Chapter 4

The Impact of Artificial Intelligence Applications in Health on Brazilian Public Policies

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The way how machines can carry out some functions more productively than people allows us to understand the exponential growth of the technology market involving automation. On the other hand, the amount of available health data grows every day, whether obtained by wearable devices, medical imaging equipment, or medical records. Therefore, this work intends to address the applications of Artificial Intelligence in health and how it can contribute to health management with the help of ongoing digital transformation, exploring a brief approach to the use of technology in hospitals as a trend to promote social well-being and eliminate waste.

4.1 Introduction

The 21st century can be considered as the century of information and communication technology, when data travel at high speeds connecting and processing thousands of groups and, consequently, dictating the pace of modern life. The facilities and services that allow quality of life are so many that it is difficult to imagine the future without them [1, 2].

After all, the Internet, Internet of Things (IoT) devices, and the evolution of electronic devices such as processors and high-performance memories are being the main protagonists in this scientific and technological revolution [3, 4]. The numerous IoT applications have potential in the environmental, industrial, public/private, medical, transportation, etc (4.1). From the perspective of private users, health, e-learning, and home automation are the main fields. In the view of business users, automation, logistics, and industrial manufacturing are the important domains [5, 2].

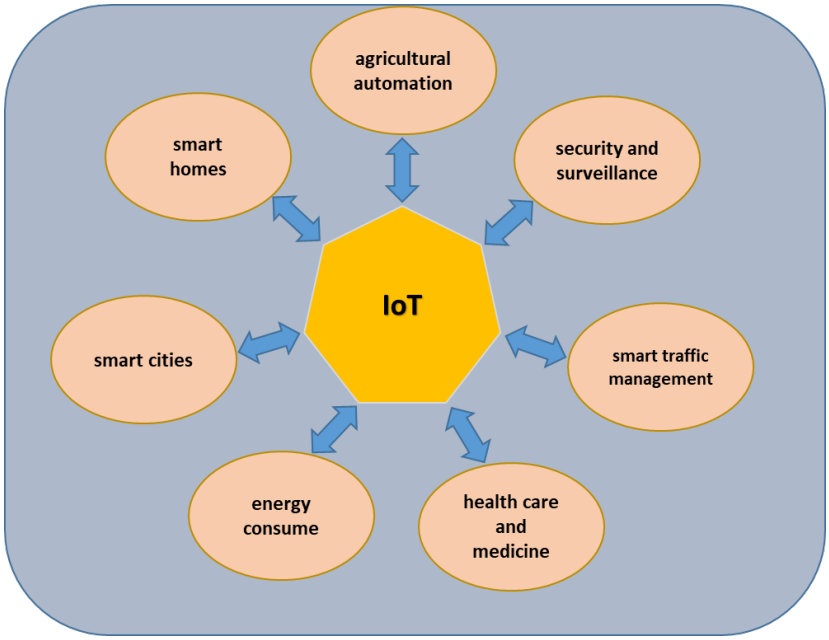

Figure 4.1: IoT applications.

Therefore, this large mass of data would be responsible, with the help of information and communication technology, to collect, store, process, and extract information that would be used in understanding the globalized world [6, 7].

And through the understanding of cities, foreign trade, diseases, and financial market, among others, provide greater efficiency and competitive advantage to industrial organizations, retail activities, services and entertainment, and governments, in addition, of course, to health and scientific research [8, 9].

In this sense, Artificial Intelligence (AI) is the ability demonstrated by machines to perform complex tasks associated with intelligent beings, in addition to being an academic field of study, it has its main objective achieved by performing functions autonomously and quickly [10, 11].

It is possible to consider some basic characteristics of these systems, such as:

- Reasoning Ability: applying logical rules to a set of available data to conclude;
- Learning: learn from mistakes and successes so that you can act more effectively in the future;
- Pattern recognition: both visual and sensory patterns, as well as behavioral patterns;
- Inference: the ability to be able to apply reasoning in our everyday situations.

Despite the numerous benefits and applications to be explored, it is only recently, with the emergence of the modern computer, that AI gained space to establish itself as a science, with its problems and methodologies [12, 13, 14].

Since then, its development has extrapolated the classic chess or conversion programs and involved areas such as computer vision, voice analysis and synthesis, fuzzy logic, artificial neural networks, and many others. Initially, AI models aimed to reproduce human

thinking [9, 15], however, such models embraced the idea of reproducing human faculties such as creativity, self-improvement, and language use, making the concept of artificial intelligence quite difficult to define. For this reason, Artificial Intelligence is a notion that has multiple interpretations whose objective is to build systems that exhibit intelligent behavior and perform tasks and decision-making with reliable levels of acceptance or higher than expert levels [11, 16].

When technology is employed correctly, industrial organizations, retail activities, services, and governments become more efficient, which means higher profits and lower costs [14, 17].

The way how machines can carry out some functions more productively than people allows us to understand the exponential growth of the technology market involving automation. However, AI is seen as a complement to improve – and not replace – the human being [18, 19].

For example, biomedical engineering, which is a branch of engineering aimed at the integration of exact sciences and health sciences, where a new approach is given in the field of biology and medicine. Therefore, it is responsible for creating technologies and software to help medicine, biomedicine, and dentistry [20, 21].

The amount of health data available grows every day, whether obtained by wearable devices, medical imaging equipment, or electronic medical records. Thus, Artificial Intelligence emerges as a tool capable of transforming this data into information, expanding the possibilities of treatment, diagnosis, and disease prevention for patients, in addition to contributing to the work of health professionals [22, 23, 24].

In this work, applications of AI in health will be addressed: 1- An approach to how AI can contribute to health management with the help of the ongoing digital transformation; 2- A brief approach to the use of technology in hospitals as a tendency to promote social well-being and eliminate waste; 3- Describe the benefits that AI and emerging technologies such as Big Data and IoT can contribute through data collection for decision-making and support for public policies and scientific research for new drugs; 4- All this access to the volume of information can bring serious threats to public order, mainly to the grouping of large capitalist groups and the formation of cartels; 5- Finally, we address the final considerations [25, 26, 27].

4.2 Health Management and Digital Transformation: A Contextual Approach in Brazil

As mentioned earlier, technology is a trend in society, and it would not be different for hospitals. It is a differential that promotes saving lives, eliminating waste, and providing a great revolution in society. Modern trends in the development of society such as population growth, increased longevity, development of medical technologies, and digitalization of business require the adaptation of services offered by health organizations [18, 28].

Leading corporations in the consulting industry point out that these Hospitals are not only being used to improve the delivery of care within the building but also to connect and contribute to a broader ecosystem of healthcare delivery [29]. Hospitals can offer more personalized care and improve customer engagement and patient experience. Using digital

solutions to support the patient, through any channel, including apps, patient portals, and digital information kits [30].

In its 2019 report, "Global health care outlook: Shaping the future" the consultancy Deloitte, pointed out that in 2022, the world cost of health and medical care would be in the order of USD 10.06 trillion [31, 32]. Considering the divergence between the growth of family income and health costs in Brazil as a specific fact in the recent history of the country, given Technical Note 54: Inflation of Health Plans – 2000-2018 (NT-54), issued by the Institute of Applied Economic Research suggests an even more worrying scenario [20, 32]. The egalitarian nature of the Brazilian Unified Health System means that the current 209.3 million Brazilians served by the system represent approximately BRL 1.61 in costs for the "public coffers" per day [33, 34, 35].

According to World Bank data, in 2015, public spending on health in Brazil was equivalent to 3.8% of GDP, which placed the country in the 64th percentile of world distribution (considering 183 countries), slightly higher than the average for Latin America and the Caribbean, 3.6%. The Public Budget of the Union for the 2019 Financial Year, sanctioned by the Presidency of the Republic and published in the Official Gazette of the Union on January 16, 2019, through Law 13808/19 allocated 4.17% of the federal budget to the area of health, just as an illustration, the area of public security received a meager 0.39%. Developed countries, in turn, apply proportionately more resources to health (on average, 6.5% of GDP), although they also serve a population with an older age structure compared to the Brazilian case. In 2015, the percentage of elderly people (over 65 years old) in OECD countries was 16.2%, while in Brazil it was 8.0%. Already in 2027, the Brazilian Institute of Geography and Statistics projects that the elderly will correspond to 12.3% of the Brazilian population [1, 21, 36]. Thus, the aging process of the Brazilian population tends to increase future health expenditures [37]. Despite all this investment, diseases such as measles, epilepsy, and appendicitis, all with known prevention and treatment methods, still lead to thousands of deaths every year in the country [38].

4.3 Smart Hospitals

The concept of a Smart Hospital is based on optimized and automated processes, with a focus on improving existing procedures and implementing new opportunities for treatment and patient care. [31]

What makes a Hospital Smart is the availability and use of significantly interconnected systems, which can significantly affect objectives depending on the type and extent of use of technologies, as shown in Figure 4.2.

Smart hospitals are present in the United States of America with about 30% of hospitals classified in the Health Information and Management System Society (HIMSS), which is an electronic medical record adoption model that indicates the use of electronic medical records of health in a more sophisticated way [39].

The advancement of the fourth technological revolution and its technologies has in health a privileged space for development and interaction, bringing enormous threats and potentialities [40]. Digitization and connectivity between people and things, artificial intelligence, use of large databases (big data), and internet of things (IoT), among others, form a block of

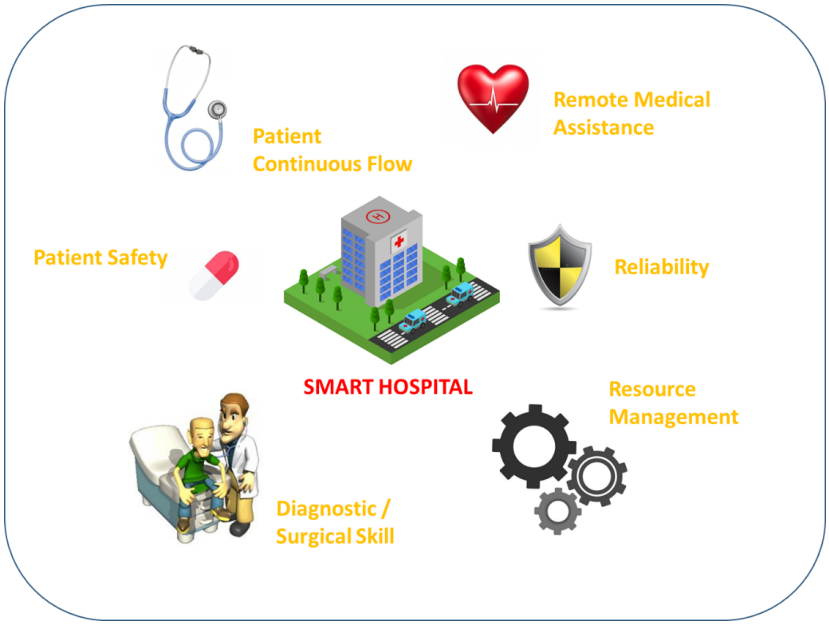

Figure 4.2: Smart hospital approach.

innovations with enormous potential to revolutionize the technical bases of capitalism, with the intense movement of automation based on the use of networks of intelligent machines [41].

Additionally, it becomes necessary to understand the technologies, impacts, and challenges of this new change, since this breadth makes it a technological, economic, political, and social revolution [42, 43].

4.4 Epidemiological Surveillance and Open Data Sources

The idea of Open Government Data is an initiative that promotes the publication of public government data and information in reusable formats to increase transparency and foster greater political participation on the part of the citizen [44]. In this sense, the Open Data movement (open data) emerged to provide more transparency in the dissemination of data and encourage its reuse, which is important, as it can reduce the need for rework [44]. Currently, there is an important non-profit foundation called Open Knowledge International, whose objective is to encourage the use of open data in society [45].

In this context, Epidemiological Surveillance (ES) uses these data to study the health-disease process and develop public health policies, which improve the lives of the population, with information being its main object of work [45]. This approach is important because it considers the potential of using open data to influence the construction of new concepts, information, and projects since, depending on the scope, they can provide new investments, both in public and private institutions that seek to transform them into something beneficial to society [46].

In Brazil, the government has an institutional repository called DATASUS, under the responsibility of the Ministry of Health, which receives data from a Health Information System

network [46]. DATASUS is housed in the Department of Informatics of the Unified Health System, and its task is to systematize, consolidate and disseminate the information produced collectively, through electronic data transfer, producing operational and/or epidemiological indicators [47].

The indicators produced are essential, as they reveal the scenario in which health is inserted and the health conditions of the population, in addition to contributing to the creation of public health policies, since the indicators can also contribute to the cycle of public policies, being in its stage of formation of the agenda, monitoring or evaluation [48, 49].

4.5 Protection of Data and Privacy Related to Health

Considering health as an essential service for a dignified life, it is necessary to promote a discussion about the most used technological innovations, to strengthen a preventive approach, through awareness and adoption of healthy habits, improvement of the patient's clinical status, preventing complications, diagnosing a problem early and reducing costs with unnecessary procedures are important. However, it is necessary to observe some precautions regarding data availability, as well as its classification [50].

After the digitization and computerization of the systems that move the world, as well as interpersonal relationships, the issue of privacy and data protection has taken on a prominent place. With the advancement of technology, a plethora of data about us is generated daily. Our habits, routes, preferences, purchase history, medical history, and even vital signs are collected and stored. This immense amount of information, called big data, is what feeds the artificial intelligence algorithms responsible for analyzing us, understanding us, and even predicting actions and manipulating us [51].

In the health area, as seen, data have different purposes. "Data is typically used to better serve customers, improve transaction efficiency and product quality, as well as to identify macro trends" [52]. Information has given personal data importance in terms of economic value and, therefore, is the substrate for the behavioral analysis of life habits, consumption habits, as well as various other information, of a population. Allowing the analysis of patterns, preferences, and consumption, among others.

In hospitals, in everyday life, and also in business, this information is generated at all times, when a doctor fills out an electronic medical record, when a patient buys a medicine at the pharmacy, or when an athlete uses a wearable to monitor vital data during a physical activity, among several other activities. This data can be used in various situations, for example, to feed artificial intelligence algorithms that allow the construction of clinical decision support systems, i.e., they interpret patterns from a colossal amount of information and help the physician in decision-making. But they can also be used by health plans to help identify potentially costly clients, patients who statistically consume more than they contribute to the service, which can cause health plans to stop accepting patients with this profile or increase their monthly fees, aiming at maximum profit.

The health sector has always needed to be aware of personal data and sensitive personal data related to health since there is no way to think about health care without having access to the person's data. Likewise, data is needed for the investigation of new health solutions, such as new drugs, medical devices, better treatments, and more assertive diagnoses.

One of the most important documents for understanding a patient's health is the medical record. In this document, the doctor describes the anamnesis, physical examination, laboratory and/or imaging tests, diagnostic hypotheses, conduct, treatment evolution, as well as other information aimed at diagnosing and treating a particular disease. All these sets of data and information are essential for the physician's work, and through them, it is possible to develop clinical reasoning about a given case [53].

Within this perspective, the current trend is to understand the human body as a large data file, a great source of information and resources for the market. In this system, they can be understood as a form of capital, in addition to a simple commodity [54]. The collection is necessary for competition between capitalist groups and becomes driven by the perpetual cycle of capital accumulation [55]. Therefore, the data is extremely profitable and can be used for the most diverse purposes. And, like capital, not all data are equal or have the same purposes, which is why there are data with different values [56].

4.6 Final Considerations

New technologies in health services can offer quality assistance, with diagnostic and therapeutic resources that facilitate the decision-making process, being a hope for controlling a large amount of clinical and research information, which can save valuable time.

Monitoring technologies based on patents is one of the methods for carrying out a prospective study, in which its results, generally quantitative, can be used in decision-making processes, taking into account the qualitative evaluations of specialists [57].

Among the gains that are expected from the use of the Internet of Things in the health sector, there is the projection that this sector will be the third most impacted in the world, with an economic gain of USD 0.2 trillion to USD 1.5 trillion. In Brazil, the Internet of Things in the health sector could generate a gain of USD 5 billion to USD 39 billion by 2025 [58].

According to the above, the Internet of Things and artificial intelligence need data to operate, and health data is the fuel that drives this process. Health data, which make up big data, are the substrate for algorithms used in artificial intelligence which are applied in the medical field to guide decision-making and are also useful in pharmaceutical research for the commercialization and/or investigation of a new drug, in the performance analysis of a health establishment, and in epidemiological studies, among other possibilities elucidated previously.

The health market is vast and lucrative, innovations in the sector involve a few thousand dollars. In 2017 there were more than 165,000 applications available for cell phones, whose solutions involve health in the digital environment [59]. Thus, it can be concluded that we are facing an extremely profitable sector and the health data, necessary for this gear to keep turning, is just as valuable. In addition, health data can be used for other purposes and sold for purposes other than care or innovative treatments.

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