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Review

Blockchain and novel coronavirus: Towards preventing COVID-19 and future pandemics

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ABSTRACT

The present world has observed the SARS-CoV2 or COVID-19 spreading rapidly with a rising death toll and transmission rates with an absence of proper data management and information sharing. The current traditional database storage system has the limitations of a centralized control system and tampering of data, particularly when it is being shared with others. The Novel technology known as "Blockchain" is a distributed ledger technology that acts as a shared database, keeping all its copies synced and verified. The objective of this article is to study the concept of a Blockchain based pandemic data management system that would ensure unified patients' data storage and reliable data management to trackdown coronavirus to combat against this and future pandemics.

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1. INTRODUCTION

The World Health Organization (WHO) and almost every country's health department suggest maintaining social distance and quarantine as the best medicine to fight against COVID-19 pandemic. The disappointment of timely production of coronavirus vaccine speaks lack of coordination among the healthcare driving forces and uncontrolled spread speaks lack of healthcare surveillance systems which put the present world in such an epidemic

situation. As of 26 April 2020, COVID-19 has spread in 213 countries and territories affecting around three million people and claiming more than 200 thousand lives [1]. Modern medical data is stored using various electronic media, database management system etc. But medical data can be easily stolen, tampered with, or even completely deleted [2]. As data stored in the general database can be stolen or tampered or even deleted completely, utilization of such data will lead to an incorrect result. Again, if the data are submitted to a third-party authenticated company for preservation, personal information may be leaked, and

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it is difficult to guarantee the reliability and availability of preservation because the third party's credibility cannot be confirmed. The novel technology Blockchain is a distributed ledger technology that acts as a shared database, keeping all of its copies synced and verified. In a recent work [3], Blockchain is formally defined as "Blockchain consists of blocks containing messages, proof of work and reference of the previous block and stored in shared database, which is able to perform transactions over P2P network maintaining irreversible historical records and transparency" In this communication article, we strived to explore the challenges of COVID-19 pandemic in terms of recording and managing COVID-19 related health data and to present how the Blockchain based system may address these challenges to fight against the COVID-19 pandemic and to guard against future pandemic.

2. COVID-19 AND THE REQUIREMENTS OF BLOCKCHAIN BASED SOLUTIONS

In contrast to traditional database systems, Blockchain technology holds several inclusive properties for ensuring accuracy, transparency and immutability in storing data and transactions to store data; that (properties) includes the service perspective (e.g., scalability, validations, and distributed trust), logical inclusion (e.g., computational logic, transactional dependency, transaction rules), and the architectural characteristics (e.g., shared database, P2P transmission, disintermediation, time-stamped blocks, immutable records and encrypted data transmission) [3]. The section focused how the Blockchain technology may address the present challenges of COVID-19 for reducing the pandemic spread and preparing for the future pandemics.

2.1. KEEPING TRACK OF COVID-19 DATA FOR FUTURE VACCINATION

Historically medical data is generally explored as one of the techniques among many to investigate and develop vaccinations and drugs. For example, during this pandemic spread of COVID-19, a recent report shows that scientists have searched for related historical records of SARS (Severe acute respiratory syndrome) and MERS (Middle East respiratory syndrome) epidemic that occurred in 2002 and 2012, respectively [4]. According to WHO, the causes of SARS and COVID-19 disease are quite different even though they are both from same family of Coronavirus. Though the common symptoms of coronavirus are severe respiratory illness, including fever, cough, and shortness of breath, a recent report showed that doctors of a specific country found some new symptoms caused by COVID-19 like patients experiencing a loss of smell and taste [5]. Though SARS and MERS should have triggered major global investments efforts to develop vaccines in anticipation of future epidemics the inventions of novel coronavirus vaccines have yet to see the light. Today

scientist relates COVID-19 and previous coronaviruses discovering about an 80 percent similarity in their amino acid and genetic code, and that they bind to the same receptor [6]. As such, this medical data of novel coronavirus needs to be preserved and digitally maintaining its security and patients' privacy is paramount. Moreover, it is to facilitate the research and development of vaccinations and drugs for the COVID-19 and future pandemics. The COVID-19 medical findings, events and patients' health data can be stored as distributed ledger maintaining a single source of information that should be accessible to all nations. Such medical data recording can be done using Blockchain technology that provides characteristics like shared database, validation, distributed trust, and immutable records.

2.2. MOBILITY CONTROL OR QUARANTINE TO CONTAIN CONTAGION

Just before COVID-19 was labelled as a pandemic, air travel practices could facilitate a COVID-19 infected individual in reaching almost anywhere in the world within a matter of hours and then even after it was declared a pandemic some countries had still not regulated international travel. As such, this made containment of contamination almost impossible mainly due to the undoubted mode of transmission of COVID-19. Many governments have since restricted or advised against all or non-essential travel both domestic and international and also imposed quarantines, entry bans, and other restrictions for citizens [7]. Contact tracing is an important method for health authorities and the government to determine the source of an infection and to prevent further transmission by ensuring social distancing. As such, trace and track of infected personnel and flow of authenticated information is needed to help the government in containment of the virus and its victims. Blockchain technology has the factors of immutability (the ability of a blockchain ledger to remain unchanged and indelible), accountability (keep authorized users responsible for any transaction) and sharing of data (with proper authentication from anywhere anyone can access) without third party intervention. Thus, the adoption of such technology to keep record of COVID-19 related health data can be one of the options to track down and contain the infected with authenticity and has the potential to transform the auditing process into a quick, efficient, and cost-effective procedure bringing more trust and integrity to the data businesses use and sharing.

2.3. FUTURE RESEARCH ON PANDEMICS

In an outbreak of a transmittable disease it is important to study and analyze all available data to identify the root causes, to prevent continued spill over, to have a better understanding of the disease's transmissibility in terms of times and context (country) and who is more susceptible to infection [8]. Scientists and health driving forces around the world are currently pursuing research and clinical trials

to explore such transmission dynamics; investing time, cost and other capitals. However, it may not be surprising to know that many research groups are working to investigate the same research question, following the same experimental approach, which might be termed as a failed approach by other researchers. Therefore, it is important for the research scholars to collaborate their findings to avoid duplication of works, waste of time and costs, and to guard against future pandemics. This needs for sharing of information, materials and expertise among each other to combat against pandemic. Blockchain technology provides logical inclusion that support transactional dependency and transaction rules that help government and epidemiologist for sharing such dataset, even across the border to reach and accumulate the global knowledge in single hub to foster the research process and to obtain the optimum outcomes within a shortest possible of time. It will also enhance subsequent research on future pandemics.

2.4. TRANSPARENCY IN PANDEMIC DATA

There is much inaccurate statistical information about the infected number of COVID-19 patients around the world [9]. In this vein, several studies, using a variety of methods, have also estimated that numbers of infections in many countries are likely to be considerably greater than the reported numbers [9]. Again, excessive secrecy can undermine the quality of public decision-making and prevent citizens from controlling public power which can have a corrosive effect on virtually all aspects of society and governance [10]. Therefore maintaining transparency of pandemic data during world public health emergency is needed for public decision making and good governance. Data transparency can be ensured through the architectural characteristics of Blockchain which includes disintermediation, trusted time-stamping (assists insecurely keeping track of the creation and modification times of a data record), immutable records and encrypted data transmission.

2.5. TRANSACTIONS AND QUALITY OF PANDEMIC DATA

Data quality plays a major role in revealing facts through research. Fictitious clinical data can be a serious threat to research particularly in clinical research findings [11]. During this pandemic situation most of the COVID-19 data is being collected from various sources, including WHO, U.S. CDC, ECDC China CDC (CCDC), NHC, DXY [12] and other news industries. As COVID-19 has spread around the world, false and misleading information has spread with it [13], which may lead to false conclusions. Moreover, a unified set of data around the globe is required to be stored, processed and gained access to which can create transaction process system (TPS) for the system stakeholders. Blockchain can support scalability (facilitate for higher TPS), as well as ensure correctness and quality of data through its service perspective and immunity, thus

greatly contribute to the quality and transfer transactions of pandemic data.

3. CONCLUSIONS

The vulnerable situation created due to the COVID-19 pandemic has shown the necessities of developing a single sourced Blockchain based pandemic health record management system to address the several existing and future challenges. This is re-enforced by the fact that the US Secretary of State has stated that every country needs to share all the data they have on the coronavirus and to do so as quickly as possible [14]. Similarly, a few specific countries have already introduced locally a Blockchain based COVID-19 data recording and management system to help fight against the COVID-19 pandemic [15], which could be studied as a viable world-wide solution. Storing, sharing and accessing data as a single source of information (database) of COVID-19 pandemic data through Blockchain is the most crucial concern to address the previously stated challenges; but still there are many issues that need to be resolve by the international health organizations, country leaders/governments, and international policy makers to introduce government to government digital health service related policy, data sharing act, health policy, as well as the issues of digital connectivity, digital inequality and digital divide that exists primarily in the least- and under-developed countries around the world - this pandemic situation is the perfect opportunity for humanity to bring all countries regardless of their differences under a single umbrella for ensuring world health safety, and for fighting against the COVID-19 and future pandemics.

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