Jurnal
ILMU KEPOLISIAN
ISSN : 2620-5025
E-ISSN : 2621-8410

Vol. 18, No. 2, 2024

Shielding Public Health: Indonesian National Police (INP)'s Measure Against COVID-19 Vaccine Certificate Forgery

Submitted 24 June 2024, Revised 26 July 2024, Accepted 26 July 2024, Published 14 August 2024

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DOI: https://doi.org/10.35879/jik.v18i2.461

Abstract

The purpose of this study is to discuss the benefits of implementing several strategies carried out during the COVID-19 period. COVID-19 vaccine certificate forgery has posed a threat to public health. The Indonesian National Police (INP) has implemented various strategies to overcome this crime. The intervention strategies involve early detection and prevention, such as cyber patrol, border control, public involvement, and strict law enforcement. Other countries have also carried out similar measures; however, there are several additional strategies, such as the formation of a special force as well as utilizing blockchain technology for a more secure digital vaccine certificate system. These strategies could be a benchmark for the INP in handling cases of letter forgery.

Keywords: COVID-19 Vaccine Certificate Forgery, Global Comparison, Indonesian National Police

INTRODUCTION

The severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was first identified in China in December 2019. The virus swiftly spread worldwide, prompting the World Health Organization (WHO) to declare a Public Health Emergency of International Concern (PHEIC) on January 30, 2020. The situation escalated, hence the WHO officially classified it as a pandemic on March 11, 2020 (WHO, 2020). On 22 May 2020, SARS-CoV-2 infected approximately 4,995,996 individuals with confirmed cases and deaths of about 327,821 people in 216 countries (WHO, 2020), and the number is increasing worldwide. Indonesia reported its first confirmed case of COVID-19 on March 2, 2020. This marked the beginning of the pandemic within the country (Rozalini et al., 2020). The epidemiological landscape in Indonesia has been profoundly affected by the COVID-19 pandemic. As of August 9, 2023, the nationwide transmission has been indicated by the country's report of over 6.8 million confirmed cases and more than 161,900 deaths (Worldometer, 2023).

However, the actual numbers of cases and deaths are suspected to be significantly higher due to many unconfirmed cases (Megasari et al., 2021).

The primary modes of SARS-CoV-2 transmission include respiratory droplets generated by coughing, sneezing, talking, and contact with contaminated surfaces (Punn et al., 2020; Rauf et al., 2021). The transmission of COVID-19 via international travel poses a significant concern; therefore, various countries have been implementing diverse control measures (Petersen et al., 2021). Primary public health strategies have emphasized non-pharmaceutical interventions (NPIs) in the early stages of addressing the COVID-19 pandemic. This has involved the strict implementation of physical distancing protocols, movement limitations, and lockdowns. In response to the pandemic, the Indonesian government has immediately implemented these social distancing protocols, extensive testing, and contact tracing to control the virus's transmission. However, these travel restrictions have had notable social and economic implications (OECD, 2020; Correia et al., 2020; Kimberly, 2020), particularly in low- and middle-income countries (LMICs). They have disproportionately affected vulnerable populations, causing job losses, disrupted education, economic shutdowns, hindered access to essential health and public services, and increased food insecurity (Kimberly, 2020). WHO has criticized blanket travel bans that impose significant hardships on both lives and livelihoods more than preventing the international spread of the virus. All countries are encouraged to reassess and revise their measures regularly (WHO, 2021). Policymakers are exploring alternative strategies to lockdown as they consider easing current restrictions.

Immunization has effectively controlled outbreaks of diseases throughout history, such as smallpox and yellow fever (compulsory for travelers to and from endemic areas) (Wagner et al., 2019). Hence, international efforts have been established to distribute vaccines to combat SARS-CoV-2 (Petersen et al., 2021). As of April 14, 2021, vaccination is underway in at least 171 countries despite the challenges (Eisenstadt et al., 2020). The Indonesian government took proactive steps to secure vaccines early, finalizing procurement in 2020. By January 2022, the goal was to administer 426 million doses from various suppliers. This effort aimed to vaccinate over 181 million citizens to achieve herd immunity (Arifin et al., 2021; Fuady et al., 2021). By November 21, 2021, 32.2% of Indonesia's general population had been fully vaccinated (Marzo et al., 2022). Global efforts to distribute COVID-19 vaccines have prompted implementation of novel public health strategies, such as vaccine mandates and certification systems (Hall and Studdert, 2021). To enhance vaccination rates, proposals for COVID-19 immunity certificates have been advanced for individuals who are fully vaccinated or have recovered from the virus. These certificates contain personal details, vaccination dates, and dosage information (Eisenstadt et al., 2020). Beyond providing proof for accessing public events and air travel (Khan et al., 2022), these certificates also serve as incentives to bolster public participation in vaccination campaigns (Hu et al., 2021).

Traditional immunization certificates or cards rollout, however, face considerable challenges such as vulnerability to forgery (Marhold et al., 2021), corruption, alterations, readability issues for non-health professionals, prone to being misplaced and susceptible to damage from rain (Wagner et al., 2019). During the pandemic, a hidden marketplace promoting counterfeit COVID-19 test, and vaccine certificates has rapidly expanded, involving over 1,200 vendors worldwide, including in the UK (BBC, 2021). The forgery of vaccination certificates is extremely dangerous and harms not only the individual but also others. Unvaccinated individuals with forged certificates face a heightened risk of contracting COVID-19 and, if infected, are more likely to experience severe symptoms. When such individuals become infected, it poses a significant risk to those around them (Kemenkes, 2021; Aisyah et al., 2022). Therefore, researching COVID-19 certificate forgery is crucial to ensuring public health safety. Counterfeit vaccine certificates have gained media attention in Europe (Ambrose, 2022; Euractive, 2021), the United Kingdom (Raj 2021), the United States (Department of State, 2021), Africa (Mawa Foundation, 2022), Australia and New Zealand (Arnold 2022), and Asia including various cities in Indonesia (Pengadilan Negeri Klaten, 2021; Pengadilan Negeri Makasar, 2022). Although there is some literature discussing COVID-19 certificate forgery (Heghes, 2021; Nasution, 2022; Georgoulias et al., 2023; Kotian et al., 2023), there are still limited studies that specifically address the police strategy to intervene in this crime, particularly in the Indonesian context.

The INP has implemented proactive measures to address the threat of COVID-19 vaccine certificate forgery, emphasizing the importance of ensuring the authenticity of vaccination documentation. This study thoroughly reviews the INP's strategy against vaccine certificate fraud by analyzing domestic case studies and comparing global approaches to provide insights for guiding future policies and supporting public health efforts.

METHOD

This study employs a document analysis to discuss the domestic case studies and a literature review to compare global strategies. Document analysis is a qualitative method used to examine and interpret data to extract meaning, gain insights, and generate empirical knowledge (Bowen, 2009; Nasri, 2023; Dalgish et al., 2020). Meanwhile, the literature review is characterized as a comprehensive evaluation of existing knowledge on a specific research topic, encompassing the associated themes and the diverse viewpoints articulated (Psarommantis and May, 2023).

We developed a comprehensive search strategy for the literature review using academic databases (e.g., PubMed, ScienceDirect, Google Scholar), institutional repositories, government publications, and grey literature. The keywords used include: "COVID-19 vaccine certificate", "COVID-19 vaccine pass" or "COVID-19 vaccine passport", "COVID-19 immunity certificate", and "forgery" or "fake" or "counterfeit" or "falsified" or "falsification" or "fabricated", and "law

enforcer" or “police officer” or “police”. Initially, our search strategy yielded 5,490 articles. Due to duplication, 855 articles were excluded, 3,681 studies with inappropriate titles and abstracts were excluded, 302 were excluded due to unavailable full text, and 174 studies with inappropriate methods and outcomes were excluded. After a thorough and detailed review of 478 studies, irrelevant studies or those lacking empirical data or critical analysis were excluded. Finally, data extraction was done for the three articles and four news. The essential data elements, including author, year, location, detail of forgery, and police officer strategy, were extracted from selected studies. Then, we synthesized findings to identify common themes, trends, and gaps related to COVID-19 vaccine certificate forgery and law enforcement responses.

We collected publicly available documents from the INP and other relevant sources about their measures against COVID-19 vaccine certificate forgery for the document analysis. We analyzed policy documents, reports, official statements, and case studies to understand the INP's strategies, challenges faced, and outcomes achieved. We compared findings from the national case studies gained from the document analysis of the INP's measures with the literature review of global comparison insights to identify lessons learned and best practices for enhancing strategies against vaccine certificate forgery.

RESULTS AND DISCUSSION

Domestic Case Studies

No	Location	Detail of forgery	Legal Basis	Strategy
1	East Java (Malang District Court, 2021)	COVID-19 vaccine certificates were promoted through social media and then edited using editing apps (e.g., CorelDraw and Photoshop) to make a fake certificate and alter the data based on the buyer's request. Outreach: 23 vaccine certificates Profit: IDR 5.000.000	Article 263 paragraph (1) of the Criminal Code Jo Article 55 Paragraph (1) to 1 KUHP.	Cyber Patrol on Facebook by INPs.
2	Jakarta (North Jakarta District Court, 2021)	COVID-19 vaccine certificates were promoted through Facebook. Then, he downloaded the vaccine certificate online and edited it through CorelDraw apps to fit the buyer data. After everything was finished, he sent it on an expedition.	Article 263 paragraph (1) of the Criminal Code Jo Article 55 Paragraph (1) to 1 KUHP.	Expedition screening and checking.

3	East Java (Surabaya District Court, 2022)	The defendant produced fake COVID-19 vaccine certificates for between IDR 150,000 and IDR 325,000, depending on the dose and speed of production. The defendant made the certificates without administering the vaccine, only by sending ID cards and phone numbers. The information was then published to the website https://Pcare.bpjs-kesehatan.go.id.	Article 35 Jo. Article 51 of the Law No. 11 of 2008 Jo Article 55 Paragraph (1) to 1 Criminal Code or Article 263 paragraph (1) of the Criminal Code Jo Article 55 Paragraph (1) to 1 Criminal Code.	The audit results show that the number of vaccine certificates and the number of vaccines administered do not match.
4	Riau Islands (Batam District Court, 2021)	A promotional video for fake COVID-19 vaccine certificates is advertised on social media. Orders are placed online, and the counterfeit certificates are delivered to the orderer and submitted to the government website. One vaccination certificate costs IDR 1,200,000.	Article 263 paragraph (1) of the Criminal Code Jo Article 55 Paragraph (1) to 1 Criminal Code.	Audit report on vaccine implementation at TAJ Sports Hall, Batam.
5	South Sulawesi (Makassar District Court, 2021)	Fatma (offender) started working at the Paccerakang Health Centre in Makassar as a volunteer without being registered as a vaccination officer. She used PCare access to create fake certificates. She used other people's ID cards and phone number data, fabricated information, and sent counterfeit certificates via PCare. She received payments ranging from Rp 50,000 to Rp 100,000 per certificate. Outreach: 179 vaccine certificates	Article 35 Jo. Article 51 of the Law No. 11 of 2008.	Community report and audit results between the number of vaccinated people and the number of vaccine certificates.
6	Central Java (Klaten	COVID-19 vaccine certificates were promoted through Facebook. Then,	Article 263 paragraph (1) of	Community report.

	District Court, 2021)	offenders downloaded the vaccine certificate online, edited it through PicCart apps to fit the buyer data, and sent it to the buyers.	the Criminal Code Jo Article 55 Paragraph (1) to 1 Criminal Code.

Table 1. Analyses of domestic case studies on COVID-19 vaccine certificate forgeries

Based on Table 1, the case studies are spread across various locations in Indonesia, including Sumatra, Java, and Sulawesi islands. The majority of the modus operandi of this crime is promoted through online media (e.g., Facebook) and then edited using editing applications (e.g., Photoshop, CorelDraw, and PicCart) (Pengadilan Negeri Malang, 2021; Pengadilan Negeri Jakarta Utara, 2021; Pengadilan Negeri Klaten, 2021). Financial transactions are conducted with varying profits, and communication is done online, although some cases are still promoted conventionally. The case in Batam was carried out by an individual who had access to the national vaccine data center, originating from healthcare workers themselves, by uploading the fake vaccine certificates to official government applications and websites (Pengadilan Negeri Batam, 2021). This abuse of power poses a significant danger, especially with the potential for citizens' privacy data leaks.

Global Comparative Analysis

No	Country	Detail of forgery	Strategy
1	Australia (Childs, 2023)	Alt-tech platform Gab online illicit networks and the development of illegal markets on the Internet.	Exploration of online distribution.
2	Nigeria (Ali et al., 2024)	An undercover investigation conducted by the Media Advocacy West Africa Foundation (MAWA-FOUNDATION) in three states of Nigeria Plateau, Ebonyi, and Gombe states and the Federal Capital Territory uncovered how Nigerian Health workers accept bribes to issue COVID-19 cards without administering the vaccine.	Involvement of local foundation, where they visited some of the Primary Health Care Centers, pretending to need COVID-19 certification cards.

3	Philippines (Calunsag et al., 2022)	The police detected non-compliance with border entry regulations, where travelers submitted falsified documents.	Border control and the use of the S-Pass, a travel management system, enable travelers to be monitored within their jurisdictions and verify the authenticity of presented travel documents with the assistance of local government units (LGUs).
4	Italy (Euractive, 2021)	The police have taken over ten Telegram accounts associated with anonymous dark web marketplaces. These channels facilitated contact with sellers who demanded cryptocurrency payments, with prices ranging from €110 to €130 for an “all-inclusive” package of fake passes and purported vaccine vials. About a hundred of approximately 250,000 registered users, including some from outside the EU, attempted to interact with the sellers.	They seized control of telegram and the dark web.
5	France (The Guardian, 2021)	Fraudsters were reported to have hacked the accounts of doctors across the country to obtain false documents.	Report from doctors (society).
6	Germany (BBC, 2021)	1) Telegram has become a central platform for anti-vaxxers, with blank certificates and doctors' stamps readily available online. 2) A Munich doctor is suspected of vaccine certificate fraud. 3) Fake certificates are being offered at vaccination centers. Some people are deceived into paying approximately €100 (£86; $122) but receive	A special task force has been set up to counter the black market. They enforce strict penalties, including potential prison terms

		nothing in return. Fraudsters often use cryptocurrency and an encrypted messenger service, complicating investigations.	for convicted fraudsters. The police searched a doctor's clinic suspected of selling fake certificates.
7	United States (US Department of State, 2021)	A California-licensed naturopathic doctor engaged in a scheme to sell fake healthcare records to her customers.	Complaints from members of society.

Table 2. Analyses of global case studies on COVID-19 vaccine certificate forgeries

Table 2 shows the dark web, Telegram, and some unethical doctors who sell fake certificates contribute to the issue. The price of these counterfeit certificate's ranges from €100 to €130 in Germany (BBC, 2021). Global comparative analysis indicates countries are implementing similar strategies, including cyber control, border control, and legal actions against offenders. However, some countries are progressing further by establishing special task forces, developing digital identification systems, and using blockchain technology to prevent and detect vaccine forgery.

Indonesian National Police (INP)'s Measures

The INPs have implemented strategies and actions to tackle this crime, such as detection and prevention, prosecution, and cooperation with multiple stakeholders.

Detection and Prevention

Monitoring

The INPs have intensified surveillance to detect forged vaccine certificates through regular monitoring and on-site inspections (e.g., border control) and cyber patrol.

Cyber patrol

According to the Regulation of the National Police of the Republic of Indonesia Number 3 of 2024, the Indonesian National Police (INP) has established a specialized organizational structure to address cybercrimes. The INP is tasked with maintaining the security of netizens in cyberspace through supervision, prevention, and enforcement of various forms of cybercrime. Additionally, the institution plays an active role in educating the public about implementing the Information and Electronic Transactions Act (ITE) to prevent netizens from becoming victims or perpetrators of

cybercrime. Through this collaboration, Indonesia can achieve secure and trustworthy digital sovereignty (Patrolisiber, 2024).

The forgery of COVID-19 vaccination certificates in Indonesia has extended into cybercrime, as exemplified by several cases promoted through Facebook and other applications involving online transactions. Cyber patrols have proven to be an effective strategy for the INP to tackle this issue. Through the Ministry of Health (Kemenkes), the government has appreciated the INP for uncovering cases of forged COVID-19 vaccination certificates in West Java (Kemenkes, 2021). Furthermore, the cyber patrol conducted by the INP in Yogyakarta has shown positive results in detecting the forgery of COVID-19 vaccination certificates (Erlin, 2023).

Border control

Indonesia's archipelagic nature provides multiple access points for entering an area, such as by land, sea, and air. The INP conducts screenings for various possible crimes distributed through the movement of people and goods between districts and cities in Indonesia. This strategy involves collaboration with relevant parties, such as the Ministry of Transportation of the Republic of Indonesia. Anggraini et al. (2022) revealed a circular from the Ministry of Transportation strengthening the penalties for using forged vaccination certificates. This indicates that the INP works with others in this strategy but is supported by relevant ministries. The police monitor not only the movement of people but also the movement of goods between districts and cities. For instance, in the case of certificate forgery in North Jakarta, falsified COVID-19 vaccination certificates sent via delivery services were detected and identified due to the strategy of inspecting goods shipped by these services (Pengadilan Negeri Jakarta Utara, 2021). The Bali Regional Police also employed this strategy. In eastern Bali, bordering West Nusa Tenggara, they successfully uncovered cases of forged vaccination certificates through border checks in sea transportation routes (Fawaidi and Agriesta, 2021).

Public Awareness and Community Involvement

Public awareness campaign

Public cooperation was vital for the success of INP's measures. Ensuring citizens knew the legal and health implications of using fake vaccine certificates was essential to the strategy. INP conducted extensive public awareness campaigns, utilizing social media, traditional media, and community outreach programs to educate the public about the dangers and consequences of vaccine certificate forgery (Patrolisiber, 2024a; Jumady, 2022). Through the *"Bimbingan masyarakat"* programme, the INP, in this case, *Bhabinkamtibmas (Bhayangkara Pembina Keamanan dan Ketertiban Masyarakat)* educated the public about crime prevention related to COVID-19 (Krisnawan and Lubis, 2024; Jumady, 2022; Kurnianto, 2021).

Community involvement

Furthermore, the community can also be involved in cyber patrols. Cyber patrols are conducted proactively by the INP and through a strategy that opens a community reporting portal for potential cybercrimes, particularly the forgery of COVID-19 vaccination certificates (Patrolisiber, 2024b). This collaboration with the community provides the INP with information to quickly identify targets for detection, thereby preventing more widespread damage or losses. Community reports have proven effective in assisting the INP to detect the forgery of COVID-19 vaccination certificates on several occasions (Pengadilan Negeri Klaten, 2021; Pengadilan Negeri Makasar, 2022).

The government has taken proactive steps to address the growing problem of vaccine certificate forgery by embedding a unique QR code on each original certificate provided to vaccine recipients. It makes it easy to distinguish between legitimate and counterfeit certificates. In addition, to combat the sale of fraudulent vaccine certificates, the government has set up a service called "Lapor Pak Kapolres" or *"Lapor Pak Kapolres"* or "Report to the Chief of Police," which allows the public to report any suspected illegal activities related to vaccine certificate fraud (Hafizh et al., 2022). For instance, The "Report to the Chief of Police Program" was launched in June 2021 at the Karawang Police Department, where residents of Karawang who witness or experience legal issues can now report directly to the Karawang Police Chief via the WhatsApp application. These reports are ensured to be promptly addressed by the relevant authorities. This program is open to any legal difficulties (Humaspolri, 2021). The police officers also socialize the "Report to the Police Chief" service to residents.

Through this program, INP has succeeded in investigating the COVID-19 certificate forgery-related cases. Hafizh et al. (2022) also shared a success story about this program; for instance, a university student in Karawang sold fake COVID-19 vaccine certificates without actual vaccination for IDR 5.000-100.000 via social media to friends seeking employment. Exploiting his access to the health department's website during an internship, he covertly offered fake certificates. A resident discovered his actions and reported them to the authorities through the "Lapor Pak Kapolres" program. This program serves as a trigger for involving the community and increasing public awareness of any dangerous and illegal activity. This initiative is crucial given the extensive responsibilities of the police and the existing staff shortages. Therefore, community engagement will facilitate, expedite, and make police preventive strategies, interventions, or repressive actions more effective and efficient.

Prosecution

The INP has implemented stringent measures to address and penalize criminal activities, including the forgery of COVID-19 vaccine certificates. Idham Azis, the chief of the INP, took

decisive action, as evidenced by a signed telegram letter ST/3220/XI/KES.7/ 2020 on November 16, 2020. This telegram urged the INP to take serious action against COVID-19-related crimes. As previously stated, forgery of the COVID-19 vaccine certificate is a crime related to COVID-19. Since the beginning of 2021, the INP has reported actions taken to prosecute 2,466 cases of document fraud, including COVID-19 vaccine certificate forgery (Pusiknas, 2021). This data shows that the INP has thoughtfully responded to address COVID-19-related crime. This repressive strategy must be connected to the aims of sentencing itself. The objectives of sentencing are the following: punishment of offenders, crime reduction, deterrence, reform and rehabilitation, and public safety (Gormley et al., 2023). Law enforcement efforts carried out by the INP are expected to ensure public safety, including mitigating health threats, by creating a deterrent effect for perpetrators and serving as a warning to those who intend to commit similar acts.

Multi-stakeholders' Approach in the Technological Solution

Given the digital nature of many forgeries, INP adopted various technological measures to prevent and detect fraudulent vaccine certificates. Collaboration with other relevant agencies was essential to ensure vaccine certificates were secure and tamper-proof. Implementing QR codes on certificates was a significant step in this direction. These QR codes could be scanned and verified against a central database, making it more difficult for forgers to create convincing counterfeit documents. This QR code feature is integrated into the PeduliLindungi application, conceived by the Ministry of Communication and Information Technology (Kominfo) and the COVID-19 Task Force through the collaboration of INP with the Ministry of State-Owned Enterprises (BUMN), National Disaster Management Authority (BNPB), Ministry of Health (Kemenkes), Indonesian National Armed Forces (TNI), and the Ministry of Administrative and Bureaucratic Reform. This initiative is based on the Decree of the Minister of Communication and Information Technology Number 171 of 2020 (Keputusan Menteri Kominfo Nomor 171 Tahun 2020), which establishes the PeduliLindungi application to conduct health surveillance in the management of COVID-19 (Fastyaningsih et al., 2021).

Indonesian citizens receive vaccination certificates after the COVID-19 vaccination, a government health facilities issue. These certificates, containing the National Identification Number (NIK), are sent via text message and can be printed by recipients. Additionally, certificates are now available for direct download from the PeduliLindungi app for easier access (Wibowo, 2021). One of the roles of the PeduliLindungi application is to facilitate public access to public facilities. The QR Code scanning feature is used to access public facilities, making it easier for people as they do not need to present a vaccination certificate (Fastyaningsih et al., 2021).

Global Comparison

The prevention of COVID-19 vaccine certificates has become a critical focus for police forces worldwide. The New York State Police have highlighted the severity of these crimes, underscoring the significant legal consequences for offenders (Department of State, 2021). Agencies like the Federal Trade Commission (FTC) and the Federal Bureau of Investigation (FBI) have proactively warned the public about the dangers and legal repercussions of using or distributing fake vaccine cards. They emphasize the risk to public safety and encourage reporting such frauds to various authorities, including the Office of the Inspector General of the Department of Health and Human Services and the FBI's Internet Crime Complaint Center (Smith, 2021). In France, the health authority has reported a surge in forged certificates, leading to multiple police investigations and arrests of healthcare workers involved in issuing fake documents (The Guardian, 2021). Public awareness campaigns and media investigations play a significant role in their efforts to reduce the demand for forged documents (Pasyeka et al., 2022).

The repression of vaccine card fraud is also a priority in other countries. In Brazil, for example, police officers actively pursue charges in cases involving high-profile individuals. The National Police of Ukraine also considered this case a serious criminal act (Pasyeka et al., 2022). They detected a website that sells fake vaccine certificates, immediately shut it down, arrested the suspect, and collaborated with medical institutions and international bodies (Pasyeka et al., 2022).

Some countries have also taken serious action against this crime. In Brazil, law enforcement is actively pursuing charges in cases involving high-profile individuals, demonstrating a rigorous approach to combating this issue. The National Police of Ukraine classify the sale and distribution of fake COVID-19 vaccine certificates as a criminal act. They have implemented strategies to identify and shut down websites selling these forgeries, conducted arrests, and collaborated with medical institutions and international bodies (Pasyeka et al., 2022). However, some countries implemented additional strategies, such as creating a special force and applying blockchain technology.

Special Task Force Formation

Germany has established a special force to combat this crime, especially in the black market (BBC, 2021). The government aims to deter individuals and groups from engaging in such illegal activities by imposing severe punishments. In addition, the proactive police searches and investigations, including the recent raid on a doctor's clinic suspected of selling fake certificates (BBC, 2021), demonstrate Germany's serious commitment to tackling this issue, that no individual, regardless of their professional status, is above the law and that the authorities are committed to rooting out fraudulent activities at all levels.

Digital Identification System

To address the shortcomings of traditional vaccination cards, it is essential to create secure, electronic-based COVID-19 vaccination certificates or passports. These digital certificates must be tamper-proof, easily accessible, safe, and designed to protect individuals' privacy (design-by-ethics). This can be achieved by integrating emerging technologies to combat COVID-19 across various fields. Such technologies include artificial intelligence, geographical information systems, the Internet of Things, Medical Things, 5G technology, Blockchain, additive manufacturing, robotics, and virtual reality (Whitelaw et al., 2021; Mbunge et al., 2020). These innovations have been employed to develop advanced applications like contact tracing apps (Mbunge et al., 2020), social distancing tools, and intelligent wearable devices.

Many countries and regions, including Australia, India, Ireland, Canada, and the European Union, are initially implementing digital identification systems, including trials (Sheth and De Alcaraz-Fossoul, 2024). These systems typically involve digitalizing identities and centralized access to government services (Childs, 2023). This technology uses a QR code to verify the certificate (Sheth & De Alcaraz-Fossoul, 2024). Tamper-proof verification methods and encrypted databases might prevent certificate forgery and personal data leakage.

In Africa, the Africa Centers for Disease Control and Prevention launched Trusted Travel, a tool to simplify verifying public health documentation for travelers during exit and entry across borders (Mbunge et al., 2021). A comparable approach was adopted in the Philippines, where a visitor movement tracking system was implemented through the S-Pass. This system monitors travel to local destinations via a unique S-Pass QR code. The S-Pass is a travel management tool that provides the public with information on travel restrictions imposed by various Local Government Units (LGUs) due to the COVID-19 pandemic. It also aids the Philippine National Police (PNP) direct residents to other LGUs for travel document applications. It assists LGUs in monitoring travelers and verifying the authenticity of their travel documents (Nicole et al., 2021).

Blockchain Technology

Lackerbauer et al. (2018) proposed a Vaccine Passport validation system using Blockchain-based Architecture.

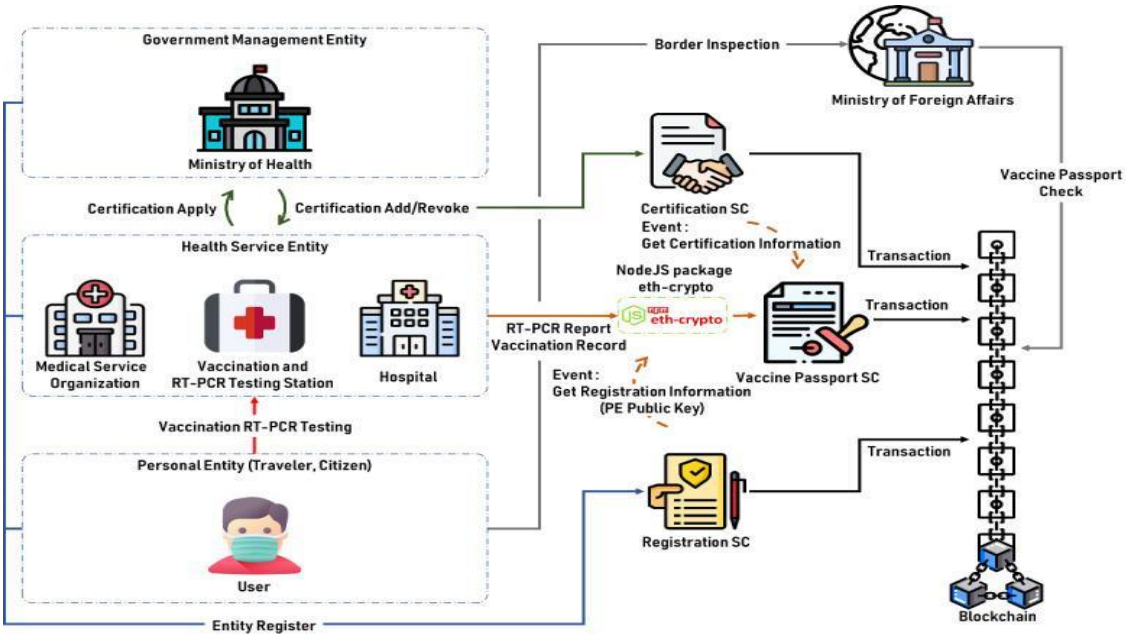

Figure 1. Overview of the blockchain architecture for VPs (Kissi et al., 2022).
PE: personal entity; RT-PCR: reverse transcription polymerase chain reaction; SC: smart contract; VP: vaccine passport

Artificial intelligence (AI) can effectively detect fake COVID-19 vaccination certificates when they are in digital format. It can also help identify and map non-vaccinated regions, aiding in strategic planning, provided digital COVID-19 vaccination certification systems are in place. Furthermore, AI can organize migration patterns based on data stored in verification applications and assist in contact tracing. Blockchain (BC) technology, with its immutable, transparent, and decentralized nature, offers a secure way to transmit information, ensuring the confidentiality of patients' data (Shah et al., 2021).

One instance of the utilization of Blockchain technology is NovidChain. The evaluation reveals that NovidChain outperforms other solutions regarding financial cost and scalability. Specifically, it demonstrates a significant improvement in operational time, with differences ranging from 46% to 56%. The assessment verifies that NovidChain maintains robust security features, including data integrity, forgery resistance, binding, uniqueness, peer-indistinguishability, and revocation (Abid et al., 2021).

To be effective, a certificate or passport must integrate two key components: access to a country’s official vaccination records and a secure means of linking individuals to their health records. Many policymakers advocate for blockchain technology as a solution to address these requirements. Even though literature reviews and case studies support the suitability of blockchain for vaccine passport programs, some ethical issues arise in its implementation. Therefore,

policymakers must address these challenges to ensure the effectiveness of such programs (Mishra, 2022).

CONCLUSION

In conclusion, the INP has implemented a comprehensive strategy to combat COVID-19 vaccine certificate forgery. This strategy encompasses three key components: early detection, prevention, and prosecution. For detection and prevention, cyber patrols are continuously conducted to identify fake COVID-19 vaccine certificates promoted on online platforms. In addition, the INP monitors the flow of people and goods crossing the border. Campaigns to raise awareness about the consequences of counterfeiting COVID-19 vaccine certificates are regularly carried out, and the public is encouraged to participate through the "Report to the Police Chief" program for prevention and public involvement. Strict legal processes are enforced to address these crimes and deter violators. A multi-stakeholder approach has also been adopted, collaborating with the Ministry of Communication and Information and the Ministry of Health to enhance certificate verification via QR codes on the *pedulilindungi* application.

Similar strategies have been employed globally, such as cyber patrols, border control, and prosecution. Several police forces have established special task forces to handle these cases particularly. Furthermore, many countries have also integrated QR codes into their verification systems, and some have enhanced their systems with blockchain technology. The INP and relevant stakeholders might also consider implementing these measures to strengthen public health safety.

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