Health 4.0 and the Impact on Post-Covid 19 Business Models

Saúde 4.0 e o Impacto nos Modelos de Negócios Pós-Covid 19

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ABSTRACT
The outbreak of coronavirus (SARS-CoV-2), which causes COVID-19, has accelerated the digital revolution and the speed of change, in all areas and is directly affecting the business world. Having said that, this work aims to discuss the impact of the paradigm shift in health, Health 4.0, on the business models in post-Covid19. It is noticed that practices related to new technologies have an impact on profound changes, bringing discussions about the use of technological innovations. The text was built with selected bibliographical references, in the business and health field, seeking to contribute to a critical view on the subject.

Keywords: Business. Digital health . Big Data . COVID-19 . Strategic Planning .

RESUMO
O surto de coronavírus (SARS-CoV-2), que causa a COVID-19, acelerou a revolução digital e a velocidade das mudanças, em todas as áreas e está afetando diretamente o mundo dos negócios. Posto isto, este trabalho pretende discutir o impacto da mudança de paradigma na saúde, Saúde 4.0, nos modelos de negócio pós-Covid19. Percebe-se que as práticas relacionadas às novas tecnologias impactam em mudanças profundas, trazendo discussões sobre o uso de inovações tecnológicas. O texto foi construído com referências bibliográficas selecionadas, na área de negócios e saúde, buscando contribuir para uma visão crítica sobre o assunto.

Palavras-chave: Negócios . Saúde digital . Big Data . COVID-19. Planejamento Estratégico .

1 INTRODUCTION

In the 21st century, the challenge presented to mankind by information technology and biotechnology is undoubtedly much greater than the challenge posed by steam engines, railroads, and electricity in an earlier era [1].

According to the Pan American Health Organization [2], the new coronavirus (n-CoV) is a new strain of coronavirus that had previously been identified in humans. Known as 2019-nCoV or COVID-19, it was only detected after notification of an outbreak in Wuhan, China, in December 2019.

Nothing will be the same after the Covid-19 crisis. But instead of being paralyzed by this thought, resilient companies all around the world are showing tremendous dynamism and willingness to embrace the challenge of making businesses stronger and safer in a sustainable way [3]. Today, there is a wide range of fascinating challenges; among them, the most intense and important is the understanding and shaping of the new technological revolution, which implies nothing less than the transformation of the whole of humanity [4].

It is still necessary to understand more about the speed and scope of this new revolution, including the limitless possibilities of billions of people connected via mobile devices, giving rise to unprecedented processing power, storage resources and access to knowledge. The staggering profusion of technological innovations spanning numerous areas such as artificial intelligence (AI), robotics and the internet of things (IoT), autonomous vehicles, 3D printing, nanotechnology, biotechnology, materials science, energy storage and quantum computing are already part of social daily[4].

Many of these innovations are just in the beginning, but they are already reaching a tipping point in their development, as they build and amplify each other, merging the technologies of the physical, digital, and biological worlds[4]. Our policies on health and health care, both during this pandemic and in the future, should reflect this reality, and we should not let the lessons of this crisis pass us by[5].

The purpose of this article is to discuss the impact of the change of health paradigm, Health 4.0, on business models, specifically an archetype for a more empirical and practical perspective.

2 THEORETICAL BACKGROUND

According to scholars from around the world, modern society has gone through three major transformations due to technologies in production processes and is in

transition to a fourth transformation. These transformations were called “industrial revolutions”. The Industrial Revolution created ways to convert energy and produce goods in large numbers, cutting humanity from its dependence on the ecosystem that surrounds it [6].Klaus Schwab [4] mentions that the changes are so profound that, from the perspective of human history, there has never been such a potentially promising or dangerous moment.

The Industry 4.0 (I4.0) concept was launched at the Hannover Fair in 2011 and can therefore be considered a nascent phenomenon with a relatively short history spanning less than a decade. Although the “official” birth year of I4.0 is 2011, shows that the narrative behind I4.0 can be traced back to the global financial crisis of 2008/2009. Similarly, argues that the concept emerged in the aftermath of the financial crisis as a way for industries to improve profitability and competitiveness, and at the national level to trigger and spur economic growth and recover from the recession [7]. The engineering capabilities introduced by industrial revolutions (Industry 1.0 to 4.0) are the foundation of the corresponding revolutions of healthcare technologies (Healthcare 1.0 to 4.0)[8].

Discussing the opportunities of technological services today is to be imbued with several phenomena that have been emerging recently, such as, for example, the interest in the biotechnology platform, or even in what has been called Health 4.0, the result of the diffusion of what would be the fourth industrial Revolution. These phenomena bring elements such as advanced manufacturing and modernization of health services, digitization and connectivity in health services, Internet of Things, Big Data analysis in Health, personalized medicine and production of monoclonal antibodies [9].

The main feature of the 4.0 era is disruptive innovation. The concept of Health 4.0 refers to the integration of the world of technology (IT) with the science of health. This real revolution in the medical field involves automated mechanisms, such as management software, cloud computing, internet of things, among others, which are made available on mobile devices and in internal systems of health establishments [10]. Innovation was one of the themes that gained the most traction. The transformation of the environment requires organizations that constantly innovate in their business to be able to deal with new consumer demands and other competitive dynamics, as new competitors, hitherto uncharted, start to emerge [11]. Knowing how to change business and technology models jointly and individually is the hallmark of a successful innovative model [12]. However, the healthcare market is complicated. Fragmented, not very transparent, resistant to change and old-fashioned in the way of doing business [13].

Health 4.0 arouses to eliminate barriers between what is an industry and what is a service. The very concept of standardized mass production no longer makes sense at the expense of a logic of customization. In the field of health, it is what you would call personalized medicine. For example, each monoclonal antibody produced to industry standards, but with characteristics for each individual patient. There would also be information about a "digital twin" of the drug with information about its entire production and use cycle. This last feature allows for a pharmacovigilance strategy with details never seen before [9].

The unusual year of 2020, with a pandemic that brought unprecedented health and economic crises, showed the importance of the work of the health and science sector for the world. But this is not just true for large hospitals, famous research centers and high-tech laboratories. Healthtechs, startups in the health sector have also made their contribution in this challenging moment [14].

The COVID-19 pandemic was a largely foreseen event that was not considered in ventures' business planning processes or outcomes, regardless of how formal or informal those efforts were. Even for those founders and investors focusing on scenario planning, such a specific event or similar scenarios were typically not considered [15]. Countries, states, municipalities, and organizations that were able to mobilize human, technological, and biological resources, articulating them in favor of the same cause, tend to face the disease more efficiently and successfully [16].

Aiming at the expansion of health services through information and communication technologies, especially to enable access to health in different spaces of society, telehealth emerges, which, as an indirect effect, can promote the development of technologies to bring each other closer together. more users, professionals, and managers of health services [9].The potential benefits of telehealth include better access to care, more efficient care management, reduced costs, the ability to assess patients in their homes while involving key caregivers in medical decisions, maintaining social distance, and increasing patient satisfaction. Challenges include changes in payment models, issues with data security and privacy, potential depersonalization of the patient-physician relationship, limitations in the use of digital healthcare technologies, and the potential impact on disparities, including socioeconomic, gender and age-related issues and access to technology and broadband [17].

While data protection regulations are an essential mechanism to ensure health-care organizations safeguard the security and confidentiality of identifiable information,

the COVID-19 pandemic has exposed the limitations of current data protection regulations in delaying timely access to data to inform policy making [18]. The General Law for the Protection of Personal Data (LGPD or LGPDP) [19], Law No. 13.709/2018, is the Brazilian legislation that provides guidelines on how citizens' personal data can be collected and processed.

In 2020, Covid-19 was the biggest driver and accelerator of digital innovation in healthcare, highlighting the need for health care reforms that promote universal access to affordable health care [5,20]. The scale and scope of the changes explain why current disruptions and innovations are so significant. The speed of innovation in terms of development and disruption is faster than ever [4].

The increase in life expectancy, advances in medical knowledge, the process of individualizing preventive, diagnostic and therapeutic measures and precision medicine make healthcare a booming sector [13]. The combination of the digital, physical, and biological worlds makes companies gain new knowledge to integrate these dimensions in their projects. The transformations impact the entire society and deconstruct the classic management models, production, consumption, logistics and distribution systems [11].

Healthcare 4.0 is a continuous but disruptive process of transformation of the entire healthcare value chain ranging from medicine and medical equipment production, hospital care, nonhospital care, healthcare logistics, healthy living environment to financial and social systems, where vast amount of cyber and physical systems are closely combined through the IoT, intelligent sensing, big data analytics, AI, cloud computing, automatic control, and autonomous execution and robotics to create not only digitalized healthcare products and technologies but also digitalized healthcare services and enterprises [8].

The provision of technological services is notorious in the medical device subsector, with the advent and evolution of Information and Communication Technologies (ICT) and the concepts of Health 4.0, which seek to generate health services in the concepts of digitization, interoperability, connectivity and traceability , automation and collaborative robotics, medical information technology and big data, artificial intelligence, mobile technology and portability, additive manufacturing, advanced manufacturing and new materials [9].

By 2040, successful companies will identify and compete in one or more of the new business archetypes, considering existing capabilities, core missions and beliefs, and expectations for the future. Largely replacing the isolated industry segments, we now

have (such as healthcare systems and physicians, healthcare plans, biopharmaceutical companies and medical device manufacturers), we expect new roles, functions, and participants to emerge. In the future of health, we expect three broad categories to emerge (data and platforms, well-being and care delivery, and care empowerment) [21].

The absence of short-term medical responses to the coronavirus required social distancing to reduce population transmission of the virus. However, this distance triggered the interruption of non-essential economic activities, something that does not resemble any previous demand or supply crisis. In addition to the activity's temporal freeze, there are growing concerns about the long-term effects stemming from the need for blocking protocol extensions (increasing its total duration and impact), as well as the need to uphold rules of behavior such as social distancing to reduce the risk of new virus infections in the future [15]. The way health stakeholders analyze, understand, and respond to these issues will shape their ability to recover and prosper in the post-pandemic [20].

Cost may be an impediment to transformation: Providers, feeling the pressure to move to new care models, may be financially strained by the postponement/cancellation of nonessential surgeries and procedures during the pandemic [20]. To plan for a post-pandemic world, businesses must understand what your stakeholders' behaviors will look like after the pandemic. Some behaviors will return to their pre-crisis state; others will be transformed; and others will disappear entirely [22].

The post-pandemic world will try to answer three questions: how will your business *really* make money? Many companies have not taken the time to articulate their critical strategic differentiators or map out how money, goods, and information flow from their suppliers to their consumers. Next, who do you depend on to drive the business? Define your most important stakeholders and their behaviors that affect your business model [22].

3 METHODOLOGY AND DATA COLLECTION

The literature review was conducted in the following steps: conducting a search of relevant databases and research platforms, building a research framework for qualitative analysis, applying the qualitative analysis framework, and exploring the impact on the business model based on the Business Model Canvas.

The exploratory research method was used to look for patterns, ideas through the in-depth study of the drivers of new technologies that impact on business models based on literature reviews. The purpose is to make discoveries with primary research source

such as technical reports and secondary with books and review articles.

Below is a sequence of activities that were carried out.

The literature collection process began with the identification of relevant databases for this research, studying focus groups and bibliographical research, especially in the following databases and platforms: Deloitte, Scielo, New England Journal, Harvard Business, FioCruz,, McKinsey , PWC, ScienceDirect. The search strategy was based on a combination of keywords: 'Health 4.0', 'business model', 'digital health', 'pandemic' and 'COVID-19′. It was carried out from October 2020 to September 2021. The search resulted in a total of 64 articles. Parallel to the research, based on the objective of discussing the impact of the health paradigm shift, Health 4.0, in the post-Covid19 business models, two dimensions that impacted the disruption were investigated. The two dimensions: (1) Drivers of change (2) Dimension of health-related technology 4.0. Finally, the content of the articles was extracted and analyzed.

The research on business strategies related to the structures of the business models have become significant around the 1990 with the advent of the internet. That is because, in this period, the pressure from market globalization and the entry of new communication technologies spurred companies to rethink their business models. This movement, consequently, accelerated the search for new forms of business structures, which allowed the passage of the existing business models for business models based on e-commerce, taking advantage of the opportunities, and thus arising in the market with the arrival of online age [23].

For this article, the Business Model Canvas archetype, proposed by Alexander Osterwalder, was chosen to demonstrate the impact on post-covid healthcare business models. The Canvas can be defined as the value logic of an organization in terms of how it creates and captures customer value and can be concisely represented by an interrelated set of elements that address the customer, value proposition, organizational architecture and economics dimensions [24]. It is a framework with nine essential “building blocks” that describe a business model.

The Business Model Canvas is presented as a shared language for describing, visualizing, assessing and changing business models. It is focused on design and innovation, in particular by using visual thinking which stimulates a holistic approach and storytelling [24].

The limitations of this work are related to the complexity of studying the emerging and rapidly evolving field around the Health 4.0 concept, with many different actors involved and even during a pandemic.

4 RESULTS

The analysis data presents presented previously, shows the content of thirty-four publications, which were analyzed in the nine building blocks (value proposition, customer segment, channels, relationship with customers, revenue streams, key resources, key activities, key partnerships, cost structure) that composes the Business Model Canvas archetype, proposed by Alexander Osterwalder.

Value proposition: what will be of value to customers?

The entire healthcare segment have achieved significant progress toward the ultimate vision of 8-P Healthcare: preventive, predictive, participatory, patient centered, personalized, precision, pre-emptive, and pervasive healthcare [8].

Focus is shifting from health care to health and well-being. More resources (time, money, and attention) are being allocated from the end of the health care value chain (treatment and aftercare) to the beginning. There will be a greater focus on promoting healthy lifestyles, vitality, and wellness; on primary and secondary prevention; and on early diagnosis [25]. Health care delivery models today are oriented around the provider, primarily focused on physical health, and prioritize location and payment model over consumer needs. Experiences are fragmented, transactional, and analog, with redundancies, misalignment, and disconnected interactions common among functions and stakeholders. These characteristics can intensify existing operational and organizational headwinds pushing against efficient and effective healthcare delivery [20].

To build trust in turbulent times, brands must look at what people value – rather than how they are – ensuring that their commitments are in sync with their competence to deliver consumer needs [26].

Many medical technology companies are already beginning to incorporate biosensors and always-on software into devices that can generate, gather, and share data. Advanced cognitive technologies can be developed to analyze a significantly large set of parameters and create personalized insights into consumer health. Data availability and personalized AI can enable precision well-being and real-time micro interventions that allow us to overcome disease and much more catastrophic disease [21]. As the portable

electronic devices worn by the patient capable of monitoring the body's vital signs, biochemical and hormonal patterns. The patient himself starts to contribute by including data in his medical record.

Data will increasingly be used for personalized insights and interventions, and primarily aimed at vitality, prevention, and early diagnosis. This will create a new data value chain, offering opportunities for existing players and new entrants in data collection, data analysis, translating analyses to personalized insights and interventions for patients, and accessing these insights through a user-friendly visual interface [25].

Customer Segment: Who will be the target customers?

Customer segmentation can be an important approach to target messages that resonate, use resources efficiently, and design products and services in a more personalized way. Many experts working on customer experience at life sciences and health care organizations told us that the use of segmentation varies by type of organization and function: Health plans focus on enrollment and retention; health systems on gaining market share within a geographic area; and pharma companies on earning trust, increasing brand loyalty, and connecting patients to the right therapies at the right time [27].

Reorganizing around groups of patients with the same demands, just as [American companies, in the 20th century] reorganized themselves around clients, is the future of healthcare", defends Porter, in the text for NEJM Catalyst [13], as they want convenience, access, and transparency around treatment care and cost [20].

A more informed, empowered consumer is more likely to make decisions that lead to better health outcomes. But health care organizations should provide transparent, accurate information for this to happen. Prioritize communication to the segments that are most anxious about privacy and transparency [27]. With greater susceptibility to incidents, information security management will become mandatory, being as important as business plans, and an integral part of the development strategy for companies, especially those dealing with innovation and personal data [28] .

Channels: how to communicate and reach customers to deliver the Value Proposition?

The advent of the use of digital tools and social media brought a relevant contribution to the issue of knowledge production, as well as enabling the expansion of

communication channels for access to health services [29]. As the CFM – Federal Council of Medicine decreed CFM Resolution No. 1,643, of August 26, 2002, and CFM Official Letter No. 1756/2020 recognizing the possibility of adopting teleconsultation, tele orientation and telemedicine for monitoring and guidance in this fight of COVID-19, but recently the Ministry of Health published in the Official Gazette of the Union (DOU) ORDINANCE No. 467, OF MARCH 20, 2020, which extends such use.

Compared to international experiences, Brazilian initiatives are also in the direction of health innovations driven by the pandemic, with the implementation of technologies for non-presential pre-clinical care, online scheduling, telemedicine, self-assessment of symptoms, chat channels, telephone channels, recruitment, and training of human resources [30].

By offering members a seamless, integrated experience, omnichannel helps increase their satisfaction and reduces churn, and has the potential to decrease claims costs by optimizing the use of medical services [31]. Marketing professionals can benefit – and stay ahead of the competition – by developing an engagement strategy based on the client's active participation in its various relationship channels [26].

Relationship with customers: how do healthcare companies at Post-Covid relate to customers to win and keep them?

The environment is dynamic and convergent and mediated by technology. With this it is possible to mitigate waste, maximize efficiency, increase profitability and bring the final consumer closer to your products in a more direct way: it is really a total space for connecting things, where repetitive human activity that does not require creativity is replaced by software, robots, machines, and high performance networks [9].

Consumers are learning about their health risks, communicating with their doctors in new and different ways, and changing their attitudes about data privacy. They want convenience, access, and transparency around treatment care and cost. Each of these factors has a significant influence on how consumers are feeling and interacting with their health system [20]. They rapidly adapt and sometimes shift their value proposition to reflect ever-evolving demand conditions and discover new growth opportunities [3].

Revenue streams: how and what are the sources of income?

Increasing revenue and growth through an improved patient experience, more effective patient steerage, and enhanced ability to meet quality and cost performance

targets [20]. The “fee for service” medical payment model, the money covers each procedure performed, medication prescribed, consultation performed. It is an invitation to waste and lack of clarity [13].

Concepts such as Value-Based Healthcare or Value-Based Payment are becoming more present, changing the way in which healthcare services are paid and the use of technologies. For the Institute for Healthcare Improvement (IHI), the Value-Based Healthcare concept is supported by three concepts that form a Triple Aims. Triple Aim is an approach method developed by IHI with a view to improving the performance of health services, acting simultaneously in three dimensions (IHI, ©2018): improving the health of the population; improve the patient's experience in care (quality and satisfaction); and reduce the per capita cost of health care [9].

Lenders and intermediaries will facilitate consumer payment and coordinate supply logistics, respectively, but may experience reductions in margins and profit sharing, driven by advanced analytics and risk assessment [21].

Key Resources: what are the resources needed to carry out the key activities of Health 4.0 in Post-Covid?

Intellectual, human, and technological resources. Multidisciplinary team, due to the need to integrate different areas of knowledge. The Health 4.0 model is directly related to telehealth and all the technologies that promote its realization, which, for the most part, make use of some telecommunication infrastructure for data transmission and reception. In this sense, it is not possible to think about health 4.0 without the use of health systems and technologies that telehealth offers in the most diverse aspects, whether in the direct promotion of care and monitoring of patients, or in the strengthening of primary health care through permanent education of its professionals, or even through efficient solutions that help health management services aiming at their sustainability and optimization, enabling an expansion in the coverage of health services without prejudice to their quality [9].

To move forward with the industry 4.0, all capabilities digital are important. A detailed approach, step by step is essential. But it is also essential to advance quickly so as not to give in your advantage to competitors [32]. Increasingly, devices will be able to communicate with each other and collect data from the environment and users (smartphones, vehicles, appliances, lighting systems) and will be worked by big data technologies, cloud computing, among other data processing technologies [9].

The company performing data analysis, Big Data Analytics is the prerequisite for successful implementation of digital solutions [32], thus being a key resource. It is essential to develop applications and solutions related to health management through remote access, relying mainly on the cell phone and, at the same time, respecting the personal data protection rules established by the General Data Protection Law, No. 13.709, approved in August 2018 and effective from August 2020.

Key Activities: what are the essential activities to make the Business Model work

Organizations are attentive and plan their activities based on user preferences and are better positioned to develop more accurate strategies that help patients in their health decisions [27]. The ability of AI to examine large amounts of information quickly can help hospital and health plan administrators optimize performance, increase productivity, and improve resource utilization, resulting in time and cost efficiencies. Additionally, AI-enabled solutions can speed up and strengthen the insight-generation process by allowing an organization to gain the holistic picture it needs to make data-driven decisions. Finally, AI can also deliver personalized experiences by facilitating conversations with patients through virtual assistants [20].

We are only now beginning to understand the implications of COVID-19 for entrepreneurship. To move forward, it will not be enough to wait for things to get back "to normal". As he identified in his fieldwork with entrepreneurs suffering the effects of the COVID-19 crisis in Germany, the way forward requires balancing building resilience as well as being ready for new business opportunities [15].

Key Partnerships: which activities will be carried out by suppliers and partners?

Organizations can better help the customers they serve by creating innovative experiences through cross-sector partnerships [26]. Current and future opportunities include integrating electronic health records across health and care providers, investing in health data science research, generating real-world data, developing artificial intelligence and robotics, and facilitating public-private partnerships [33].

Adaptable structural Supply Change designs for supply–demand allocations and, most importantly, establishment and control of adaptive mechanisms for transitions between the structural designs [40]. Medical technology innovation and adequate medical personnel can be considered the two most important internal resources that need to be developed [34]. It will demand unconventional and unexpected partnerships across

competitors, niche players, and nontraditional competitors [20].

Cost Structure: what are the costs involved in the operation?

The introduction of technological innovation is one of the fundamental ways to lower production and delivery costs of clinical interventions [34]. The challenge of Health 4.0 related to the cost of the system is to develop solutions that contribute to making the allocation of resources more transparent and efficient, minimizing waste, lowering costs for the SUS and for the supplementary system [9]. The companies will launch new industrial products with digital features and grow the existing portfolio. Digital services based on data analysis, or even complete digital solutions that serve the ecosystem of customers, will drive revenue growth [32].

The Global Industry Survey 4.0 [32] mentions that digital technologies allow for shorter delivery times, better use of assets and maximum product quality. Thanks to this, the cost savings are considerable. In Deloitte Insights 2021[27] identify and adopt the technology that enables the work of each team and function. Cloud technologies, remote-work platforms, shared services, and AI can enable organizations to extend remote work arrangements they established during the pandemic well into the future. In preparation, organizations should prioritize spending on cloud security and governance tools, virtual-desktop infrastructure, and other key instances that can securely support their remote workforce Reducing the total cost of care through more effective and efficient population health management techniques that use technology to lower unit costs and utilization rates.

5 CONCLUSIONS

The objective of this work was to analyze Health 4.0 and its impact on Post-Covid Business Models. To describe these impacts, the Business Model Canvas method was chosen. This analysis was possible by the analysis of the referenced literature. The contributions presented by the literature review confirm the expansion of this subject in the literature, and it is important to recognize the impact of new technologies on new business models.

Based on international experiences, guidelines for the implementation of non-presential care technologies, establishment of digital security mechanisms, protection of privacy and continuous assessment of interventions are highlighted. The challenges of the new health paradigm, Health 4.0, for the competitiveness of companies are many, such

as the fusion of technologies and the interaction between the physical, digital, and biological domains. Therefore, it is part of our responsibility to ensure that we establish a set of common values, as well as make the changes that will make Health 4.0 an opportunity for good business.

In this moment, it is critical to adapt a mindset of learning and discovery. Companies and people reinventing themselves, new realities, and new opportunities. How stakeholders in the healthcare industry deal with these issues will enable them to thrive in the post-pandemic "new normal". The review aims to serve as a basis for the development of future studies related to the theme and its immediate application in the new disruptive scenario that is taking shape.

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