosystem.

It was also observed that the majority of implemented advancements focus on micro-management, providing specific solutions aimed at benefiting the end users, which include patients and healthcare professionals. The key facilitator that has been identified is the involvement and interest of relevant stakeholders in AI projects, including healthcare providers, patients, technology companies, and other stakeholders. This has enabled investment in innovative and effective solutions that address the needs and desires of patients and providers, even in the absence of structured collaboration.



3. The Healthcare Sector in the Era of the Revolution 4.0

Within the framework of Revolution 4.0, also known as the fourth Industrial Revolution, **the field of medicine has been one of the sectors with slower integration of digital technologies into healthcare processes. This includes artificial intelligence, robotics, process automation, and real-time connectivity through the Internet of Things (IoT).**¹ This revolution has the potential to transform the way healthcare is delivered by optimizing diagnostic processes, monitoring, medical data management, and personalized treatments.² Additionally, it is projected that medical knowledge will double every three years, making this sector fertile ground for the implementation of AI.³ The use of advanced algorithms and big data analysis will enable healthcare professionals to make more precise decisions and improve clinical outcomes.⁴

The delay in the integration of digital technologies in healthcare, compared to other sectors, can be attributed to several factors. These include **the high costs and complexity of the technologies required for digital transformation, gaps in training and education of healthcare professionals in the use of these technologies, limiting the adoption of digital solutions,**⁵ as well as **cultural barriers and resistance to change within healthcare organizations.**

Despite these challenges, the healthcare sector in Latin America exhibits the second-highest level of AI activity (17%) among specialized companies that apply their knowledge in various areas such as diagnosis, patient monitoring, data management, and medical research.

This evident contrast between AI developments in the field of healthcare and their adoption and integration into healthcare systems highlights the need for a regional strategy to facilitate the digital transformation process. In this regard, the Pan American Health Organization (PAHO) has developed a document titled "Eight Guiding Principles for Digital Transformation in the Health Sector," which proposes a framework to guide and support health systems in implementing digital transformation strategies.⁶ One of the principles is Artificial Intelligence (AI), which encourages countries to participate in global cooperation and work within multisectoral and interdisciplinary networks to design and adopt AI solutions that promote equity, gender, and cultural diversity with secure, reliable, and open algorithms.

Particularly in healthcare, different experiences worldwide demonstrate the potential of artificial intelligence to transform healthcare systems by reducing costs, improving the quality of care, expanding access, and driving precision medicine and clinical research advancements.⁷ However, these innovations also bring their own set of challenges that need to be addressed. **The implementation of these technologies is particularly challenging for low- and middle-income countries, as they may be either benefitted or disadvantaged by the adoption of AI-based strategies.**⁷ For example, access to



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the internet is a fundamental facilitator for implementing AI applications, as they require a certain level of connectivity to function. **While the costs of broadband and connectivity have significantly decreased, they still remain prohibitively high in some low- and middle-income countries, especially in the least developed countries. This poses a barrier to accessing digital health services and artificial intelligence.**⁷

In Latin America, around two-thirds of people have access to the Internet. Experts expect that the COVID-19 pandemic will drive governments to address the digital gap in poor areas of cities and "encourage authorities to consider affordable internet connectivity as a right and a basic service, similar to water and sanitation systems that cities are expected to provide."⁸ In this sense, connectivity, and bandwidth could be considered a new social determinant of health, as already mentioned by the PAHO in one of its documents.⁶

Data is crucial for generating robust AI tools. Advances in AI and healthcare in recent years have been facilitated by the exponential increase in accessible data, greater computing power, and progress in methodological aspects. However, it is essential to prioritize working on data **quality, accessibility, privacy, and interoperability**, which refers to the ability to exchange and interpret information among different systems. In this way, the quantity of data is not as important as its quality and interoperability.⁷

The COVID-19 pandemic has highlighted the importance of data for population health management, enabling decision-makers to make more informed and timely decisions. However, the majority of countries still have a long way to go in terms of information technology and health information management. **If governments do not invest in these areas, they run the risk of deepening existing health inequalities in their populations.**⁷



4. Key concepts of Artificial Intelligence

The original definition of Artificial Intelligence (AI), coined by McCarty in 1955, describes it as **"a group of technologies capable of performing tasks that would require intelligence if performed by a human."** It includes methods that represent human knowledge (symbolic AI) or use data to generate knowledge (machine learning-based AI). These classifications apply to various objectives, such as natural language processing, computer vision, robotics, and speech processing, among others.⁹

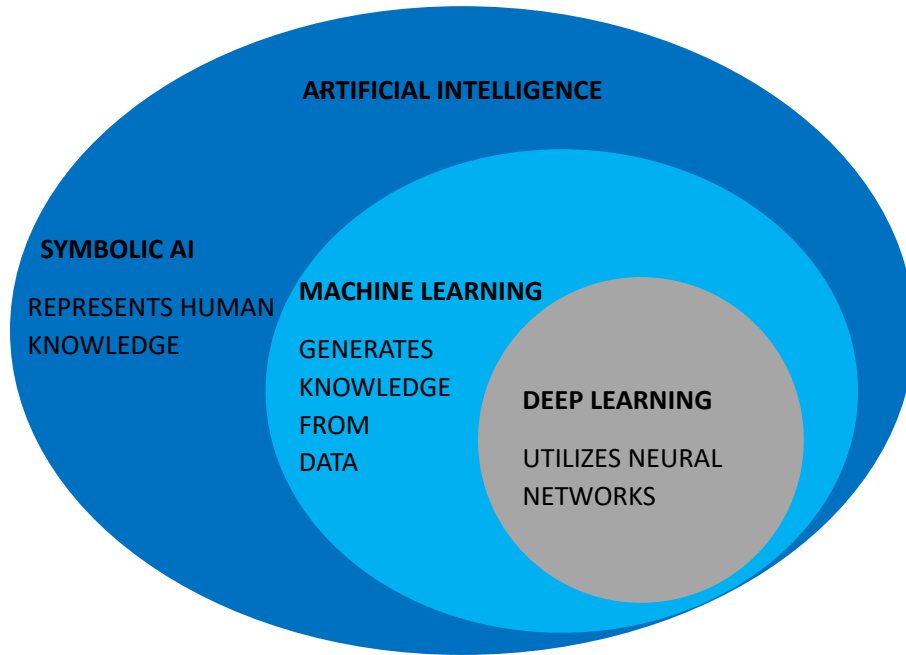
Symbolic AI focuses on processing symbols and symbolic rules for reasoning and decision-making. It represents knowledge explicitly and is used for inference and problem-solving. This approach is used, among other things, for expert systems, automated reasoning, natural language processing, and task planning.¹⁰ For example, in the resolution of **Natural Language Processing (NLP)** tasks, symbolic AI would involve defining grammatical rules to identify nouns, verbs, and adjectives, as well as semantic rules to establish relationships between different parts of speech, in order to analyze and break down human language.

Machine learning, on the other hand, forms the basis of most current applications of artificial intelligence, including in the field of health.⁷ It is a technique that has changed the way computers can process and analyze large amounts of data. Instead of requiring humans to explicitly program all the rules for data processing, machine learning allows computers to learn those rules themselves by finding patterns and relationships in the data. This generates new insights and enables the efficient performance of complex tasks. Continuing with the example of NLP, machine learning could solve typical tasks such as summarization, information extraction, or text generation by extracting patterns from the analyzed data without the need for explicit rule programming.

Deep learning is based on the same principles as machine learning but uses more complex algorithms to perform increasingly precise and sophisticated tasks through **neural networks**.⁷ A neural network is a method that teaches computers to process data in a way inspired by the way the human brain works. It uses interconnected nodes or neurons in a layered structure that resembles the human brain. It creates an adaptive system that computers use to learn from their mistakes and continuously improve. In this way, artificial neural networks attempt to solve complex problems, such as document summarization or face recognition, with greater accuracy. Figure 1 provides a simplified overview of the classification of AI.



Figure 1. Classification of Artificial Intelligence

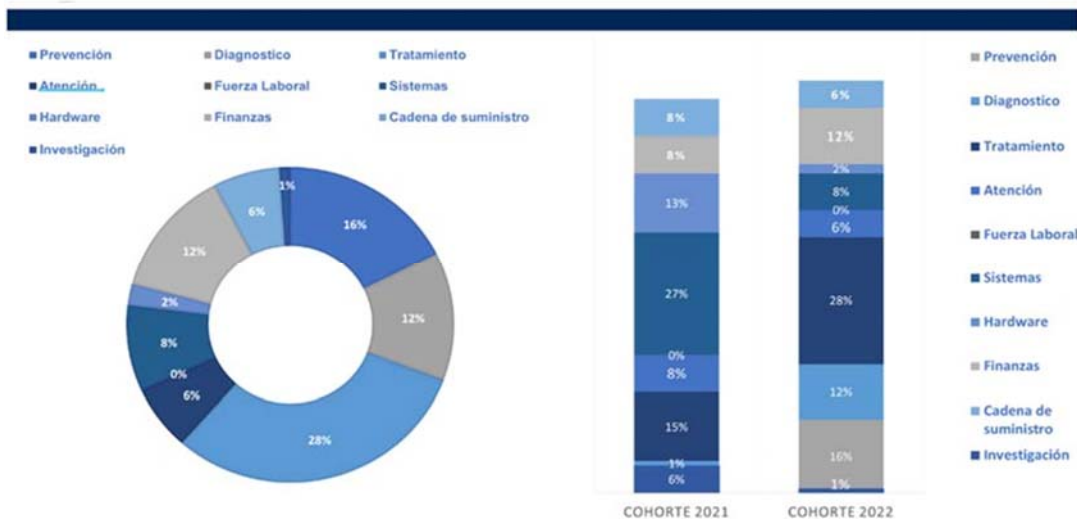


Source: McCarthy J. A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence.

5. Artificial Intelligence in the Healthcare Sector

The use of artificial intelligence in healthcare encompasses almost all value chains within the healthcare system. HolonIQ conducted an analysis of the clustering of healthcare startups in Latin America and the Caribbean (see Figure 2), revealing that **the majority of startups are focused on patient care** (treatment, prevention, and diagnosis), while a smaller number are involved in research and healthcare education.¹¹

Figure 2. Distribution of artificial intelligence experiences in Latin America and the Caribbean in the healthcare sector.



Source: HolonIQ

The implementation of AI tools in public policies and services, including the healthcare sector, requires **governments to progress towards creating a favorable and conducive environment for the development of these strategies.**

According to the AI Readiness Index¹², which measures the necessary foundations for a government to effectively and responsibly integrate AI into services, there are 10 pillars distributed across 3 categories (government, technology sector, data and infrastructure) that need to be analyzed to assess AI implementation. The maximum score a country or region can obtain is 100. Oxford Insights conducted a ranking based on this assessment, evaluating various countries divided into 9 regions (North America, Latin America and the Caribbean, Western Europe, Eastern Europe, Middle East and North Africa, Sub-Saharan Africa, South and Central Asia, East Asia, Pacific).



In Latin America and the Caribbean, the average index was 41,26, the third lowest globally after the Middle East and North Africa, and nearly half of the index obtained in North America, which had the highest index (82,94).

Among the Latin American countries with higher indexes are **Chile, Brazil, Colombia, Uruguay, Argentina, Peru, and Mexico**, all of which surpass the global average of 44.61. In the Caribbean, **Barbados** has the highest index (39,53). Analyzing the data at a regional level, the most notable aspect is **the level of disparity between countries. For example, Chile has an index of 62.52 compared to Nicaragua, which has less than half (28.33).**¹²

To further analyze the preceding data and the progress of AI in healthcare in the region, experiences of countries were explored according to the 6 pillars proposed by the tool developed by the Program for Appropriate Technology in Health (PATH)¹³, which measures the maturity level of AI in Health: People and workforce; Data and technology; Governance and regulation; Design and processes; Partnership and stakeholders; and Business models. Each pillar has criteria⁷ that will be used to describe the situation in the region.

People and workforce: emphasizes the prioritization of AI and data science in university education and post-university training.⁷ The Inter-American Development Bank (IDB) observed that more than 96% of the leading universities in the region offer AI-related programs that are not specifically linked to healthcare¹⁴. **Regarding healthcare programs, although some computer science courses are included in undergraduate education, artificial intelligence is not specifically addressed.**^{15,16} However, there are some noteworthy cases in postgraduate education. Various universities in Brazil, such as the Federal University of Rio Grande do Norte (UFRN)¹⁷ and the University of Sao Paulo¹⁸, as well as online platforms like evoluxIA¹⁹, offer AI training programs for healthcare professionals. There are also a few medical residencies such as the Medical Informatics residency at the Italian Hospital of Buenos Aires in Argentina²⁰, but AI master's programs are mainly directed towards computer science or systems engineering careers.

A survey conducted by the Laboratory of Technological Innovation in Public Health at the Faculty of Medicine of the University of Buenos Aires in Argentina showed that **most of the educational efforts in digital health are focused on the implementation of health information systems.** They have initiated a project focused on learning Data Science with a practical training methodology based on solving real-world problems.²¹

Data and Technology: requires countries to prioritize a robust technological architecture, access to quality data, data security and privacy layers, interoperability, and equitable, transparent, and explainable AI models.⁷ In the measurement of the AI Readiness Index, the technology sector pillar in the region has not yet become competitive, despite the inclusion of startup creation and investment in technology and health governance driven by the COVID-19 pandemic.¹¹

Additionally, the IDB measured the infrastructure and connectivity of each country by calculating the average percentage of the World Bank's Digital Adoption Index and the World Economic Forum's



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Network Readiness Index (NRI) and determined 4 levels: "leader" (>90%), "very advanced" (80-89%); "advanced" (70-79%), and "semi-advanced" (60-69%). According to this classification, **Chile and Uruguay are leaders in infrastructure and connectivity, followed by Argentina, Brazil, Colombia, and Costa Rica, which fall into the "very advanced" category. Mexico, Peru, and Trinidad and Tobago were categorized as "advanced," and finally, Ecuador, Paraguay, and the Dominican Republic as "semi-advanced."**¹⁴

Governance and Regulation: includes leadership to establish strong governance structures and regulations that ensure innovation of AI focused on health priorities.⁷ According to the AI Readiness Index, **Latin America and the Caribbean (LAC) show better development in the "Government" pillar compared to other pillars**, especially in the "Vision" dimension, due to the creation of strategies and policies around AI and the incorporation of initiatives sensitive to development and programs seeking the social impact of AI.¹¹ **Colombia and Uruguay are leaders in this pillar according to Oxford Insights. However, several countries in LAC, such as Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Uruguay, have a national AI strategy, according to the Organization for Economic Cooperation and Development (OECD).**^{22,23} **On the contrary, in the Caribbean, notable efforts to create a conducive ecosystem for implementing AI have been led by international and external initiatives rather than governments.**¹¹

Design and Processes: focuses on incorporating AI solutions into healthcare systems and clinical workflows, performance models and metrics, and solution localization. In the region, some solutions driven by the COVID-19 pandemic have been observed, such as the integration of an AI algorithm into the patient care pathway for suspected COVID-19 cases to detect lung consolidations in chest X-ray images at the British Hospital in Buenos Aires, Argentina.²⁴ In Peru, the Ministry of Development and Social Inclusion (MIDIS) and the Cayetano Heredia University developed an application called AnemiaApp for intervention in the flow of anemia detection in remote areas. The app allows for the interpretation of digital images of the person's eye, analyzes the characteristics of the membrane covering the outer surface, and determines the level of hemoglobin using algorithms based on neural networks.¹⁴

Partnership and Stakeholders: indicates strategic and purpose-driven partnerships that generate agreements for the use of diverse data and avoid fragmentation.⁷ In this aspect, the region has various private experiences of entrepreneurship and investment in infrastructure, as well as some public experiences involving stakeholders.¹⁴ However, **no structured or coordinated collaborations involving all actors, including the government, were found.** Additionally, no country has a strategy, commitment, or agreement that promotes a joint vision and common approach to AI within its territory.²² However, the Electronic Government Network of Latin America and the Caribbean (Red GEALC) exists to facilitate information sharing among member countries regarding the development of national digital government strategies, allowing for horizontal cooperation.²²

Business Models: requires countries to focus on financing resources, incentives, sustainable financing, pricing models, and other forms of innovative monetization.⁷ In Latin America, there are government



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funding programs such as the experience in Peru with the "Innovate Peru" program, which co-finances business innovation and entrepreneurship projects, including those related to AI in healthcare. External funding for entrepreneurs also exists, such as Microsoft's program that funds AI for health projects.¹⁴ Additionally, **entrepreneurs are using new business models that aim to produce social impact and achieve financial self-sustainability to expand their operations.**²²

In this diverse and varied scenario, the Pan American Health Organization (PAHO) warns that more vulnerable countries may face difficulties in implementing a sustainable, regulated, and needs-aligned AI strategy in healthcare. This is mainly due to **resource scarcity, lack of a favorable ecosystem, fragmented and segmented healthcare systems, complexity and lack of transparency in procurement processes, and a lack of multidisciplinary training and education.**²⁵

These are challenges that countries in the region should clearly identify in order to incorporate solutions with a local perspective, aiming to make progress in reducing existing health equity gaps.

The analysis of artificial intelligence in Latin America and the Caribbean, based on the reviewed information and considering the criteria for each pillar and the levels of AI maturity in healthcare described by PATH, reveals that the pillars of "people and workforce," "data and technology," "governance and regulation," "design and processes," "partnership and stakeholders," and "business models" are at an exploratory level. Despite this, the pillars of "data and technology" and "governance and regulation" stand out in their development. All pillars require greater attention and strengthening to promote a comprehensive AI ecosystem in the region



6. Experiences of AI in Healthcare

As observed in the preceding sections and through different examples, the implementation of AI tools has progressed simultaneously but in a disjointed manner across the three levels of healthcare management:²⁶

Macro-management corresponds to the intervention measures adopted by the government to regulate all stakeholders involved in the healthcare sector. It takes the form of public health policies and expresses the government's position on financing models, service delivery, market regulation, and addressing health determinants comprehensively.

Meso-management focuses on coordinating specialized healthcare facilities. It involves the coordination among various centers, hospitals, and other healthcare establishments. The goal is to achieve national health objectives through effective coordination and collaboration.

Micro-management or clinical management pertains to the tasks carried out within healthcare services. It involves the efforts of healthcare professionals to provide more precise diagnoses and efficient care processes.

To delve into the exploration of the use and implementation of AI tools in healthcare, different experiences at the regional and global levels will be analyzed in the three mentioned levels, as well as in clinical research and education. This not only allows us to observe how these advancements have developed retrospectively but also identify future opportunities. Experiences related to the fields of **clinical research** and **healthcare education** will also be included.

For this purpose, a search was conducted on Google using keywords such as "AI in macro-healthcare management," "AI in meso-healthcare management," "AI in micro-healthcare management," "AI in clinical research," "AI in preclinical research," "AI in healthcare education," and "AI in public health." The search was also replicated in the English language to identify AI experiences in each of these levels of healthcare management.

6.1. Macro-management or Health Policy

One of the potential applications of AI in macro-management is in the monitoring and prediction of infectious disease outbreaks, as well as in the reduction and control of non-communicable diseases in the population. Healthcare systems can also leverage AI tools to achieve greater efficiency in administrative tasks, such as using maintenance data to predict equipment failures and request budgets or using natural language processing to extract data from reports and automatically fill in registration forms, which could reduce labor costs.²⁷



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At a global level, AI tools have been successfully used to predict disease outbreaks, such as cholera in Haiti in 2010²⁸ and dengue fever in Pakistan in 2013²⁹, as well as to manage the COVID-19 pandemic.²⁸ These tools have also been applied to prevent and monitor non-communicable diseases such as diabetes and hypertension, leading to more efficient healthcare management for the population.²⁷ A particular use case is the management of administrative tasks in certain African countries such as Sierra Leone, Tanzania, Mozambique, and Nigeria, through a tool called Macro-eyes developed by a company in the United States. This tool predicts medication consumption levels and provides recommendations to prevent stockouts.³¹

In Latin America and the Caribbean (LAC), numerous initiatives were developed during the recent COVID-19 pandemic to aid in real-time monitoring and predictions of the disease's progression.³² The Institute for Clinical Effectiveness and Health Policy (IECS) created a customizable open-source tool used to predict the impact of COVID-19 expansion on the preparedness of health systems in different countries in the region. The tool aims to estimate the transmission dynamics of COVID-19 and the preparedness and response capacity of health systems, providing decision support for policymakers.³³ While this tool does not use AI, it is an example of data-driven decision-making relevant to macro-management. Among the notable experiences that used AI in this area, Cuba stands out with the Technical Group for Modeling and Epidemiology for the Confrontation of COVID-19, responsible for managing the health crisis. This technical group used artificial intelligence to monitor and analyze real-time data, creating the Covid19CubaData platform, which contributed to decision-making and response efforts during the pandemic.³⁴ Similarly, in Colombia, an AI model was developed to predict COVID-19 diagnoses based on reported symptoms.³⁵ In Argentina, the Secretariat of Innovation and Digital Transformation of the Buenos Aires City Government developed an AI system called IATos, which uses neural networks to recommend COVID-19 testing based on the analysis of the patient's cough. The recommendation flow is integrated within "BOTI," a WhatsApp-based chatbot.³⁶

6.2. Meso-management or service management

At the meso-management level, **AI-based tools can also be used to optimize support processes in healthcare systems and operations involving inputs and services (such as efficient distribution of inputs, fraud detection, and reducing service waiting times), as well as healthcare processes.**³⁷ AI enables the identification of patterns in health data, which can help predict and prevent complications, improve the management of chronic diseases, the workload of healthcare professionals, and coordination among healthcare team members.

The application of AI-based systems for supply chain optimization in the healthcare sector has been widely researched and can have a positive impact on the efficiency and quality of healthcare processes.³⁸ Additionally, AI has proven to be a useful tool for assisting in the diagnosis and management of diseases in various areas of medicine, such as dermatology, immunology, pulmonology, and oncology.



At a global level, **AI usage for diagnosis** is particularly notable in the field of oncology. In South Korea, it has been used to early predict certain types of colon cancer that require more specific therapies.³⁹ Similar experiences can be observed in the United States for predicting other tumor pathologies such as breast cancer,⁴⁰ and even predicting the likelihood of an acute myocardial infarction based on the analysis of an electrocardiogram.⁴¹

Regarding its use for **process improvement**, in Argentina, for example, Wúru developed an application called Magic Calendar that optimizes resource management and operational processes in the operating room area.⁴²

Furthermore, digital transformation in healthcare has allowed for the integration of technologies such as machine learning and advanced analytics to **enhance healthcare**. Citing a few examples from the region, in the city of Pelotas, Brazil, different algorithms were used to predict the demand for emergency medical services,⁴³ while in Chile, AI models were employed for professional schedule management in three regional hospitals, resulting in a 20% reduction in patient absences.⁴⁴

6.3. Clinical micro-management or clinical management

In the field of diagnostic imaging, AI can be highly valuable in improving the accuracy and speed of diagnosis, especially in diseases such as cancer and heart disease. AI facilitates the analysis of large datasets of medical images and assists in identifying diseases at an early stage.²⁶

Furthermore, AI has the potential to enhance the patient experience through tools like Symptoms Checkers, which utilize AI algorithms to help patients identify their symptoms and provide treatment recommendations. A notable example is Wysa,⁴⁵ a company founded in India that applies this technology in the field of mental health, offering emotional support through an AI-based chatbot. In a similar vein, Vitalk⁴⁶ in Brazil provides mental health monitoring and emotional therapy. Through a combination of knowledge-based natural language processing and machine learning, the chatbot can guide patients in simple behavioral therapy exercises and raise alerts about more serious issues or suggest that the patient see a doctor.

On another note, in Argentina, the company Entelai⁴⁷ has developed a program that analyzes images within the medical reporting system. The program was designed to address the problem of workload overload for imaging specialists. For such cases, the company developed a solution called EntelaiPic, which allows the specialist to not only view the MRI or mammogram but also provide a preliminary report indicating which area requires attention and highlighting the presence of lesions in the MRI. Furthermore, amidst the pandemic, Entelai leveraged this system to develop the EntelaiPic Covid-19 tool, which enables the accurate and rapid analysis of a vast number of chest radiographs to detect pneumonia or lung infections through the analysis of thousands of images.

Among other examples in the region, TeleDx⁴⁸ stands out in Chile, which has developed a software system called DART that utilizes AI to detect and prevent diabetic retinopathy, the fastest-growing cause



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of blindness worldwide. Trained technicians capture specialized digital images of the eye and input them into DART, which employs machine learning to search for diabetic retinopathy.

Furthermore, in other areas such as pulmonology, neural networks have been employed to classify asthma and provide timely treatments.⁴⁹

These tools have the potential to improve the accessibility and effectiveness of healthcare, especially in remote areas or those with limited resources.

6.4. Clinical and Preclinical Research Experiences

The process of drug research and development is long, costly, and complex, often taking over a decade from the identification of molecular targets to approval and commercialization of the final product. Given that the majority of drug candidates in development do not reach the market, innovation in this field is difficult and expensive. Additionally, there are increasing regulatory complexities and difficulties in finding molecules that are significantly better than existing products on the market.

Artificial intelligence has the potential to transform many key steps in clinical trials, from protocol design to study execution, thereby improving trial success rates and reducing the research and development burden in biotechnology and pharmaceutical industries. Specifically, AI technologies can provide vital assistance by automatically extracting meaningful information from electronic health records (EHRs) and other sources of unstructured data to identify participants with matching criteria. This can help both patients and physicians understand and evaluate eligibility for a specific trial. Moreover, AI can aid in protocol design by making predictions about the risk of resource wastage, which may lead to early termination of the clinical trial.⁵⁰

Within preclinical research, AlphaFold is a notable success story. This development began at University College London, where researchers aimed to use an AI model to predict the three-dimensional structure of proteins from their amino acid sequences. The AlphaFold 1 and AlphaFold 2 versions achieved first place in the Critical Assessment of Techniques for Protein Structure Prediction (CASP) competitions, a global experiment held every two years to predict protein structure, in 2018 and 2020, respectively. This breakthrough has significant implications for the selection of candidate molecules and the development of targeted therapies for diseases, leading to higher success rates and reduced waste.⁵¹

Indeed, Cuba has been implementing data mining techniques in clinical research to improve primary healthcare. The digitization and automation of processes have generated large volumes of information, and data mining enables the discovery of relevant and non-trivial information within the stored data.⁵²



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6.5. Experiences in Health Education

In the context of health education, few use cases have been found in the region where **artificial intelligence allows for the automation and optimization of pedagogical and educational processes. One notable use case is the application of AI in clinical simulation.** In Spain, for the training of urological surgeries, artificial intelligence models are used in procedure simulation to optimize the learning and training of surgeons.⁵³

This becomes even more relevant when it is observed that, according to a survey, undergraduate students agree that acquiring knowledge of AI during their education is important.⁵⁴



7. Conclusions

The advancement of AI in healthcare in the region can be considered **exploratory** in terms of maturity. **Heterogeneity and fragmentation prevail, with the majority of projects being individual and providing specific solutions at the meso and especially micro-management levels. Furthermore, the lack of implementation of regulations** presents a challenging landscape where barriers and factors that could facilitate integration with the healthcare system can be identified.

In this regard, the main barriers to the development of AI in healthcare identified in the region are, in general terms, **the absence of AI governance, implemented regulations that involve all stakeholders, implementation of electronic health records, programs that drive technological development, designated budget for AI, trained personnel, and research on the application of AI in healthcare.**

Figure 3. Degree of maturity of AI in LAC according to each analyzed pillar.

PILLARS	EXPLORATORY	EMERGING	INTEGRATED ECOSYSTEM
PEOPLE AND WORKFORCE	X		
DATA AND TECHNOLOGY	X		
GOVERNANCE AND REGULATION	X		
DESIGN AND PROCESSES	X		
BUSINESS MODELS	X		

Source: Own Elaboration

However, factors that can facilitate the implementation of AI in healthcare have also been identified, such as the **growing interest and investment in AI by healthcare providers and technology companies.** Additionally, the importance of **addressing the issue of AI education in the healthcare sector** has been discussed to enable professionals in the field to harness the full potential of this technology. **The need to promote research in AI in healthcare to develop innovative solutions that can improve medical care and patients' quality of life** has also been highlighted. In this regard, the emergence of **ChatGPT** represents a promising tool that could collaboratively support the healthcare system by providing solutions for education, research, and healthcare assistance.

In general, it is concluded that AI in healthcare in Latin America and the Caribbean is in an early stage of maturity, and there are still numerous challenges to overcome for its consolidation. These challenges represent opportunities for improvement and areas where efforts can be focused. The implementation of AI solutions in various levels of management, education, and research will require collaboration from



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all stakeholders and the adoption of policies and regulations that facilitate integration and sustainable development of this technology in the region.

This document represents an approach to analyzing the maturity of AI in healthcare and regional experiences, marking the beginning of subsequent assessments to determine the level of maturity in each country of LAC. This information will enable informed decision-making regarding the next steps in the roadmap for implementing AI in healthcare and achieving an integrated ecosystem.



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