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## Abstract

The modernization of health institutions is one of the biggest trends of our time. Part of the 4th industrial revolution, the Internet of Things, that allows a more personalized care and greater appreciation for the patient, can be a reality that is in the process of being consolidated worldwide. In Brazil, through the promulgation of decree number 9.854 of June 26th of 2019, the democratization and popularization of these technologies have started. This integrative review intends to verify the introduction of IoTs in the Brazilian scenario by investigating the potential as well as the weaknesses of this new technology. The research suggests that IoTs are a unique content that may improve productivity and process efficiencies but are still permeated by caveats that indicate system deficiencies and the need of further studies.

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# Health management trends: The Internet of Things as a modernization and care tool

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## Abstract

*The modernization of health institutions is one of the biggest trends of our time. Part of the 4th industrial revolution, the Internet of Things, that allows a more personalized care and greater appreciation for the patient, can be a reality that is in the process of being consolidated worldwide. In Brazil, through the promulgation of decree number 9.854 of June 26th of 2019, the democratization and popularization of these technologies have started. This integrative review intends to verify the introduction of IoTs in the Brazilian scenario by investigating the potential as well as the weaknesses of this new technology. The research suggests that IoTs are a unique content that may improve productivity and process efficiencies but are still permeated by caveats that indicate system deficiencies and the need of further studies.*

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## 1. Introduction

Nowadays, the use of information and communication technologies (ICT) is being establish and expanding. Increasingly, people are seized by a technological spirit that makes them connected most of the time. All of these gadgets and devices are essentially connected to a network that allows them to exchange and receive information. In health, the inclusion of information and communication technologies (ICT) is something that has been used by managers of large and small institutions. As such, their use not only allows an improvement in the services offered, but also makes them more effective and efficient, as well as providing higher quality processes and less patient wear (Barbosa, 2018).

In addition, information and communication technologies and the emergence of new media have enabled

the development of smart cities concept, which have occupied more space in the society. Performance indicators and these technologies were commonly referred to as a knowledge-based social capital, which broadly served to denote what can be achieved through communication tools and networks derived from a social network individual or social unit.

The Internet of Things concept was introduced by information and communication technologies, which is a technological paradigm that interconnects the physical and digital worlds, in a way that creates an informational space, where people's perceptions of the scenery around them are broadened and connected. In the conceptualization of IoTs, intelligent individuals and objects are hyperconnected on the Internet in any environment at all times, producing and consuming information that they are able to communicate with each other (Rozsa, Dutra, Pinto, & Muriel-Torrado, 2017). As a ubiquitous technology, IoTs everywhere, will revolutionize the information access/availability and the automation of entire sectors of the economy and social life, based on machine-to-machine communication, such as logistics, agriculture, transportation of people, industrial production and more specifically in health. (Magrani, 2018).

Hyperconnectivity is a central term in IoTs, serving to designate the willingness of people to communicate at any time with each other, i.e, person-to-person (P2P), person and machine (human-to -machine, H2M) and machine-to-machine (M2M), which leads to a continuous flow of information and data creation. Thus, the greater the number of devices, the greater the data production capacity (Magrani, A internet das coisas, 2018).

This research aims to study, through an integrative literature review, how Brazilian society has been linked to IoTs and how it has spread in this context, thus discriminating the potentialities and vulnerabilities that such a system may entail.

## 2. Literature Review

IoTs have been climbing steps and gaining more acceptance and attention in the world context and market over the last decade. Thus, the IoT market is expected to grow from $ 591.7 billion in 2014 to $ 1.3 trillion by the end of 2019 (Verizon, 2017). To comprehend IoT growth, the lowest expected growth in 2025 is estimated at $ 4 trillion and a favorable estimate at $ 11 trillion (Mckinsey Global Institute, 2015).

IoTs have been progressing, becoming a powerful communication model, gathering more researchers around it in the present century (Wu T. , Wu, Redouté, & Yuce, 2017). By connecting numerous objects - such as sensors, vehicles, homes and appliances to the internet – and allowing the sharing of information, data and resources, they are providing a holistic monitoring that encompasses the most diverse content (Wu, Rüdiger, & Yuce, 2017).

In terms of health this means applying wireless sensors that can monitor even the patient's physiological conditions through devices attached to the body. This data can then be transmitted to a cloud that in turn is accessed by the end user or tool, which upon inspection of the user or the surrounding environment may provide physiological or environmental measures that will be taken care of the patient (Wu, Wu , & Yuce, 2018).

Wearable devices are generally employed to monitor physiological signals such as heart rate, respiratory rate, electrocardiography, body temperature, blood pressure and others. In addition, for medical

applications the area network (WBAN) can be used to monitor environmental conditions around the person. In this way, applications can provide useful information to deepen understanding of the patient's condition and the environment in which he lives, providing valuable information for in-depth gain and knowledge about the patient and the environment in which he lives (Antolín, Medrano, Calvo, & Pérez, 2017).

In Wu, Wu , & Yuce (2018), the authors demonstrate a network system with a wearable hybrid sensor that lends itself to monitoring environmental conditions such as temperature, humidity, solar ultraviolet (UV) overexposure, CO2 levels and vital signs, which are important in dealing with diseases such as skin cancer, eye disease, breathing problems and headaches. The objective of these sensors was to monitor and coach employees, which demonstrates the immense utility of IoT technologies in the care and prevention of possible diseases. It was also shown that they could promote data collection that allows their manager to have elements able to study about such admonitions.

With the advent of IoTs many applications have been proposed not only for disease monitoring, but also on prevention, revealing that such tools may become important in disease endeavors and even in some cases to prevent possible outbreaks. For example, smart watches are integrated with electrocardiogram (ECG), with temperature and oxygen saturation sensors in the blood, allowing for data collection such as blood pressure, glucose and temperature of people who can live in rural areas transmitted via LoRa (a long range, low power wireless protocol designed for use in building IoT networks) (Chen, Ma, Song, Lai, & Hu, 2016).

The IoTs scenario is recent - mainly in the health area – so the resulting hyper connectivity depends on a close relationship between intelligent objects (sensors), big data and computational intelligence, the so-called ABC of information technologies, and communication (analytics + big data + cloud computing) that underlie and structure IoTs. This triad is responsible for boosting and making health more independent and with possible expansion of daily care for patients and non-patients, who can use these sensors to manage a health (Magrani, 2018).

IoTs are probably one of the most modern contributions that technological and innovation tools are providing, however, many aspects still tend to be discussed and analyzed by professionals, researchers and especially the community that will be the main beneficiary or harmed. In this sense, this paper seeks to promote a reflective debate on the introduction of IoTs in the Brazilian scenario, considering the perspective elements and discernment between the opportunities that may come, as well as the weaknesses of their use. Investigating through scientific and literary production what its scope and diffusion have been like.

This work, in turn, is justified since IoTs are technologies that have been projected in the world scenario as something that can enable homecare as an important helper in health actions. Having an IoT participating in the health care system can expand care as well as reduce possible health costs. In addition to combining preventive measures in the formation of healthy habits.

## 3. Methodology

In this work, the adopted method was the integrative literature review. At first, the theme was defined and it was determined which descriptors would be used. In the case of this research the descriptive terms used were: Internet das Coisas e Brasil, Internet of Things and Health and Brazil and Internet of Things and

Healthcare and Brazil.

According to Souza (Souza, Silva, & Carvalho, 2008), the integrative literature review is a research method that provides the synthesis of knowledge and the incorporation of the applicability of results of significant studies in practice. For Botelho et al (Botelho, Cunha, & Macedo, 2014) the integrative review should be chosen when the synthesis and analysis of the scientific knowledge already produced on the investigated theme is to be performed and/or when it is intended to create information that will enable readers to evaluate the relevance of the procedures employed in the elaboration of the review.

Regarding the inclusion and exclusion criteria of the work: all texts that were of Brazilian origin, dealing with the IoT and health theme, and published between 2014 and 2019 were included. The ones not related to health in the Brazil in the scope of the study were excluded.

Databases such as Capes, LILACS, PUBMED, SciELo, PsyINFO e Google Scholar were used during the research.

Although Google Scholar is not a specialized database, it was chosen once it was possible to distinguish how publications on IoTs were being treated at a national level, as many articles in this area were made available in this database. By choosing Google Scholar, it was possible to notice that more articles available and recognize that the theme was widely used rather than what was indicated inPUBMED, LILaCS, SciElo, PsyINFO and Capes, where most of IoTs articles were not related to the health are, being related other sectors. The study was divided into three moments. The first, in which we researched and selected articles that contained the intended theme. In the second moment, the titles and keywords were read and those related to the area of interest were selected. In the third, the abstracts were read to verify the potential inclusion. And fourth, the full reading was performed to verify the inclusion or exclusion of articles in the review and was finalized with its analysis and categorization.

The research in several databases returned between 6 and 399 articles. One exception being Google Scholar who returned 2,230. It is noteworthy that, among all the works, most of them did not deal with topics related directly to IoT and health in Brazil, so that after extensive reading of titles and abstracts, 35 articles were marked. In addition, there was a considerable part that was duplicated in the various databases searched. Regarding Google Scholar, we chose the most relevant and closely linked to the subject of research.

## 4. Results

The direct results of the objective analysis allowed us to infer at first that the electronic media in its various databases have an large amount of articles related to IoT in Brazil, especially in Capes and Google Scholar, although many are from technical nature (not fitting the theme of this work) and that a considerable portion is repeating itself on the various bases, it is still a relatively large amount. However, the IoT + health + Brazil theme, in both Portuguese and English, returns few articles that really belong to this scope. The large amount of academic Google mostly refers to IoT technologies in non-medical private institutions, often the term health appears loose, having no relation to the proposed theme. So the articles could easily be distinguished from those that escaped the goal.

The flowchart of the article selection and selection process can be clearly seen in figure 1. This denotes the entire path taken to select the material.

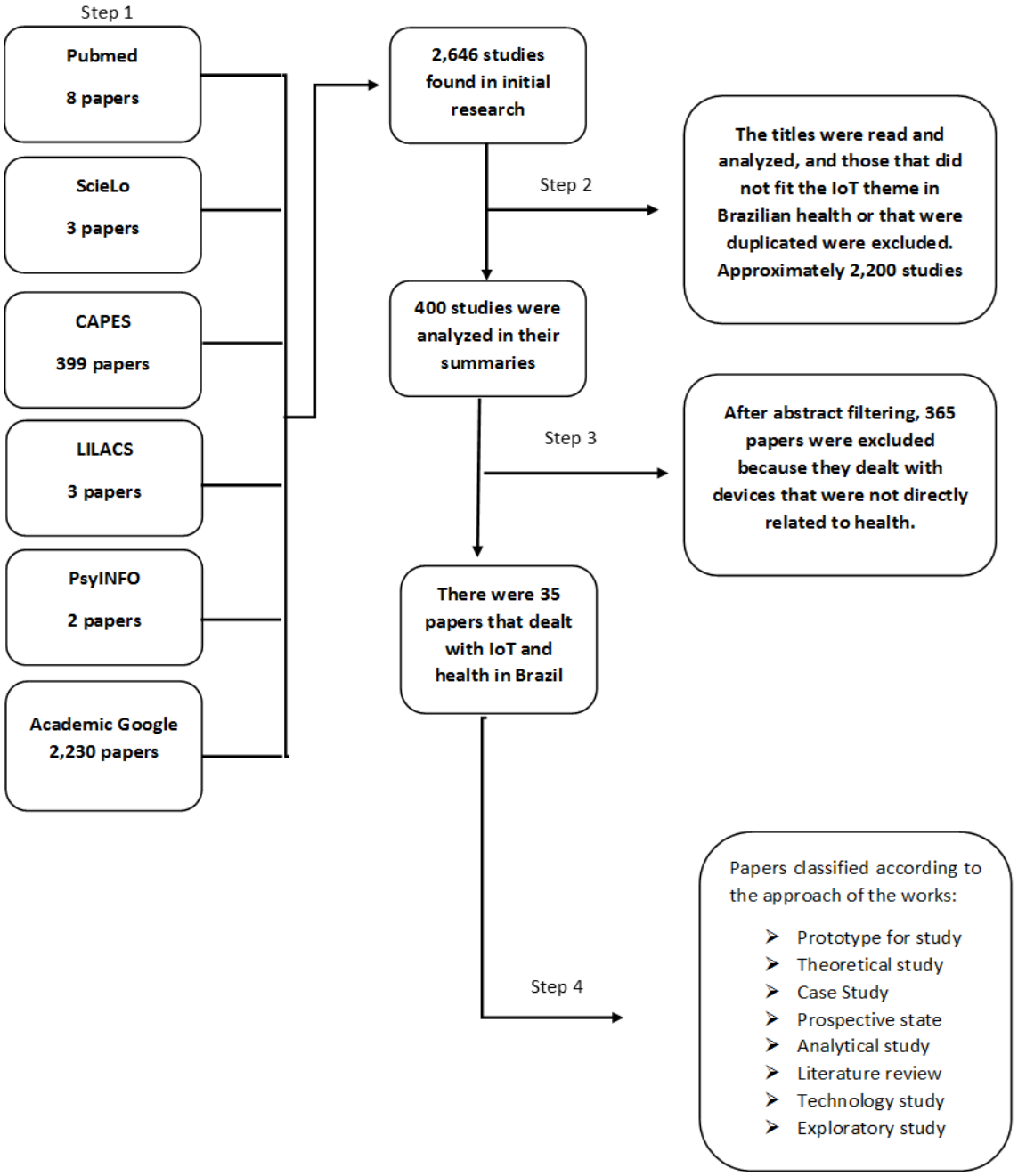


Figure 1: Job Selection Process Board. Prepared by the Authors (2019).

In table 1, we have the articles according to internet search sources. These data show that at the level of international database systems, there are still a small number of researchers sending the studies to be published with the IoT theme in Brazilian health. The database that obtained the most articles used was Google Scholar, which was expected due to the quantity of articles available. In second place was Pubmed, which was peculiar as this database provided only 8 articles and 7 of these were used, perhaps due to the fact that search engines are more effective. Capes presented 399 articles in total, being only 2 adequate for using once they were related to IoT in healthcare area in Brazil.

Table 1. Distribution of publications selected with bases in 2019 reference sources

| DATABASE AND SOURCE OF CONSULTATION | TEXTS RELATED TO THEMATIC | Selected publications | |
|---|---|---|---|
| | | (n) | (%) |
| SciELO | 3 | 0 | 0% |
| PUBMED | 8 | 7 | 20% |
| PsyINFO | 2 | 1 | 3% |
| Google Acadêmico | 2,230 | 24 | 68% |
| PERÍODICOS CAPES | 399 | 2 | 6% |
| LILACS | 3 | 1 | 3% |

Source: Prepared by the authors (2019).

It was also verified the origin of the articles, as the city and state. In the city with the most related articles is Rio de Janeiro, followed by São Paulo and São Leopoldo. When we gather by state, the one that presents the most articles on the IoT theme is the state of São Paulo with 10 articles associate with the subject and, secondly, we have Rio de Janeiro and Rio Grande do Sul tied with 6 each. This information can be seen in table 2.

Table 2. Distribution of articles according to bibliographic source 2019

| Research production city | Selected Articles | |
|---|---|---|
| | (n) | (%) |
| Belo Horizonte-MG | 1 | 3% |
| Bragança Paulista- SP | 1 | 3% |
| Brasília- DF | 2 | 6% |
| Campina Grande- PB | 1 | 3% |
| Campinas-SP | 1 | 3% |
| Caraúbas- RN | 1 | 3% |
| Florianopolis- SC | 1 | 3% |
| Fortaleza- CE | 3 | 8% |
| Imperatriz- MA | 1 | 3% |
| Mogi das Cruzes- SP | 1 | 3% |
| Natal- RN | 2 | 6% |
| Passo Fundo- RS | 1 | 3% |
| Porto Alegre- RS | 2 | 6% |
| Recife- PE | 1 | 3% |
| Rio de Janeiro- RJ | 6 | 17% |
| São José do Rio Preto – SP | 1 | 3% |
| São Leopoldo- RS | 3 | 8% |
| São Paulo- SP | 5 | 14% |
| Taguaritinga- SP | 1 | 3% |

| | | |
|---|---|---|
| Total | 35 | 100% |

Source: Prepared by the authors (2019).

According to table 3, the most used approach was the study of technologies developed for health, that is, studies aimed at the improvement of technologies such as software and devices and IoTs connections, for application in human care. In second place were the review studies, which give an overview of what is being produced in literary terms in the medical and health fields. In third place were the theoretical studies, which approach the technologies about a possible scope of applicability and diffusion. In fourth place were analytical studies, followed by prototypes for study. Finally, there were exploratory, prospective and particular case studies.

Table 3. Classification of articles according to the most used approach

| Approaches used | Number of Publications | Percentage |
|---|---|---|
| Literature review | 7 | 20% |
| Case Studies | 1 | 3% |
| Analytical studies | 5 | 14% |
| Prototype for study | 4 | 11% |
| Theoretical study | 6 | 17% |
| Prospective Study | 2 | 6% |
| Technology Study | 8 | 23% |
| Exploratory study | 2 | 6% |
| Total | 35 | 100% |

Source: Prepared by the authors (2019).

The verified articles presented a multitude of IoTs applications for health that directly interfere with their effectiveness and performance of their daily activities. The use of remote activity sensors and monitoring enables the user to continuously monitor their physical and physiological conditions and situations that could be considered inhospitable. Using IoTs for physiological data allows invasive measurements to be exchanged for more comfortable analyzes, as they can be performed at home. With sensors such as photoplethysmography it is possible to monitor patient conditions, such as pulse oximetry, continuous cardiorespiratory and cardiovascular information, and when compared to the electrocardiogram, it is not a complex hardware implementation and can be incorporated into wristbands (Moraes, et al., 2018). Sensors can also measure systolic blood pressure and associated with other variables determine the risk of hypertension, designing a healthier lifestyle (Santos & Albuquerque, 2019).

The wearable devices are used in order to accompany the patient, providing a more active and healthier life by providing data such as lifestyle, diet, weight, sleep, stress, etc. (Veiga, Rodrigues, Trevizan , Rebonatto, & Marchi, 2017). And it allows immunobiologicals to have their temperature recorded, tracked and monitored so that they are stored in such a way that there is no loss and preserve the quality of the material, as in the case of vaccines that have to be constantly closely monitored (Santos & Felisbino, 2018).

The literature also mentions the use to provide care and independence of the elderly, who due to age may

be affected by diseases and falls. This is used to avoid these situations by applying answers that offer greater security. The insertion of motion-capturing sensors such as the gyroscope and accelerometers make this concept a reality, and Machine Learning (which will be discussed later) prove to be effective in detecting. This proves that people can have their own individual health care system (Mano, Volpato, Funes, & Torres Neto, 2016).

Some studies also use IoTs to change so-called unhealthy attitudes, such as obesity problems that are being considered one of the biggest public health problems not only in Brazil, but worldwide, as developed by the Federal University of Rio Grande do Sul (Sgobbi, Tarouco, & Reategui, 2017). In this work, they use IoTs technologies and virtual world to enable the change of health habits. And even for amputated limbs, IoTs have a practical utility; in the case of wounded soldiers, they lend themselves to aiding in rehabilitation through smart myoelectric prostheses that are compatible with this technology and - by communicating and providing feedback on real time muscle activities - contributes to the strengthening of the patient's patterns, consequently decreasing their recovery time (Silva, Silva, & Brito-Filho, 2018).

In fact, the growing use of IoTs comes from the widespread popularization of wireless and sensor technologies, which, coupled with the demand for new applications is creating a new ubiquitous era of intelligent applications. IoTs are comprised of a set of technologies that provide connectivity anytime, anywhere and with anything. By connecting to each other, objects or things, they interact and cooperate over the wireless connection to ensure ubiquitous communication (Machado, Rosário, Loureiro, Neto, & José, 2014).

IoTs are associated with the term Big Data, which comes from the sheer amount of data produced by these Internet connections, which, among other things, enables healthcare providers to use maps that warn and prevent outbreaks of diseases such as H1N1 by identifying foci of transmission (Magalhães, Martins, & Hartz, 2014). Considering this data, the government can act effectively by controlling and preventing a global pandemic. Even with neglected diseases such as endemic tropical diseases that occur in low-income populations such as Africa and Latin America, data from IoTs and Big Data can be important in preventing (Magalhães, Martins, & Hartz, 2014).

Radio Frequency Identification Systems (RFID), are also well used by IoTs, since through this technology, it is possible not only to monitor the location and information, but also to track the temperature and humidity of environments, refrigerators and freezers. When deployed in a hospital in Rio de Janeiro, increased hospital safety was observed, followed by cost savings and increased efficiency (Alves, Morim, Souza, & Rosário, 2014). An added benefit of such technology is the ease of checking and monitoring all data without human intervention, which is essential is a Hospital Accreditation process as it ensures that data is not biased as to its registration (Alves, Morim, Souza, & Rosário, 2014).

Other authors propose the use of Machine Learning concepts as a way to improve the use of IoT technology, such as Cantanhede e Silva, who believe that it is possible to develop intelligent appliances with the marriage between the two technologies (Mano, Volpato, Funes, & Torres Neto, 2016) (Cantanhede & Silva, 2104). In this direction, Costa et al, argues that the development of Machine Learning based algorithms together with IoTs technologies may reduce the risk to the patient, while optimizing resources in hospitals and determining the future of health and safety of the patient (Costa, Pasluosta, Eskofier, Silva, & Righi, 2018). For these authors the immense availability of data in Cloud Computing will require concepts such

as Machine Learning so that there can be filters and data selection to make the system more optimized and fluid, allowing learning techniques to be used to interpret this data to that research with them can be better viewed and interpreted effectively (Costa, Pasluosta, Eskofier, Silva, & Righi, 2018).

Technological solutions such as IoTs can be applied to improve current healthcare system delivery issues. The application of computational tools for hospital activities has the propensity to make major changes in the operating environment, in order to increase the quality of care and work processes. Remote patient monitoring optimizes and changes the doctor/patient relationship positively, as does the information is best accessed and shared between the doctor and the medical team. Provides even more patient mobility as health status can be monitored both at home and at work without restricting hospital facilities (Fernandes & Lucena, 2017). In addition, it allows:

• Collaborative work between the local and external team of professionals, providing a second opinion about the patient and their diagnosis and treatment.

• An automated process for monitoring vital patient data using sensors.

• Remote and real-time monitoring of patient health conditions.

• Alerts to health professionals in emergency situations.

• Decrease the time taken for detection of abnormalities in vital signs monitored patient due to the use of software agents, which in this context is a computational entity that allows responses activities to emergency situations (Fernandes & Lucena, 2017).

However, for some authors, the focus of IoTs should also be on some very important challenges, such as security, privacy, and trust issues from those who will be impacted by such technologies. As well as usability, personalization, familiarity and comfort issues that are directly related to the expansion and use of such technologies (Roehrs, Costa, Righi, & Oliveira, 2017).

There is, also, a discussion that concerns about Electronic Health Record (EHR) versus Personal Health Record (PHR), in which is debated the patients right to have exclusive access to their data, the option of making it available to their physicians when they want is debated and, therefore, the possibility of integrating the information into the healthcare system that allows it to be accessed convenience in any healthcare organization (Roehrs, Costa, Righi, & Oliveira, 2017).

## 5. Discussion

With the establishment of Decree No. 9,854 on 06/26/2019 in the Federal Official Gazette, the National Internet of Things (IoT) Plan was established in Brazil, which aims to implement and develop technologies related to this concept, which includes various products connected in homes, hospitals, industry etc. Considering that, more than just a propensity, IoTs have become a reality that is already accepted as present in our current context and that should be encouraged and regulated (BRASIL, 2019). Among other goals, IoTs focus on: improving people's quality of life and promoting service efficiency gains through the implementation of solutions.

The IoTs are the current innovation and it is expected from them to bring solutions for the healthcare sector, including the improvement of unites operational efficiency - with better control of resources – and patients follow-up or distant support (Reis, Pimentel, Machado, & Barbosa, 2018). To have a dimension, the

McKinsey Global Institute (Manyika, et al., 2013) undertook a study in which it identified 12 technologies that would have a possible economic impact of tens of trillions of dollars per year starting in 2025, and among the trends were: mobile internet, internet of things and cloud technology, which are part of the same niche.

In health, IoTs are undoubtedly a worldwide trend and are adapting to the Brazilian scenario that is opening its doors to the entry of such technologies, at least with regard to national policies. The reality is that about 80% of deaths in Brazil are caused by cardiovascular disease and cancer, in addition to violence. Currently, the public and the private sector model is based on individual interventions. However, assistance to these diseases requires a model of continuous and full attention (Vecina Neto & Malik, 2017). To guarantee the quality of life, it is necessary that these information technologies can be strategically used so that they can gain in efficiency and in the universality of health.

The use of IoTs can potentially offer patient care in a variety of ways, from hospital emergency treatment for long-term case management to community-based treatment. In this context, IoT technologies have stood out for allowing the creation of new treatments with precision and greater amount of information, since it has the ability to track people, equipment, supplies, and provide analysis of captured data. Once the patient is connected to sensors, it is possible to measure vital signs and other biometric data and information, which allows problems to be quickly diagnosed and, consequently, superior and more efficient healthcare resources can be offered (Oliveira & Silva, 2017). The biggest opportunities come from the category of chronic diseases, as they are responsible for 71% of deaths worldwide and, according to the World Health Organization, in 2018 it represented approximately 41 million people (World Health Organization, 2018). Many of these diseases refer to heart problems, asthma, diabetes, unhealthy eating, and physical inactivity, which are an open field for digital health to occupy, as applications enable both patients to understand their current state and how to act on it. In addition, alert health professionals about the possibility of acute events (Oliveira & Silva, 2017).

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Regarding to drug traceability, IoTs can fulfill a fundamental level role, enabling the adaptation to the regulation that establishes the National Drug Control System (SNCM) and which proposes to implement a drug identification system. Currently, the proposed identification is through a Datamatrix code, which confers an identity on the factory drug until it is received at pharmacies. With IoTs, data reception be in real time, even more so by pairing with RFID tags that ensure the entire process is tracked with data at any time, ensuring that counterfeiting problems are almost over. The effective guarantee of drug safety is ensured when technologies such as RFID (Radio Frequency Identification), RSSF (Wireless Sensor Network), GPS (Global Positioning System) and QR (Quick Response) ensure tracking, quality monitoring, and almost immediate return when a problem is detected, without even reaching the consuming public (Metzner, Silva, & Cugnasca, 2015).

While there are many healthcare benefits of IoTs, the challenges are not few. Issues like data security and IoT device management concern users. Another question is related to interoperability, which, despite relying on supportive government intentions, represents a challenge path, especially considering the full potential if managers start making data-driven decisions. It is possible, with this technology, to manage patient data and provide with greater confidence a holistic look at it, maximizing benefits and streamlining processes and care that would claim to be more effective (Massola & Pinto, 2018).

Concern about privacy is critical since it involves large volumes of data that can be used in various types of analysis, such as predictive analysis, prescriptive analysis, descriptive analysis and diagnostic analysis, highlighting the potential and usability, that contributes to the decision making, structured on historical evidence, in real time or through foresight. Thus, while on the one hand, they make it possible to bring numerous benefits to the health sector, on the other, ethical issues related to privacy and security imply disadvantages that can be derived from the IoTs associated with the use of big data (Araújo , Lima, Campos, Azevedo, & Barbosa, 2019). According to Araújo et al (Araújo, Lima, Campos, Azevedo, & Barbosa, 2019), is essential that subjects – such as ethics of personal information for business or government control purposes and discrimination in admission examinations – should be debated and reflected once information would, theoretically, be available and could regulate the hiring of people who are willing to develop illnesses among others.

About security, developers themselves still do not have a clear idea of what is really needed. A continuous measurement of vulnerability on software and systems must be done, as well as tests that allows users to

be aware of the importance of keeping their devices up-to-date and with accessible security tools (Magrani, 2018). Bringing it to a broader context, Peppet (2014), says thar IoT objects are susceptible to security breaches and hacking intrusions for three reasons:

1ª Organizations willing to work with IoTs are not specialists in developing high-end software or hardware, but rather on generating relatively common consumer goods in the marketplace. This means that the engineers involved with the projects are inexperienced in designing high level security systems.

2ª The small and compact size of the devices creates a difficulty due to lower processing capacity required for an efficient data security system. In addition, the size is sometimes so small that its battery is not sufficient to handle complex data security systems.

3ª The fact that most IoT objects are not designed to be constantly updated to improve your data security systems.

Other critic about IoTs is related to the anonymization of data, which is not a real fact once it may be deleted to maintain user privacy but can be reidentified by an adversary. This can be done by crossing other user information that is available on the network, which may eventually bring out the real identity of the person. Another risk is tracking, which allows you to locate a person in a given space and time. There is still the risk of profiling, which is the creation of information files about a particular person, in order to make correlations with other data and information. While releasing information there is also a risk of releasing information to unauthorized individuals, called shoulder surfing. And during the change of control of the lifecycle, personal information may still be released from the user, this is a change of user control to a third party, as IoT technologies will have a much more dynamic life cycle in which objects will be discarded, modified and borrowed more flexibly (Peppet, 2014).

Adding to the IoTs, the sheer volume of data produced by it and the change in traditional forms of data analysis, big data is a reality that is taking shape more and more, establishing a new way of dealing with information. And the number of data generated by the Internet of Things will be very useful for epidemiologists, as it will enable to know all the immediate and distant steps that led to the emergence of a given disease or even death. We are currently locked into active research, but in the near future the biggest challenge for science will be to persuade the population to provide data that has already been collected automatically and stored (Chiavegatto Filho, 2015).

The truth is that IoTs are becoming so important that it, along with other technologies, has ushered in what has been called the fourth industrial revolution, which is characterized by a ubiquitous and mobile internet, sensors and devices - which become more accessible and smaller, and the improvement of artificial intelligence (Magrani, 2018). And with the revolution came industry 4.0 which has as its basic foundation that by connecting machines, systems and assets, companies can create intelligent networks throughout the value chain that in turn can control production modules autonomously. In order to produce smart organizations that will have the ability and autonomy to schedule maintenance, anticipate process failures and shape unplanned demands and changes. In practical terms, for healthcare that means we will have assets, taking care of people, recognizing risks and scheduling maintenance with unique and more systematic care plans for the information system (Alves, Carvalho, & Cassias, 2019). There are six industry 4.0 core principles that define intelligent production systems that are likely to influence healthcare systems: 1) Real-time operating capacity; 2) Virtualization; 3) Decentralization; 4) Service orientation; 5)

Modularity, which produces according to demand. These principles applied to industry 4.0 are increasingly being incorporated into the health system, where individuals are monitored for their operation and tracked through health indicators (Alves, Carvalho, & Cassias, 2019).

It can be a system of networks considering that internet is a globalized tool that enables people to communicate via machines. The association of IoTs with RFID technologies, sensors and actuators will lead to many other applications, which are essentially more effective and more efficient. RFID is a technology that comes on top of IoTs, so it opens up a wide field in the market and in globalized health. Some authors believe that with the popularization of IoTs the RFID market will become increasingly promising, generating opportunities and benefits for those who use it (Leite, Ursini, & Martins, 216).

It is only logical that there is still a hard way for ubiquitous computing to become a reality for most of the population, but much has been advanced in technology to make this happen, and with the help of IoTs, new technologies information, tracking systems and wearable computing, it is believed that in a short time the ideal of a society of functional and invisible technology can be achieved. Much remains to be done improving Machine Learning algorithms, improving security standards and efficiency in data privacy, and cheapening wearable devices and technologies that will surely improve the quality of life (Boscarioli, Mello, Siqueira , & Vilain, 2016).

## 6. Conclusion

The debate around IoTs has been fierce, many are those who defend their use without restriction, and with the decree of 9,854 the truth is that, whether or not Brazil will be entering a new technological age, that of industries 4.0. Through research in international and national databases, it was found that, in terms of international bibliographic production, Brazil is still in the beginning - only 8 articles were returned - if compared to what has been produced abroad. Already in other databases like LiLacs, PsyINFO and ScieLo, the return was equally small. With the exception of Capes and Google Scholar who presented a significant number of articles, the theme has not been gaining ground in specialized magazines around the world. In any case, Google Scholar research has served to pinpoint how much this topic is beginning to get important in national discussions. It can be said that one is still in a technical capacity for the effective promotion of such technologies, although there are a large number of articles in local journals, but they do not have the proper academic expressiveness. In any case, the national literature is very wide and diverse, starting to deal with topics such as security, anonymization of information, improper traceability among other topics of great relevance.

However, when compared to the number of articles in the PUBMED database, the difference is striking, so there are 766 articles dealing with the theme around the world that are indexed in this database, while Brazil has 8 articles on this same subject on that basis.

As for the potentialities, the use IoTs in healthcare system are numerous, highlighting the monitoring of patient physiological conditions, epidemiological survey – in order to study the spread of diseases –, physical rehabilitation – through the sensors – and monitoring the medication from the factory to the patient – taking care to avoid mistakes during the process, such as falsification, tampering.

Overcoming system weaknesses, such as security, could be the impetus IoTs need for exponential growth.

Even if this is not done, it seems that these technologies are already gaining ground, including at the political level. There is also a need for broad debate about who owns the health data, whether the patient or institution, and who will be able to access it.

Therefore, IoTs will transform positively human processes and activities to significantly in a indispensable and intelligent way through devices of various shapes and sizes, at anywhere and anytime.

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