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Big data analytics and COVID-19 vaccine

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ABSTRACT

COVID-19 has severely affected almost every aspect of society worldwide. During the uncertainties of this pandemic, COVID-19 vaccines were a new hope. In particular, Covid's monitoring of the information, big data analysis played a major role. What started as the basic use of big data analysis is the core component of worldly initiatives Therefore, based on enlightening experiences of big data application for fighting the pandemic, this research focuses on the ethical objectives to be promoted in vaccine delivery, assessing the potential effect of big data analytics on reaching these goals by enabling people to receive a digital passport or certificate.

1. Introduction

Nearly every aspect of society in the world has been severely affected by COVID-19. Rapid growth in disease cases has led to extensive planning needs [1]. COVID-19 vaccines have been a new hope during the uncertainties of this pandemic. But this is confused with numerous challenges [2].

The demand for related information and situational awareness is unusually strong during a significant social crisis, according to the idea of media reliance, and the media are widely regarded to best provide these needs [3].Because of the rapid growth of data in modern society as a result of the development of multiple information technologies and the widespread use of social media [4], the notion of big data arose to provide new meaning and value to a large amount of data already available [5].

Big data is described as information technology that generates important information from massive amounts of data in a practical and efficient manner in order to forecast the future. It differs from previous data in terms of amount, speed, and type of data. It also refers to a high number of massive data sets that exceed the storage, management, and analysis capabilities of a standard database [6].

Particularly, in monitoring of Covid's information big data analysis has played an important part. The core substance of worldly initiatives is what started as the fundamental use of Big data analytics [7].On the other hand, due to the introduction of vaccines and passports, the world has escaped the initial fear. Governments across the globe are taking new measures, such as Covax, to simplify the distribution of vaccines to poor countries.

Therefore, based on enlightening experiences of big data application for fighting the pandemic, this research focuses on the ethical objectives to be promoted in vaccine delivery, assessing the potential effect of big data analytics on reaching these goals by enabling people to receive a digital passport.

2. Challenges

2.1. Ethics surrounding vaccine distribution: The case of COVID-19

The first step in evaluating the ethics of the COVID-19 vaccine allocation is to examine it's intended objectives. The proposed objectives for future COVID-19 vaccination camps include the reduction of morbidity and mortality, minimizing social and economic impacts of the pandemic, and unfair health inequalities [8]. The identification of these objectives provides criteria for evaluating the ethical effects of various vaccine allocation strategies. However, even with these defined goals in place, there are still numerous complexities regarding the best way of achieving these goals and how possible compensation measures should be weighed up.

A robust supply system will be required for successfully implementing the COVID-19. vaccination programs. Such systems are to ensure efficient storage, handling, and inventory management of vaccines, rigorous supply chain temperature controls, and proper logistic information systems. [9]. Vaccine supplies are at risk if there are no reliable surveillance measures when they reach a hospital or public health facility administering the vaccines. Public health facilities can rob the black market or private resale vaccines of their own. The risk is especially marked if supplies and demand are small, as is the case in a pandemic [10].

2.2. COVAX global allocation approach

Unfair access to vaccines is no unprecedented one. Rich countries bought most of the global supplies of influenza pandemic vaccine for the 2009 H1N1 influenza pandemic, leaving insufficient amounts to resource-poor countries, many of which were among the worst affected countries in the world [11]. To avoid repetition of the H1N1 scenario, WHO announced in April 2020 the establishment, in collaboration with CEPI and Gavi, of a global allocation mechanism for COVID-19 Vaccine Global Access (COVAX) [12].

Apart from the physical work on distributing vaccines, technology plays a major role and tracks the numbers equally. The data dashboards

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are used for the most recent information on the Covid-19 world vaccine market and on the delivery of Covax facilities [13]. The data table provides a detailed picture of the development and progress of vaccine approvals, the global capacity of vaccine production, production agreements, bilateral and multilateral supply agreements, and vaccine prices. It also offers an outlook on total daily deliveries, assigned doses, and orders of Covax vaccines.

2.3. Transparent and responsible procurement of vaccines

During a pandemic, transparent and accountable public emergency procurement processes are essential, and e-procurement will help. E-procurement has the potential to be a powerful tool in the fight against corruption. It enables the public dissemination of relevant data, such as contract bidding and awarding, through a dedicated website, ensuring transparency [14].

2.4. Vaccines Passport

Anti-bodies are shown as a type of currency in the COVID-19 era, allowing "certified" individuals to return to work or travel [15].Anti-bodies to SARS-CoV-2 (the COVID-19 coronavirus) could serve as the Vaccine passport in this case. A vaccine passport is documentation that a person has tested negative for specific illnesses or has been immunized against them [16].

However, with clinical unknowns, as well as legal and ethical complexities, the concept is a changing target [19]. Some persons may have SARS-CoV-2 antibodies that are false positive, leaving them with no protection against their first infection [21]. Patients who had previously tested positive for SARS-CoV-2 RNA (active infection with or without symptoms) but negative for SARS-CoV-2 antibodies are another possible scenario that has been reported [22]. Those who have negative antibody test results could employ various means of identity theft to fake a positive result. The ethical call is to think about these antibody-related issues ahead of time in order to develop systems that are therapeutically safe, fraud-resistant, and discrimination-free.

3. Role of big data analytics to risk-reduction measures

In the face of these major challenges, the following immediate and long-term measures for the identification and mitigation of risks that could compromise access to safe and effective COVID-19 population-based vaccines should be considered by the Member States.

3.1. COVID-19: Big Data Resources Associated with Major Public Health Incidents

Big data analytics can achieve high speeds, discover and analyze high volumes and varieties of data to extract value by developing a new generation of technology and architecture. In healthcare, transport, finance, logistics, supply chains, manufacturing, and other industries the large-scale data technology has been widely used. These new data storages and analytical technologies offer key decision-making support for analyzing huge data quantities. We have summed up the following big data sources, which can be used to support and implement pandemic prevention and control, to combat important incidents of public health in category COVID-19 [17].

3.2. Alleviate the risks by secure storage and dispatch systems

For the safe supply of COVID-19 vaccines and the risk mitigation for vaccines to be transferred from public supply to black markets, secure storage systems and distribution systems are critical. This may include the use of a global tracking system for the monitoring of transport supplies [18].for rigorous supply chain temperature controls and proper logistic information systems technology plays an important role such as, by equipping every thermal shipper with GPS-enabled thermal sensors and a control tower that will monitor the position and temperature of each vaccine shipment as it travels along pre-determined routes [19].

3.3. Digital Vaccine Passport

Vaccination passports or certificates have been digitized using these technologies. Digitization is a standard technique for saving time and effort when it comes to managing data for vaccination passports. In terms of the vaccine passport, digitization has the potential to make contact tracing easier. Contact tracing is critical for COVID-19 in order to quickly identify cases and their contacts and prevent resurgence. Furthermore, it will restore life to the way it was [20].

3.4. How big data can be used for experience improvement

The core component of worldly initiatives is big data analytics now. Customer experience depends on data efficiently and successfully. Typically, these data are collected by companies to understand the attitudes of their customers and to offer customized on-demand services to make consumers happier. This customer database collection supports companies with competitiveness in the market, user productivity, sales, and ultimately client experience. Big data analytics is convenient to support. Big data analysis makes it even more convenient for customers to receive response support across the preferred platforms [21].

4. Conclusion

To ensure that every subsequent allocation strategy advances the intended public health objectives for COVID-19 vaccination: namely, to minimize morbidity and mortality loss, avoid economic harms from the pandemic, and narrow unfair health disparities, proactive preparation for the ethical distribution of vaccines toward COVID-19 is essential. There is no single method of prioritization that can successfully achieve all objectives. Instead, a multifaceted strategy should be enforced, considering the possibility of severe COVID-19 disease, instrumental importance, and transmission risk.

To deal with these challenges, big data is an effective tool for assisting in the prevention and management of risk in vaccine assignments. Governments should allow full use of big data in an outbreak situation in all areas of prevention and control, and they can use big data analytics to enhance the epidemic prevention process. Data collection systems for the Internet of Things, mobile devices, navigation and search engines, social media, and large-scale gene banks can all be completely developed in terms of knowledge collection.

Recommendations

Some recommendations such as using big data with other emerging technologies to develop new COVID-19-fighting solutions, should be investigated. For example, Oracle cloud computing data analysis technologies were used to build a vaccine, a new vaccine candidate against the COVID-19 virus [22]. Such type of idea should be addressed in future research and applications to aid stakeholders including governments, Mohs, hospitals, patients, and accountable authorities in making decisions and forecasting the future.

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Authors' contributions

The authors of this manuscript are FA and YY. FA is the main investigator of the study. FA made a considerable contribution to the study design and drafting of the manuscript and YY was involved in

critically reviewing the manuscript. All authors read the final document and approved it.

Availability of data and materials

The data set used and/or analyzed during the current study is available from the corresponding author upon reasonable request.

Declaration of Competing Interest

The authors declare that they have no competing interests.

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References

[1] Lee D. Unemployment hits 14.7% in April. How long before 20.5 million lost jobs come back? 2020. Available: https://www. latimes. com/politics/ story/ 2020- 05-08/ jobs- report- labor- market- shock [Accessed 3 Jun 2020].
[2] KA. Bramstedt, Antibodies as Currency: COVID-19's Golden Passport, J Bioeth Inq (2020).
[3] S.J. Ball-Rokeach, M.L DeFleur, A dependency model of mass-media effects, Commun. Res. 3 (1976) 3–21.
[4] Q. Luo, D. Zhong, Using Social NetworkAnalysis to ExplainCommunication Characteristics ofTravel-Related Electronic Word-of Mouth on Social Networking Sites, Tour. Manag. 46 (2015) 274–282.
[5] G. George, M.R. Haas, A. Pentland, Big data and management, Acad. Manag. J. 57 (2014) 321–326.
[6] R. Gonzalez, J. Llopis, J Gasco, Social networks in cultural industries, J. Bus. Res. 68 (2015) 823–828.
[7] Analytics insight,HOW BIG DATA ANALYTICS CAN BE USED TO IMPROVE CUSTOMER EXPERIENCE?,available at:https://www.analyticsinsight.net/how-big-data-analytics-can-be-used-to-improve-customer-experience/, 2020.
[8] Interim updated planning guidance on allocating and targeting pandemic Inf luenza vaccine during an influenza pandemic, centers for disease control and prevention (2018).
[9] World Health Organization, Immunization supply chain and logistics. www.who.int/immunization/programmes_systems/supply_chain/en/, 2020.
[10] T. Koller, D. Clarke, T. Vian, Promoting anti-corruption, transparency and accountability to achieve universal health coverage, Global Health Action 13 (2020). Issue sup1 and Patricia J. Garcia,Corruption in global health: the Lancet.
[11] WHO. Report of the WHO Pandemic Influenza A(H1N1) Vaccine Deployment initiative. 2012. https://www.who.int/influenza_vaccines_ plan/resources/h1n1_deployment_report.pdf (accessed Dec 19, 2020).
[12] Gavi, the Vaccine Alliance. COVAX explained. Sept 12, 2020. https://www.gavi.org/vaccineswork/covax-explained (accessed Jan 14, 2021).
[13] Apoorva Bellapu,REAL-TIME DATA STREAMING: LEVERAGING THE POSSIBILITIES OF DATA ANALYSIS(2021),https://www.analyticsinsight.net/real-time-data-streaming-leveraging-the-possibilities-of-data-analysis/.
[14] United Nations Office on Drugs and Crime, Guidebook on anti-corruption in public procurement and the management of public finances, op.cit (2013).
[15] J. Bartlett, Chile's "immunity passport" will allow recovered coronavirus patients to break free from lockdown, get back to work, Washington Post (2020). April 20. https://www. washingtonpost.com/world/the_americas/chile-coronavirus- immunity-passport-anti.
[16] What Is a Vaccine Passport? WebMD. (n.d.) (2021) https://www.webmd.com/vaccines/covid- 19-vaccine/vaccine-passport-covid (accessed March 20).
[17] J.S. Ward, A. Barker, Undefined by data: A survey of big data definitions, arXiv 1309 (2013) 5821, arXiv.
[18] United Nations Office on Drugs and Crime, State of integrity: A guide on conducting corruption risk assessments (2020) www.unodc.org/documents/corruption/Publications/2020/State_of_Integrity_EN.pdf.
[19] Daniel Bukszpan,The challenges Pfizer faces distributing its Covid-19 vaccine to the masses(2020),https://www.cnbc.com/2020/11/25/challenges-pfizer-faces-distributing-covid-19-vaccine-to-the-masses-.html.
[20] Tracking COVID-19: Contact Tracing in the Digital Age, (n.d.). https://www.who.int/news-room/feature-stories/detail/tracking-covid-19-contact-tracing- in-the-digital-age (accessed March 20, 2021).
[21] Analytics insight,HOW BIG DATA ANALYTICS CAN BE USED TO IMPROVE CUSTOMER EXPERIENCE?(2021),https://www.analyticsinsight.net/how-big-data-analytics-can-be-used-to-improve-customer-experience/.
[22] V. Rees, "AI and cloud computing used to develop COVID-19 vaccine," 2020. [Online]. Available: https://www:drugtargetreview:com/news/59650/ai-and-cloud-computing-used-to-develop-covid-19-vaccine/.

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