The impact of the COVID-19 pandemic on the blockchain implementation project in Brazil's public health system

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ABSTRACT – The world COVID-19 pandemic has caused significant changes in many aspects. Regarding technological projects, it evidenced the need to expand the applications of new technologies, such as blockchain, which has been receiving more and more investments. However, governments with a restricted budget and skilled labor had to face a higher priority: how to address to the COVID-19 crisis. In Brazil, one of the countries with the highest number of reported cases, the manpower available – already scarce – was forced to focus on simpler digitalization processes. If on the one hand it boosted and benefited technological advancements, on the other it required the government to abandon bolder projects to the detriment of more modest initiatives. This paper aims to analyze this impact on the evolution of Brazilian blockchain project called National Health Data Network (RNDS), by collecting its information before and after the pandemic outbreak. It was found that initially the program targeted blockchain usage on the public health system to promote the exchange of information between the nodes of the health care network, but it had to be redesigned to receive and share tests results related to COVID-19, while the original proposal was postponed.

Keywords: Blockchain; COVID-19; Brazil.

1. INTRODUCTION

Declared as a public health emergency by the World Health Organization (WHO) on January 30, 2020, the rapidly transmitted coronavirus disease 2019 (COVID-19) has reached all continents in a short period of time, becoming officially a worldwide pandemic on March 11, 2020 [1]. In order to contain the spread of the SARS-CoV-2, many countries have adopted lockdown measures, quarantine of the infected, and social distance protocols, following WHO's recommendation. Consequently, the responses to the crisis have rushed the implementation of digital technologies, which includes blockchain.

According to the International Data Corporation's (IDC) report, COVID-19 may encourage investments in blockchain and distributed ledger technologies, due to their characteristics of transparency, resiliency, and immutability [2]. In fact, the IDC forecasts that blockchain spending in Europe, for example, will triple in the next five years, specially driven by healthcare [3]. In Brazil, the third country with the most cases of COVID-19 registered, the Brasscom's pre-pandemic report showed a perspective of US$620 million in blockchain investments from 2020 to 2023 [4]. After the pandemic, the expectation increased to US$960 million from 2021 to 2024 [5].

In this context, governments have also been looking for possible blockchain applications in the public sphere. In 2020, the Brazilian federal government released the 11 major projects for blockchain application in the public administration, involving finance, aviation, and healthcare sectors [6]. Special attention is given to the blockchain project on the health care sector that was still under development at the time the state of public health emergency was declared in Brazil, on February 6, 2020. Hence, this paper aims to analyze the effect of the COVID-19 pandemic on the advancements of this program, contributing to the literature with a real-life case study on the blockchain application in the government healthcare system.

2. LITERATURE REVIEW

The literature review will briefly address blockchain concepts, possible blockchain applications in the government sphere, and the blockchain-based healthcare project in Brazil.

2.1. Blockchain Technology

In line with the Organisation for Economic Co-operation and Development (OECD), blockchain can be defined as "a shared ledger of transactions between parties in a network, not controlled by a single

central authority" [7]. In essence, the blockchain operation consists of a set of transactions that are validated by the network participants and, if approved, it composes a block in the ledger, containing the hash – a cryptographic summary - of the previous block and the hash of its own block. Any change in the block modifies the hash, being easily detectable, as there would be an inconsistency in the chain. Therefore, the use of blockchain technology is indicated when the reliability of information and process must be improved in situations that include diverse and heterogeneous stakeholders [6].

Moreover, blockchains can be classified into two main categories: public/private and permissioned/permissionless. Public blockchains are open to the general public, while private blockchains are restricted. Likewise, permissioned blockchains require authorization to write and commit, unlike permissionless blockchains [7]. Government blockchain implementations, though, are mostly permissioned [8].

2.2. Potential Blockchain Application in Government Services

The application of blockchain technology in public administration is suggested in different ways and fields. Terzi *et al.* presents how blockchain could support energy and health-oriented e-government services [9]. Corten explored the dilemmas in the application of design principles for blockchain in government services, providing important perceptions into which design actions are recommended and which dilemmas possibly occur [10]. Going further, Clavin et al. summarized the blockchain use cases already being adopted by governments in different spheres, including healthcare, financial applications, critical infrastructures, blockchain city, asset and data management, and education, concluding that blockchain could be the best technology option to apply to guarantee data integrity and service availability [8].

2.3. The Blockchain Project in the Brazilian Public Health System

Of the 11 main government projects in Brazil involving blockchain listed by the study of the Union's Court of Accounts (Tribunal de Contas da União), 9 were related to the financial sector, 1 to the aviation sector, and 1 to the healthcare [6]. As the interest in blockchain started with cryptocurrencies, it was expected that most applications would be financial [9]. Nevertheless, due to the public calamity of the pandemic, a greater focus will be given to the health system application, which was the most affected.

The Brazilian public health system is called Unified Health System (Sistema Único de Saúde, SUS), in which services are financed and provided by the government at the federal, state, and municipal levels [11]. The use of blockchain was proposed by the National Health Data Network (RNDS), which consists of a national platform intended to promote the integration and interoperability of health information between public and private health and the federal entity of health management, to ensure access to information necessary for the continuity of citizen care. The RNDS initiative belongs to the program Connect SUS (Conecte SUS), created to boost the Brazilian digital health strategy [12].

Initially, the RNDS' proposal was to facilitate interoperability of citizen records by making patient history items available in a blockchain structure shared across states. The permission blockchain was chosen, in which only the Ministry of Health, the secretariats of health that chose to be part of the network and, in the future, private participants, such as health plans or large hospital networks, would be allowed to participate, having their own nodes [6].

3. METHODS

The latest public information about the Brazilian government's blockchain project RNDS was collected and its progress during the COVID-19 pandemic was discussed.

4. RESULTS

The results section is split into three: the summary of changes to the RNDS project scope, the numerical results of adapting the project to meet the needs of the COVID-19 pandemic, and the RNDS' future steps.

4.1. RNDS Scope Changes

The RNDS development started in September 2019, expecting that by March 2020 a pilot project would be launched on the state of Alagoas with a duration of 4 months to allow the health professionals and citizens of the state to share and have access to health information for the transition and continuity of user care, as well as to analyze the lessons learned that should be applied in the future expansion of the project to the rest of the country, and to allow the health [13]. However, due to the outbreak of COVID-19 pandemic, the beginning of the pilot project was deprioritized, being replaced by the Crisis and Contingency Management Plan. In which, the RNDS project was modified to admit the results of COVID-19 tests upload on an integrated system (Portal Conecte-SUS) and communicate the test results to citizens and health professionals, being available to the population in August 2020 [14]. It should be noted that in May 2020 the government issued the ordinance GM/MS nº 1.046 to regulate the integration of tests results carried out for the detection of COVID-19 by any laboratory in the national territory, whether from the public or private sector, in the RNDS. The laboratories had 60 days from the date of its publication to make the necessary adjustments regarding the submission of data to the RNDS in their systems information and internal procedures [15].

In February 2021, the RNDS was again adapted to allow the monitoring of the immunized population, guaranteeing the correct application of the immunization agents, and recording the adverse effects after receiving the vaccine, using a connected ecosystem [16].

4.2. RNDS and COVID-19

According to the bulletin published by SUS, from March 2020 to June 2021, 19 million COVID-19 test results have been submitted to RNDS [17]. As expected, this number is in line with the data collected by the Laboratory Environment Management System (GAL) of total molecular tests performed for COVID-19 in Brazil, arranged in Figure 1 per month [18]. This shows that the GAL data has been fully loaded into the RNDS.
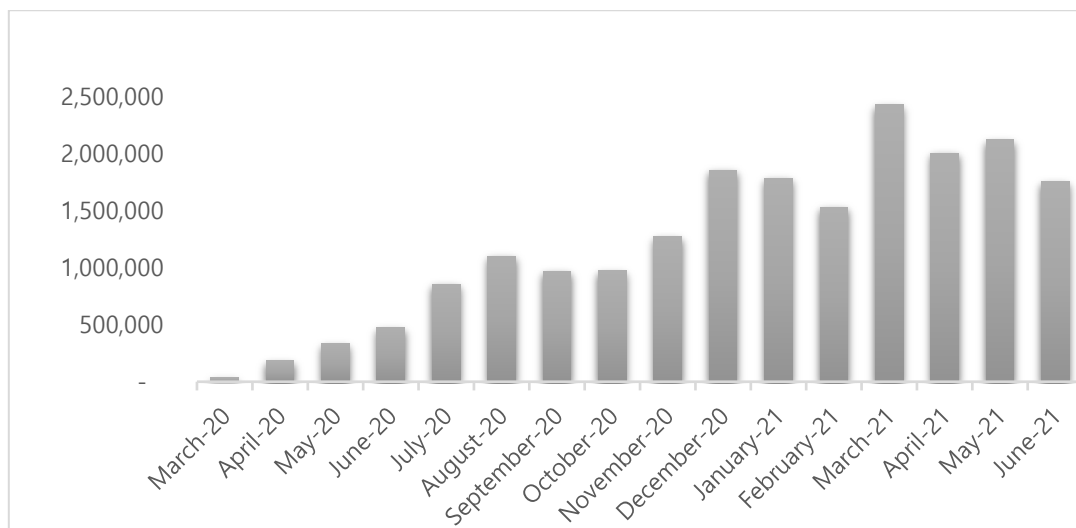

Figure 1. Number of molecular exams for COVID-19 per month in Brazil
Source: GAL, 2021 [20]

However, it is important to note that when adding other types of COVID-19 tests, such as the quick test, at the end of June 2021 the total number of tests performed was close to 54 million, as estimated by Giscard [19].

In relation to the number of COVID-19 vaccines applied, by June 2021 83 million doses had been registered in the RNDS [17]. Due to the obligation to report vaccination data to the RNDS and because the entire vaccination campaign is being carried out exclusively by the Brazilian public health system,

it is considered that all data are already interconnected to the RNDS.

4.3. RNDS Future

According to the Ministry of Health in Brazil, "as soon as the emergency actions to combat COVID-19 are better structured, the Conecte SUS program [to which RNDS belongs] will resume its initial strategy, prioritizing computerization, and the exchange of information between Primary Healthcare facilities using the Electronic Health Record" [14]. Nevertheless, no other schedule-related information or more specific goals were found, since the COVID-19 pandemic is not yet under control.

5. DISCUSSION

First of all, despite the lack of qualified professionals for systems development in Brazil [20, 21], it surprised researchers about emerging technologies in the COVID-19 pandemic when appeared in the eighteenth position regarding papers production, being the only Latin American country in the ranking [22]. Still, it is one of the few nations to explore blockchain technology in government applications, following the market trend with higher investments planned for the evolution of this technology.

The Brazilian government's blockchain project in the healthcare sector – RNDS – was initially directed towards data sharing in a secure and reliable way, like most other similar projects from different countries [8], but its prime concern was changed to provide more immediate solutions to deal with COVID-19 pandemic, such as unifying data from tests performed and vaccines applied. Then, two considerations can already be made. First is that, undoubtedly, driven by COVID-19, interoperability with public and private laboratories was the first major achievement of the RNDS. However, the second is that since the project was remodeled without clear goals of when the expansion of the RNDS will be prioritized again, it is uncertain to estimate the time needed for the advancement of blockchain technology in the healthcare system, although it is expected that it will take years, considering all the challenges to be overcome, such as heterogeneity of data and the use of different management systems [23].

In search of other cases for comparison, we found Ontario, Canada, which also made available on its eHelth platform immediate access to COVID-19 lab test results stored in Ontario Laboratories Information System (OLIS), as well as to COVID-19 vaccination information from COVaxON (Ontario Ministry of Health's application for COVID-19 vaccination information), but there was no data about blockchain usage, and the eHealth program was already underway even before the outbreak of the pandemic, with 98% of Ontario's hospitals and 100% of Home and Community Care Organizations (LHINS) connected [24]. Also, there is the MyHealth-MyData (MHMD) blockchain project in Europe presented in 2017, whose main objective was to develop an open health information network connecting organizations and people [25], though no guidance regarding the COVID-19 pandemic was given, suggesting Brazil has a unique case of study.

The lack of sufficient data to assess the performance of RNDS in dealing with the pandemic, and the fact that it is still too early to consider its next steps are the limitations of this paper. As future directions, we suggested to continue monitoring the development of blockchain projects, so that this disruptive technology can be increasingly exploited.

6. CONCLUSION

Although timidly, the outbreak of COVID-19 pandemic contributed to the actual initiation of the RNDS project, allowing interoperability between the country's public and private laboratories in a short period of time to consolidate data related to the number of tests carried out and vaccines applied, in a way similar to the solution adopted by the eHealth system in Ontario, Canada. However, it was also responsible for the changes in the project scope, postponing without deadlines the boldest proposals of digitalization of Brazil' public health system using blockchain, even though it is still too early to evaluate effectiveness.

The theoretical contribution of this article was to add the case of blockchain application in public health system in Brazil to the literature, focusing on the effects of the COVID-19 pandemic on the project's progress. The practical contribution is to disseminate the Brazilian efforts about heath digitalization solutions.

AUTHOR CONTRIBUTIONS

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