PERSPECTIVE

Health Science Reports Open Access WILEY

Cognizance and mitigation of falsified immunization documentation: Analyzing the consequences for public health in Nigeria, with a focus on counterfeited COVID-19 vaccination cards: A case report

Victor E. Ali[1] | Marvellous O. Asika[1] | Emmanuel Ebuka Elebesunu[1] | Chioma Agbo[1] | Maxwell Hubert Antwi[2]

[1]Department of Medical Laboratory Science, University of Nigeria, Enugu, Nigeria

[2]Department of Medical Laboratory Science, Koforidua Technical University, Koforidua, Ghana

Correspondence
Maxwell Hubert Antwi, Department of Medical Laboratory Science, Koforidua Technical University, Koforidua, Ghana.
Email: maxwell.antwi@ktu.edu.gh

Abstract

Background and Aims: The global immunization campaign against COVID-19 has mandated vaccination certificates, leading to a surge in fake documentation. In Nigeria, the proliferation of counterfeit COVID-19 vaccination cards, facilitated by unscrupulous health workers, raises critical public health concerns. This research spotlights various forms of this malpractice, analyzes the factors contributing to the circulation of fake vaccination cards, their implications on public health, and provides recommendations for addressing the issue.

Methods: Extensive literature review and analysis were conducted to investigate the emergence of fake COVID-19 vaccination cards in Nigeria. Perspectives from health workers and reports from reputable undercover investigations were examined to identify factors contributing to the circulation of fraudulent records. The research also delved into corruption within the health sector and the impact of low salaries on healthcare workers. Additionally, global instances of fake vaccination cards were explored to provide a comprehensive understanding of the issue.

Results: Healthcare workers' vaccine hesitancy, corruption, and inadequate salaries were identified as key contributors to the circulation of fake vaccination cards in Nigeria. Instances of health workers accepting bribes to issue cards without administering vaccines were uncovered. The implications on public health included threats to herd immunity, compromised disease surveillance, erosion of public trust, and reinforcement of vaccine hesitancy. The research also highlighted global challenges with fake vaccination cards, emphasizing the need for international cooperation.

Conclusion: Fake vaccination cards in Nigeria poses challenges to public health, affecting the reliability of immunization data and jeopardizing disease control efforts. It is crucial to strengthen healthcare worker engagement, tackle corruption through

increased transparency and improved policies, and implement digital vaccination verification systems. International collaboration is essential to establish standardized security measures and verification checkpoints. Addressing flawed vaccination records requires urgent action to enhance vaccination efforts, and safeguard the population from the resurgence of vaccine-preventable diseases.

1 | INTRODUCTION

The global immunization campaign against the COVID-19 virus has been a monumental endeavor, with governments and healthcare workers striving to vaccinate populations worldwide to combat the spread of the virus. As a result, vaccination certificates have become mandatory in many countries as proof of immunization for travel and access to various establishments. However, the proliferation of fake vaccination cards has emerged as a significant concern, casting a shadow over vaccination efforts and raising serious public health risks.[1]

In Nigeria, the presence of fake COVID-19 vaccination cards, primarily distributed by unscrupulous health workers, has led to the creation of flawed vaccination records within the country. These fraudulent cards enable individuals who have not received the COVID-19 vaccine to falsely claim immunization, undermining the integrity of vaccination campaigns and posing substantial challenges to effective public health management.[2] The circulation of inaccurate records hampers the ability to accurately assess vaccination coverage and identify vulnerable populations, hindering disease surveillance, outbreak control, and contact tracing efforts.

While this paper focuses on the COVID-19 pandemic as a case study, it goes beyond the immediate crisis. Its primary objective is to analyze the potential future impact of fake vaccination cards, shedding light on the long-term consequences and implications for public health in Nigeria. Understanding the ramifications of these deceptive practices allows policymakers to make informed decisions, implement preventive measures, and develop robust healthcare systems to address similar challenges in the future. This research is significant as it informs policy development, improves public health practices, and strengthens the integrity of vaccination programs.

1.1 | Overview of the importance of accurate vaccination records in public health

Accurate vaccination records serve as a crucial indicator of a health system's capacity to deliver essential immunization services to the targeted population, especially children at specific ages, and are instrumental in monitoring progress toward achieving sustainable development goals.[3] Immunization is widely recognized as a vital public health intervention for reducing childhood morbidity and mortality, emphasizing the significance of accurate vaccination records in ensuring the success of immunization programs.[4]

Health system reports of vaccine doses administered play a critical role in providing routine and systematic information on immunization at various administrative levels, and also serves as a valuable resource for identifying performance gaps, driving informed decision-making in public health.[5] Studies demonstrate the effectiveness of immunization information systems (IIS) in improving vaccination-related activities, leading to increased vaccination rates and reduced risks of vaccine-preventable diseases.[6] IIS supports critical functions such as determining client vaccination status, generating and evaluating public health responses to outbreaks, assessing vaccination coverage and missed opportunities, identifying disparities in vaccination rates, and facilitating vaccine management and accountability.[6]

1.2 | Emergence of fake COVID-19 vaccination cards in Nigeria

Widespread use of fake COVID-19 vaccination cards in Nigeria have raised significant concerns regarding the authenticity and reliability of vaccination documentation. The use of vaccination certificates as proof of immunization has become a global requirement for travel and access to various establishments.[3] However, the validity and genuineness of these certificates have also come under scrutiny due to the presence of illegal and fake COVID-19 vaccination groups.[7]

During a ministerial meeting on the update of Covid-19 response and development in the Federal Ministry of Health, the Director of Port Health Services revealed that between July and August 2022, they had nabbed 422 persons intending to use Fake covid-19 vaccination cards to travel.[8,9] An undercover investigation conducted by the Media Advocacy West Africa Foundation (MAWA-FOUNDATION) in three states of Nigeria—Plateau, Ebonyi, and Gombe states, as well as the Federal Capital Territory uncovered how Nigerian Health workers accept bribes to issue Covid 19 cards without administering the vaccine.[10] A complimentary investigation conducted by Sahara Reporters, a Nigerian based investigative media outlet, revealed that health workers in 10 primary healthcare centers and clinics in the Federal Capital Territory purchased the vaccination cards for as low as 15,000 naira ($23), when it was made

mandatory by the presidential Steering Committee on Covid 19 in 2021. They preferred purchasing the cards than getting the vaccine due to widespread misinformation which accompanied the vaccine at that time. This problem extended to students in tertiary institutions[11] The widespread practice affected Nigerians traveling to other countries as they faced scrutiny and were forced to repeat the Covid–19 test upon arrival.[12] An investigative report conducted most recently in 2023 by Premium Times revealed the activities of a Nigerian nurse working with the Lagos state Teaching Hospital (LASUTH) Immunization Clinic— Solomon Oriere who facilitates acquisition of COVID-19 test results and vaccination cards in exchange for payment, proudly touting the ease with which he can provide these documents and even offering discounts for referrals. Disturbingly, these illegally acquired vaccination cards successfully passed online verifications.[13] After his arrest few days later, LASUTH alledged he was not a staff, but had full access to the National Primary Health Care Development Agency.[14]

Earlier cases of falsified vaccination cards are well documented. In 2019, Devex, an independent news organization covering global development bought an official yellow fever travel document for $8.50 with no evidence of immunization. While the Nigerian government claimed the cards were fake, evidence at the airports suggests they were authentic but fraudulently obtained. Devex interviewed airport workers and travelers, with both claiming that acquiring the card illegally was faster, and made travels seamless.[15] Despite the introduction an e-registry since 2019, it was relatively easy to obtain a government-issued certificate for yellow fever vaccination, suggesting a weakness in the system that could allow for the issuance of fraudulent certificates even before the Covid–19 pandemic hit.[16]

This issue has also been observed in many countries worldwide. Scammers exploit the high demand for vaccination cards and offer fraudulent cards for a price, leading to an increase in Google searches for "fake vaccination cards." These fake cards can be obtained through various platforms, including the dark web and popular messaging apps.[17] In July 2021, the Office of Public Affairs, US Department of Justice arrested a California–Licensed naturopathic doctor for running a fake COVID-19 Immunization and Vaccination Card Scheme. According to this report, she created fake Covid-19 vaccination cards and instructed her customers to falsely mark that they had received a vaccine. This violation extended to children in schools where she offered homeoprophylaxis immunizations for childhood illnesses.[18] In December 2021, The US Attorney's Office, District of Maryland charged a man for selling fraudulent Covid-19 vaccination cards and distributing them through a mail service. This man had purchased over 600 cards and sold them through advertisement on social media. This report mentions that the US Customs and Border Protection (CBP) Officers have seized thousands of fraudulent COVID-19 vaccination cards with majority originating from Asia.[19] In the Philippines, the implementation of vaccination cards as a travel requirement has faced opposition from local government units (LGUs) due to concerns about the authenticity of these cards as they lack security features and machine-readable codes, making them susceptible to forgery.[20] In Africa, as early as 2020, the World Health Organization had reported on its efforts in combating fake yellow fever and Covid-19 immunization cards which were sold for between US$ 15–20 in

Zimbabwe and Zambian travel Terminals using digital technology.[21] A similar incident was reported in Uganda where travelers were intercepted with falsified yellow fever vaccine cards at the airport, indicating a concrete case of fraudulent vaccine documentation in 2016.[22]

1.3 | Factors contributing to circulation of fake vaccination cards in Nigeria—*Perspectives from Health Workers*

Analysis of the factors contributing to the circulation of fake vaccination cards in Nigeria reveals several key findings. First, there is a high likelihood of vaccine hesitancy among healthcare workers, particularly nurses and pharmacists, as observed in multiple studies.[23] These studies show that the COVID-19 vaccine acceptance rate among healthcare workers is as low as 32.5% in all six geopolitical zones.[24] Hesitancy among healthcare workers is concerning as they are considered reliable sources of health information, especially for vaccine programs in developing countries. When healthcare workers do not promote vaccination, it can undermine all efforts to protect public health and negatively impact their ability to communicate the importance of COVID-19 preventive measure,[23] as well as other diseases where vaccination may be required.

Corruption among health workers is another contributing factor to the circulation of fake vaccination cards in Nigeria. The health sector in Nigeria is vulnerable to corruption, with a lack of accountability and transparency being the common causes. A recent review which identified corrupt practices among health workers highlighted the need for enforcement, transparency, and citizen participation to address these issues.[25]

Additionally, low salaries of health workers in Nigeria are a significant factor contributing to the circulation of fake vaccination cards. Many health workers face the need to take on additional paid work or seek alternative means of income due to their small and irregular salaries.[25] Primary healthcare facilities, which are under the responsibility of local governments, are often given low priority in terms of funding allocation, resulting in healthcare workers being owed and grossly underpaid. The weak economic welfare of primary healthcare providers compared to their counterparts at the state and federal levels further exacerbates the situation.[26]

2 | IMPLICATIONS OF FAKE VACCINATION RECORDS ON PUBLIC HEALTH IN NIGERIA

2.1 | Threats to herd immunity, disease surveillance, and response

Fake vaccination records pose a significant threat to herd immunity,[27,28] as Vaccination coverage plays a vital role in epidemic control, reducing childhood morbidity, and mortality.[4]

Health workers in Nigeria have been implicated in corrupt practices, accepting bribes to issue COVID-19 vaccination cards without actual vaccination. Health authorities heavily rely on accurate vaccination data to estimate and maintain herd immunity levels. Instances of individuals presenting fake COVID-19 vaccination cards compromise the reliability of this data, potentially leading to an overestimation of vaccination coverage. This jeopardizes the achievement and maintenance of herd immunity, as a substantial number of people with fraudulent certificates may undermine the protective barrier it creates. Consequently, this unethical behavior can result in resurgence of various vaccine-preventable diseases such as measles and polio within communities, and can affect both vaccinated and unvaccinated individuals.[27]

The integrity of disease surveillance faces challenges due to the presence of fake immunization records. Distortion of accurate epidemiological data makes it challenging for health authorities to assess the true prevalence of infectious diseases, and can lead to delayed outbreak detection, and hinder timely and targeted responses. Moreover, compromised contact tracing which is a crucial component of infectious disease control, becomes affected by false documentation and contributes to the rapid spread of diseases as well as hindering containment efforts.

The lack of clear policies on the flow of reports within the healthcare system in Nigeria has resulted in problems in the reporting chain. These gaps provide opportunities for data manipulation, fraudulent practices, and unchecked circulation of fake vaccination certificates.[29] Consequently, it becomes difficult to assess disease prevalence, plan targeted interventions, and respond effectively to disease outbreaks.[30]

2.2 | Erosion of public trust and reinforcement of vaccine hesitancy

Nigeria is faced with mistrust in the government and its health policies due to lack of awareness, fear of adverse events, and shortage of health workers. Emergence of fake vaccination records further exacerbate these problems, and are the primary barriers to vaccination uptake in Nigeria.[31] When individuals discover the existence of fraudulent practices, it fuels their concerns about vaccine safety and efficacy,[4] and undermines their confidence in the healthcare system, making them hesitant to seek immunization services or follow public health recommendations.[32] Vaccine hesitancy even among healthcare workers, contributes to low vaccine acceptance rates.[33] Compromised records make it difficult to identify susceptible individuals and effectively plan immunization campaigns which can result in inefficient vaccine distribution, inadequate coverage, and increased disease transmission.[34] Circulation of fake cards undermines the credibility and effectiveness of COVID-19 vaccination efforts which is a long-term precursor to anticipated challenges in any epidemic, or pandemic. Restoring public trust becomes very crucial for regaining confidence in the vaccination process and high immunization coverage, which is necessary for disease control and prevention.[35]

3 | RECOMMENDATIONS FOR ADDRESSING THE ISSUE OF FLAWED VACCINATION RECORDS IN THE NIGERIAN CONTEXT

3.1 | Strengthening healthcare workers and community engagement

Enhancing healthcare worker capacity to counter antivaccine arguments and improve communication skills can be achieved by investing in community health programs that prioritize information dissemination, health education and promotion to address misconceptions, and restore confidence in vaccination programs.[24,36] It is important to integrate health literacy into educational curricula, including the basics of information technology among healthcare workers, and provide sustained resources to improve community health worker training.[37]

These combined efforts elevate efforts geared at raising awareness about the dangers and legal consequences of using fake vaccination cards among healthcare providers, employers, and other relevant parties, as well as measures to identify signs of fraudulent vaccination records and report suspicious cases.[37]

3.2 | Addressing corruption and strengthening the health system policies

The media can be employed to play vital roles in exposing corrupt practices. Increased transparency, improved salaries, consistent payment, incentives, and an efficient pension system can help mitigate the issues that discourage healthcare workers from fulfilling their responsibilities.[26,36]

An increase in lawful penalties for forging vaccination records, including the enforcement of stricter penalties for individuals involved in the creation, distribution, or use of fake vaccination cards are highly encouraged This will serve as a deterrent and discourage the production and circulation of fraudulent documents. Regular and timely data sharing and interoperability between healthcare providers, public health agencies, and vaccination registries can help detect inconsistencies, identify fraudulent records, and ensure accurate vaccination information across different systems.

3.3 | Development of multiplatform digital vaccination verification systems

The use of digital platforms or mobile applications to electronically verify vaccination records on the go, while not a permanent solution will be highly effective for vaccines requiring multiple doses. These systems can integrate with official databases and utilize secure QR codes to authenticate vaccination status, reducing reliance on physical cards and preventing easy acquisition.[38] Digital signatures or blockchain, when utilized to verify the authenticity of vaccination

cards and records, can also help reduce costs.[39] This can be achieved through partnerships with technology companies, such as the National Information Technology Development Agency (NITDA), or other private enterprises to develop innovative solutions for secure digital vaccination records.[40] This collaboration will leverage expertise in data security, encryption, and user verification to create robust systems that are difficult to manipulate.

3.4 | Foster international cooperation

International collaboration can address the global issue of fake vaccination cards by sharing best practices, coordinating efforts, and implementing standardized security measures. This will assist in alleviating the cross-border circulation of fraudulent documents, particularly at the African level.[41] Verification checkpoints at key locations where vaccination status is crucial, such as airports, schools, or workplaces, should be established. Several of these measures will have minimal impact on genuine cardholders but will keep fake cardholders constantly vigilant.

4 | CALL TO ACTION

Addressing flawed vaccination records in Nigeria requires collaboration among healthcare authorities, policymakers, and the general public. It is essential to ensure the integrity of vaccination programs, combat fake vaccination cards, and safeguard public health. By implementing these recommended strategies, Nigeria can enhance its vaccination efforts, improve health standards, and protect its population from vaccine-preventable diseases.

AUTHOR CONTRIBUTIONS

Victor E. Ali: Writing. **Marvellous O. Asika**: Writing and Review. **Emmanuel Ebuka Elebesunu**: Writing. **Chioma Agbo**: Writing. **Maxwell Hubert Antwi**: Review. All authors have read and approved the final version of the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Maxwell Hubert Antwi had full access to all of the data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis. Data available on request from the authors.

TRANSPARENCY STATEMENT

The lead author Maxwell Hubert Antwi affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

ORCID

Victor E. Ali 🔟 https://orcid.org/0000-0001-7815-4999
Marvellous O. Asika 🔟 https://orcid.org/0000-0001-9430-3069
Maxwell Hubert Antwi 🔟 https://orcid.org/0000-0002-5997-9829

REFERENCES

1. Arif M, Shamsudheen S, Ajesh F, Wang G, Chen J. AI bot to detect fake COVID-19 vaccine certificate. *IET Inf Secur*. 2022;16(5): 362-372. doi:10.1049/ise2.12063

2. Lara A. Man nabbed for issuing fake COVID-19 vaccination cards. *The Punch*. 2022. Accessed August 20, 2023. https://www.punchng.com/man-nabbed-for-issuing-fake-COVID-19-vaccination-cards

3. Abba-Aji M, Balabanova D, Hutchinson E, McKee M. How do Nigerian newspapers report corruption in the health system? *Int J Health Policy Manag*. 2021;10(2):77-85. doi:10.34172/ijhpm.2020.37

4. Shearer JC, Nava O, Prosser W, et al. Uncovering the drivers of childhood immunization inequality with caregivers, community members and health system stakeholders: results from a human-centered design study in DRC, Mozambique and Nigeria. *Vaccines*. 2023;11(3):689. doi:10.3390/vaccines11030689

5. Dunkle SE, Wallace AS, MacNeil A, et al. Limitations of using administratively reported immunization data for monitoring routine immunization system performance in Nigeria. *J Infect Dis*. 2014;210(suppl 1):S523-S530. doi:10.1093/infdis/jiu373

6. Groom H, Hopkins DP, Pabst LJ, et al. Immunization information systems to increase vaccination rates. *J Public Health Manag Pract*. 2015;21(3):227-248. doi:10.1097/PHH.0000000000000069

7. Choudhary OP, Priyanka I, Singh I, Mohammed TA, Rodriguez-Morales AJ. Fake COVID-19 vaccines: scams hampering the vaccination drive in India and possibly other countries. *Hum Vaccines Immunother*. 2021;17(11):4117-4118. doi:10.1080/21645515.2021.1960770

8. Fake COVID-19 vaccination certificates. *Leadership News*. 2022. Accessed November 12, 2023. https://leadership.ng/fake-covid-19-vaccination-certificates/

9. Shallpella HU. 422 passengers arrested with fake COVID-19 vaccination cards in Nigeria. *Pilot News*. 2022. Accessed November 11, 2023. https://www.westafricanpilotnews.com/2022/09/14/422-passengers-arrested-with-fake-covid-19-vaccination-cards-in-nigeria/

10. MAWA Foundation. *Undercover Investigation: How Health Workers Collect Bribes, Issue COVID-19 Cards Without Vaccination*. MAWA Foundation; 2022. https://mawafd.org/2022/02/04/investigation-how-health-workers-collect-bribes-issue-covid-19-cards-without-vaccination/

11. Sahara Reporters. How Nigerian health workers collect bribes, issue COVID-19 cards without vaccination. *Sahara Reporters*. 2022. Accessed November 14, 2023. https://saharareporters.com/2022/02/18/how-nigerian-health-workers-collect-bribes-issue-covid-19-cards-without-vaccination

12. Akor O, Jimoh A, Aliyu A. COVID-19: How record falsification sets Nigeria against other countries. *Daily Trust*. 2021. Accessed November 12, 2023. https://dailytrust.com/covid-19-how-record-falsification-sets-nigeria-against-other-countries/

13. Ileyemi M. INVESTIGATION: Lagos officials sell COVID-19 vaccination cards without jabs, sell fake but 'authentic' test results. *Premium Times Nigeria*. 2023. Accessed October 17, 2023. https://www.premiumtimesng.com/investigationspecial-reports/574313-investigation-lagos-officials-sell-covid-19-vaccination-cards-without-jabs-sell-fake-but-authentic-test-results.html

14. Nigeria G. LASUTH apprehended Impostor, Solomon Oriere, who sells COVID-19 vaccination cards. *The Guardian Nigeria News-Nigeria and World News*. 2023. Accessed November 12, 2023. https://guardian.ng/news/nigeria/metro/lasuth-apprehended-impostor-solomon-oriere-who-sells-covid-19-vaccination-cards/

15. Adepoju P. Here's how people in Nigeria are avoiding vaccination. *Devex*. 2019. Accessed November 15, 2023. https://www.devex.com/news/here-s-how-people-in-nigeria-are-avoiding-vaccination-94878

16. Adepoju P. The yellow fever vaccination certificate loophole in Nigeria. *Lancet*. 2019;394(10194):203-204. doi:10.1016/s0140-6736(19)31670-8

17. Shohreh Ghasemi G, Zohreh Mortezania M, Maryam Mohammad alizadeh Chafjiri C, Mahmood Dashti D. Increase of fake Covid-19 vaccination card and test certification. *Int J Pharm Biol Sci Arch*. 2022;3(2):133-135. doi:10.53771/ijbpsa.2022.3.2.0064

18. U.S. Department of Justice. Woman arrested for fake COVID-19 immunization and vaccination card scheme. 2021. Accessed November 12, 2023. https://www.justice.gov/opa/pr/woman-arrested-fake-covid-19-immunization-and-vaccination-card-scheme

19. Man facing federal charges for selling fraudulent COVID-19 vaccination cards and distributing them through a mail service. 2021. Accessed November 13, 2023. https://www.justice.gov/usao-md/pr/man-facing-federal-charges-selling-fraudulent-covid-19-vaccination-cards-and-distributing

20. Rocha ICN. How to avoid fake COVID-19 vaccine passports as a travel requirement? *J Public Health*. 2022;44(4):e608-e609. doi:10.1093/pubmed/fdab308

21. WHO | Regional Office for Africa. *Fighting Fake Immunization Travel Certificates With Frontier Technologies*. WHO | Regional Office for Africa; 2023. https://www.afro.who.int/news/fighting-fake-immunization-travel-certificates-frontier-technologies

22. Travellers with forged yellow fever cards intercepted. *Monitor*. 2021. Accessed November 10, 2023. https://www.monitor.co.ug/uganda/news/national/travellers-with-forged-yellow-fever-cards-intercepted-1672568

23. Ogunbosi BO, Alao MA, Ibrahim OR, et al. COVID-19 vaccine hesitancy in six geopolitical zones in Nigeria: a cross-sectional survey. *Pan Afr Med J*. 2022;42:6. doi:10.11604/pamj.2022.42.179.34135

24. Olu-Abiodun O, Abiodun O, Okafor N. COVID-19 vaccination in Nigeria: a rapid review of vaccine acceptance rate and the associated factors. *PLoS One*. 2022;17(5):e0267691. doi:10.1371/journal.pone.0267691

25. Ogbozor P, Onwujekwe O, Balabanova D, et al. The gendered drivers of absenteeism in the Nigerian health system. *Health Policy Plan*. 2022;37(10):1267-1277. doi:10.1093/heapol/czac056

26. Agwu P, Ogbozor P, Odii A, Orjiakor C, Onwujekwe O. Private money-making indulgence and inefficiency of primary healthcare in Nigeria: a qualitative study of health workers' absenteeism. *Int J Public Health*. 2020;65:1019-1026. doi:10.1007/s00038-020-01405-3

27. She J, Hou D, Chen C, Bi J, Song Y. Challenges of vaccination and herd immunity in COVID-19 and management strategies. *Clin Respir J*. 2022;16(11):708-716. doi:10.1111/crj.13543

28. Suryawanshi YN, Biswas DA. Herd immunity to fight against COVID-19: a narrative review. *Cureus*. 2023;15(1):33575. doi:10.7759/cureus.33575

29. Phalkey RK, Yamamoto S, Awate P, Marx M. Challenges with the implementation of an integrated disease surveillance and response (IDSR) system: systematic review of the lessons learned. *Health Policy Plan*. 2015;30(1):131-143. doi:10.1093/heapol/czt097

30. Bloland P, MacNeil A. Defining & assessing the quality, usability, and utilization of immunization data. *BMC Public Health*. 2019;19(1):8. doi:10.1186/s12889-019-6709-1

31. Eguavoen A, Larson HJ, Chinye-Nwoko F, Ojeniyi T. Reducing COVID-19 vaccine hesitancy and improving vaccine uptake in Nigeria. *J Public Health Afr*. 2023;14(5):2290. doi:10.4081/jphia.2023.2290

32. Sadiq M, Croucher S, Dutta D. COVID-19 vaccine hesitancy: a content analysis of Nigerian YouTube videos. *Vaccines*. 2023;11(6):1057. doi:10.3390/vaccines11061057

33. Mutombo PN, Fallah MP, Munodawafa D, et al. COVID-19 vaccine hesitancy in Africa: a call to action. *Lancet Glob Health*. 2022;10(3):e320-e321. doi:10.1016/S2214-109X(21)00563-5

34. Omale UI, Oka OU, Amuzie CI, et al. COVID-19 vaccination acceptance (uptake, hesitancy, intention to receive and timeliness of the intention to receive) and the determinants among health workers in Ebonyi state, Nigeria: an analytical cross-sectional study. *BMJ Open*. 2023;13(7):e068668. doi:10.1136/bmjopen-2022-068668

35. Lucia VC, Kelekar A, Afonso NM. COVID-19 vaccine hesitancy among medical students. *J Public Health*. 2021;43(3):445-449. doi:10.1093/pubmed/fdaa230

36. Ogundele OA, Ogundele T, Beloved O. Vaccine hesitancy in Nigeria: contributing factors–way forward. *Niger J Gen Pract*. 2020;18(1):1. doi:10.4103/1008-682X.275508

37. Burki T. The future of childhood immunisation. *Lancet Respir Med*. 2023;11(7):1. doi:10.1016/S2213-2600(23)00182-0

38. Fugkeaw S. An efficient and scalable vaccine passport verification system based on ciphertext policy attribute-based encryption and blockchain. *J Cloud Comput*. 2023;12:111. doi:10.1186/s13677-023-00486-8

39. Zixiong Z, Jiaqi M. Application of Blockchain in trusted digital vaccination certificates. Accessed November 19, 2023. doi:10.46234/ccdcw2022.021

40. Ahanwa ES, Okoloma HC. Telehealth in Nigeria: a legal perspective. *Int J Clin Leg Educ*. 2023;4:6. https://nigerianjournalsonline.com/index.php/IJOLACLE/article/view/3704

41. Kiguba R, Olsson S, Waitt C. Pharmacovigilance in low-and middle-income countries: a review with particular focus on Africa. *Br J Clin Pharmacol*. 2023;89(2):491-509. doi:10.1111/bcp.15193