

[Open Peer Review on Qeios](#)

# Post-Pandemic Reflections from Sub-Saharan Africa: What We Know Now That We Wish We Knew Then

Obinna O. Oleribe<sup>1</sup>, Simon D. Taylor-Robinson<sup>2</sup>, Andrew W. Taylor-Robinson<sup>3</sup>

<sup>1</sup> Nigerian Institute of Medical Research

<sup>2</sup> Busitema University

<sup>3</sup> VinUniversity

**Funding:** SDT-R is grateful to the United Kingdom National Institute for Healthcare Research at Imperial College London for infrastructure support. He is funded in part by a Wellcome Trust Institutional Strategic Support Fund awarded to Imperial College London.

**Potential competing interests:** No potential competing interests to declare.

## Abstract

The commonly heard aphorism about history repeating itself suggests an endless cycle of recurring events. However, George Santayana offered a similar sentiment when he said, "Those who do not learn from history are doomed to repeat it". This emphasizes that the responsibility for the recurrence of events lies not with history itself, but with humanity. It underscores that if we desire change, it is our responsibility to initiate it, rather than attributing it to external forces such as fate, luck, or time. With this thought in mind, here we offer a narrative view from sub-Saharan Africa, focusing primarily on our own experiences in Nigeria and Uganda, on what harsh lessons can be learnt from the COVID-19 pandemic regarding emergency preparedness to respond effectively to the next major infectious disease outbreak. Four strategies are suggested, the implementation of which may contribute substantially to safeguarding against an experience similar to the catastrophic public health, social and economic costs borne by African nations during COVID-19 and in its immediate aftermath.

**Obinna O. Oleribe**<sup>1,2</sup>, **Simon D. Taylor-Robinson**<sup>3,4,5</sup>, **Andrew W. Taylor-Robinson**<sup>6,7,\*</sup>

<sup>1</sup> *Office of the Director-General, Nigerian Institute for Medical Research, Lagos, Nigeria*

<sup>2</sup> *Best Health Consult Limited Liability Company, Klamath Falls, Oregon, USA*

<sup>3</sup> *Department of Medicine, Busitema University, Mbale, Uganda*

<sup>4</sup> *Department of Public Health, Busitema University, Mbale, Uganda*

<sup>5</sup> *Department of Surgery and Cancer, Imperial College London, St Mary's Hospital Campus, London, UK*

<sup>6</sup> *College of Health Sciences, VinUniversity, Hanoi, Vietnam*

<sup>7</sup> *Center for Global Health, Perelman School of Medicine, University of Pennsylvania, Philadelphia, USA*

\* *Corresponding author: Professor Andrew W. Taylor-Robinson, e-mail [andrew.tr@vinuni.edu.vn](mailto:andrew.tr@vinuni.edu.vn)*

**Keywords:** COVID-19, SARS-CoV-2, Infectious disease, Pandemic, Prevention, Control, Preparedness, sub-Saharan

Africa.

## Introduction

Much has been written and published on COVID-19 from all parts of the world.<sup>[1][2][3][4]</sup> We have also published several manuscripts on the epidemiology of the pandemic, people's perspectives, lessons learned, and why Africa was relatively spared from the worst of the pandemic.<sup>[5][6][7][8][9][10]</sup> However, there is still much more on which to reflect as the world transitions into the post-pandemic era.

Although there are still new infections and deaths, the 4-year-long COVID-19 pandemic appears to be drawing to a close. The toll exacted on humankind is more than 6.9 million recorded deaths, unquantifiable hardship, and ongoing complications of long-COVID.<sup>[11][12][13]</sup> At the peak of COVID-19, several policies were made that impacted global and local travel, human relationships, work practices, and people's social lives. New operating procedures were developed that changed the way infectious diseases were monitored, managed, and mitigated.<sup>[14][15][16]</sup> Novel non-pharmaceutical interventions and vaccines were fast-tracked into development and manufacture to curtail the worst effects of COVID-19.<sup>[14]</sup> Nations invested heavily in vaccine production, some prepaying for millions of vaccine doses even before they were tested and declared effective.<sup>[16]</sup>

Drawing on the West and East African examples of Nigeria and Uganda, the national governments made several promises – some of which they were not able to keep. Frequently, front-line workers who failed to keep to the hastily approved policies and procedures were punished or relieved of their posts.<sup>[6]</sup> Some individuals (including the first author) missed their international flights because of late or expired COVID-19 rapid antigen test results. Governments made money from travel corridor mandatory testing and screening, and new businesses emerged to exploit the benefits of the pandemic policies and programs.<sup>[7]</sup>

What has sub-Saharan Africa learned from this pandemic that could help us manage future epidemic and pandemic infectious diseases outbreaks more effectively and efficiently? Here are our observations and recommendations.

## Separating science from politics

In responding to COVID-19 initially, the governments of some nations, including many in Africa, moved into the driver's seat to direct the pandemic control program and process, even though they did not have the right qualifications and credentials to make scientific decisions or statements. Some made promises on vaccine production, effectiveness, efficacy, and use without allowing the right vaccine and therapeutics development processes to be followed.<sup>[17][18][19]</sup> This fueled all types of conspiracy theories and resistance to vaccine uptake across all nations of the world.<sup>[20][21]</sup> When scientists later made statements or released study reports predicated on recent research discoveries, their findings were doubted as people's views were already biased by political interventions earlier in the pandemic.<sup>[7]</sup>

In their desire to reopen societal systems as quickly as possible, thereby preventing impending economic collapse, governments also made vaccination and other pandemic control practices mandatory, infringing human rights and restricting individual freedom of choice.<sup>[22]</sup> In Nigeria, for example, governmental and public organizational staff were mandated to be vaccinated or otherwise lose their jobs. The use of face masks, social isolation, and quarantine were all made compulsory in many jurisdictions. Travel was prohibited and social events were canceled. Places of worship, schools, businesses, restaurants, and shopping malls were all closed.<sup>[5]</sup>

Individuals who valued their freedom resisted this political intrusion – even if it was just for the sake of protecting and preserving their freedom of choice. Vaccine refusal and hesitancy surged to an all-time high and conspiracy theories soared across social media.<sup>[23]</sup> Many denied the effectiveness of different vaccines, challenged their development processes, and saw the entire process as fraudulent and money-making for biotech and pharmaceutical companies who exploited pandemic-fueled societal fear to make untold profits in the return on investment.<sup>[24]</sup>

Moving forward, it is our perspective from sub-Saharan Africa that governments should steer clear from making uninformed statements on infectious disease outbreaks. Moreover, when aiming to prevent or control future epidemics and pandemics, evidence-based decisions should be left in the jurisdiction of public health professionals. Only in this way will avoidable conflicts and crises be mitigated.

## Separating medical practice from business

With COVID-19, there was considerable business interest in the management and control of the pandemic.<sup>[25]</sup> Entrepreneurs made millions to billions of dollars from the development and marketing of face masks, hand sanitizers, antiseptics, ventilators, and personal protective equipment in the first 18 months of the pandemic, and from the distribution of vaccines and therapeutics in the subsequent period.<sup>[26]</sup> Although COVID was projected to devastate economies, this proved not to be the case for many high- and middle-income nations as immediate negative impacts were short-lived.<sup>[27][28]</sup> While these resources were greatly needed to translate policies into practices across different global regions, the emphasis on profitability and gains by manufacturers fueled societal outbursts, anger, and revolt.

During this time of great uncertainty, insurance companies continued collecting premiums from individuals even though hospitals and health institutions were off limits to those who did not have COVID-19 and governments were paying for COVID-19 treatment for those infected and admitted for care.<sup>[29]</sup> One of the authors heard a leading insurance company executive boast that they made more money during COVID-19 than in any other period in their history. The concern is that if this apparent greed is not addressed, those insuring the use of the commercial healthcare sector may seek further monetary gains for their organizations in the face of future public health threats.

Should insurance companies be asked to refund all the premiums collected during COVID-19 to participating individuals and recommence premium collections only at the conclusion of this pandemic era? From the perspective of justice and fairness in managing pandemics, this would be an equitable, if not expected outcome.<sup>[24]</sup> Otherwise, we will be tacitly

encouraging “double dipping” by insurance companies that during the pandemic kept collecting premiums every month while still allowing governments to foot the bill for treatment of all clinical cases when COVID-19 management made up over 90% of healthcare costs in developed and developing countries alike. In sub-Saharan Africa, this redirection of resources drained national budgets for public health, leading to reduced allocations for prevention, control and therapy of other notable infectious diseases, such as malaria, HIV, tuberculosis and schistosomiasis.<sup>[30]</sup>

## Separating proven public health practices from untested behaviours

Consequent to the escalating global death toll due to COVID-19, there was a pressing need to institute a range of non-pharmaceutical interventions to curb transmission by aerosol and droplet of the causative SARS-CoV-2 virus.<sup>[14]</sup> This led to the promoting of handwashing and the wearing of face masks, each a tried and tested public health preventive practice, alongside several other previously untested practices like elbow bumping and physical distancing.<sup>[16]</sup> In addition, as the pandemic deepened, masks and respirators also evolved from high-quality clinically-tested versions to a varied assortment of facial coverings produced from all manner of fabrics with little or no effectiveness and efficiency testing.<sup>[16]</sup> The unregulated manufacture of poorly protective masks flooded the global online market, the popularity of what soon became fashion accessories boosted across social strata. People began designing and selling poorly fitting masks handmade from unsuitable materials as there were gullible individuals ready with cash to buy and use, even if the products were ineffective.<sup>[31]</sup>

The production of hand sanitizers and personal protective equipment was also unregulated during the pandemic due to overwhelming demand. Quality and effectiveness were sacrificed at the expense of quantity and access. For the vast majority of such nominally antiviral products, how effective they were remains even now to be analyzed and documented. Yet, the continued prevalence of SARS-CoV-2 despite the widespread adoption of face masks, hand sanitizers, and elbow bumping could provide anecdotal evidence that these measures were not as effective as public health authorities thought at the time.<sup>[17]</sup>

## Separating prevention practices that are distinct to nations, societies and cultures

In the emergency response to COVID-19, ostensibly the entire world adopted similar practices, even though geographic and demographic circumstances, cultural practices and societal implementation varied.<sup>[32]</sup> In high-income countries, it was common for a residence to be occupied by a single person, while overpopulated domiciles were rare. However, this is not the case with sub-Saharan African homes in which it is the cultural norm for at least three to four people to share the same space across urban and rural communities. Therefore, asking people to stay at home may prevent the spread of infection in the Global North but allow continued disease transmission in the Global South.<sup>[9]</sup>

In contrast, while windows are hardly ever opened in industrialized nations in temperate climates, the heat and humidity of Africa make the opening of windows a preferred lifestyle choice. This means that typically without the installation of air conditioning units, homes in sub-Saharan Africa have access to natural ventilation, the effect of which is to dilute the

interior concentration of respiratory infective agents.<sup>[9]</sup> On the other hand, windows in high-income countries were hardly ever opened, allowing stale air to be recirculated in residential and office buildings, thereby increasing potential transmission.<sup>[9]</sup> This makes the stay-at-home policy debatable in both cultural contexts and may account for the transmission of SARS-CoV-2 among those who self-isolated as instructed. More detailed studies should be conducted to determine the efficacy of the stay-at-home policy across the world.

## Discussion

COVID-19 has provided insights that are critical to enhance the management of future pandemics in sub-Saharan Africa. The impact of the pandemic on children in the region underscores the need to prioritize preventive health services, including vaccination and malaria control, in order to safeguard vulnerable populations.<sup>[33]</sup> It is crucial to address burnout of healthcare professionals and support frontline workers to ensure an effective response. Additionally, the high seroprevalence among emergency responders in urban settings highlights the urgency of developing locally parameterized mathematical models to predict epidemic trajectories for evidence-based policy decisions and public health response planning.<sup>[34]</sup> Genetic variations in sub-Saharan Africa may confer resistance to COVID-19, suggesting the importance of understanding regional genetic factors in pandemic management.<sup>[35]</sup> Furthermore, the pandemic has underscored the imperative for sub-Saharan Africa to build capacity for manufacturing vaccines, therapeutics, and diagnostics to address public health crises effectively.<sup>[36]</sup> Lessons from the Ebola epidemics have offered valuable awareness of how best to strengthen the COVID-19 response in the region, emphasizing the need for effective translation of these lessons into pandemic management strategies.<sup>[37]</sup> Moreover, community-based and community-led strategies are crucial for achieving pandemic control in sub-Saharan African communities, necessitating the availability of necessary socioeconomic resources and contextual adaptation of interventions.<sup>[38]</sup> The pandemic has also revealed the importance of so-called 'systems thinking' in COVID-19 recovery to deliver sustainable development for African women and girls.<sup>[39]</sup> However, challenges such as poorly resourced mental health systems, gender inequalities, and the impact on adolescent health and well-being need to be addressed to improve pandemic preparedness on the continent. These lessons collectively provide a comprehensive framework for enhancing future pandemic preparedness and response efforts in sub-Saharan Africa, encompassing various aspects of healthcare, public health, community engagement, and sustainable development.<sup>[40]</sup>

## Conclusions

Reflecting on how the COVID-19 pandemic was handled by public health authorities in sub-Saharan Africa, there is much that can be learnt in preparing for emerging and reemerging infectious disease outbreaks in coming years.<sup>[41]</sup> Here, we have identified four issues that should be addressed:

1. Separating science from politics is a complex and multifaceted issue. On the one hand, the integrity of scientific research and evidence-based decision-making is crucial for addressing public health challenges effectively. On the

other hand, however, the intersection of science and politics is inevitable, particularly in matters of public policy, resource allocation, and regulatory frameworks. While it is important to maintain the autonomy and objectivity of scientific inquiry, it is equally important for policymakers to consider scientific evidence when formulating policies.<sup>[41]</sup>

2. Separating medical practice from business is a critical consideration in ensuring the ethical delivery of healthcare. While healthcare is undoubtedly a business in terms of resource allocation and financial sustainability, the primary focus should always be on patient care and well-being. The commercial aspects of healthcare should not compromise the quality of medical services or patient outcomes. It is essential to maintain the integrity of medical practice by prioritizing evidence-based care, patient safety, and ethical decision-making, rather than solely focusing on financial gain. This separation is crucial for upholding the trust and confidence of patients and the community in the healthcare system. Additionally, it is important for healthcare professionals to adhere to ethical guidelines and standards, ensuring that patient care remains the central focus of medical practice.
3. Separating proven public health practices from untested behaviours is essential for safeguarding the well-being of communities. Evidence-based public health practices are rooted in rigorous research, empirical data, and scientific consensus, providing a foundation of reliability and effectiveness. In contrast, untested practices may lack empirical support and could potentially pose risks to public health. It is crucial to prioritize evidence-based interventions and policies to ensure the safety and effectiveness of public health initiatives. This approach requires a comprehensive evaluation of available evidence and a commitment to implementing practices that have demonstrated positive outcomes in public health.
4. Separating prevention practices that are unique to nations, societies, and cultures. This is a complex and multifaceted issue that involves understanding the local social, cultural, and contextual factors that influence health behaviours and practices. Public health strategies should be sensitive to cultural norms, values, and beliefs, and should be designed to be culturally appropriate to increase their relevance and effectiveness. However, it is important to critically evaluate these practices to ensure that they are evidence-based and aligned with public health goals. Understanding the social and cultural context is essential for tailoring prevention strategies to specific populations, but it is equally important to ensure that these strategies are grounded in scientific evidence and contribute to positive health outcomes.

It is to be hoped that by implementing these ideas, low-income countries in sub-Saharan Africa will be far better resourced, equipped, and prepared to combat the next infectious disease epidemic or pandemic than our lived experiences tell us they were for COVID-19. If ever there was a case of wishing we had known then what we know now, this is it. The imperative is to learn from our previous mistakes, not to let history repeat itself.

## Authors' Contributions

Article conception, OOO; literature search and data collection, OOO and AWT-R; interpretation of information, all authors; writing — original draft preparation, OOO and AWT-R; writing — manuscript preparation, all authors; writing — editing critically for important intellectual content, SDT-R. All authors read and approved the last version of the manuscript.

## Acknowledgements

We are grateful to the following individuals for fruitful discussion on this subject: Professor Sir Tumani Corrah, Africa Research Excellence Fund, MRC@LSHTM, Fajara, The Gambia; Professor C. Wendy Spearman; University of Cape Town, South Africa; Professor Salim Abdool Karim, Centre for the AIDS Programme of Research in South Africa (CAPRISA), Durban, South Africa.

## Funding

SDT-R is grateful to the United Kingdom National Institute for Healthcare Research at Imperial College London for infrastructure support. He is funded in part by a Wellcome Trust Institutional Strategic Support Fund grant awarded to Imperial College London.

## Competing interests

None declared.

## References

- <sup>^</sup> Ciotti M, Ciccozzi M, Terrinoni A, Jiang WC, Wang CB, Bernardini S. The COVID-19 pandemic. *Critical Reviews in Clinical Laboratory Sciences*. 2020 Aug 17;57(6):365-388.
- <sup>^</sup> Lone SA, Ahmad A. COVID-19 pandemic – an African perspective. *Emerging Microbes & Infections*. 2020 Jan 1;9(1):1300-1308.
- <sup>^</sup> Padhan R, Prabheesh KP. The economics of COVID-19 pandemic: a survey. *Economic Analysis and Policy*. 2021 Jun 1;70:220-237.
- <sup>^</sup> Omer SB, Malani P, Del Rio C. The COVID-19 pandemic in the US: a clinical update. *JAMA*. 2020 May 12;323(18):1767-1768.
- <sup>a, b</sup> Oleribe O, Olawepo O, Ezechi O, Osita-Oleribe P, Fertleman M, Taylor-Robinson SD. Describing the epidemiology of COVID-19 in Nigeria: an analysis of the first year of the pandemic. *Journal of Health Care for the Poor and Underserved*. 2022;33(1):33-46.
- <sup>a, b</sup> Oleribe OO, Osita-Oleribe P, Salako BL, Ishola TA, Fertleman M, Taylor-Robinson SD. COVID-19 experience: taking the right steps at the right time to prevent avoidable morbidity and mortality in Nigeria and other nations of the world. *International Journal of General Medicine*. 2020 Aug 4;13:491-495.
- <sup>a, b, c</sup> Oleribe O, Ezechi O, Osita-Oleribe P, Olawepo O, Musa AZ, Omoluabi A, Fertleman M, Salako BL, Taylor-Robinson SD. Public perception of COVID-19 management and response in Nigeria: a cross-sectional survey. *BMJ Open*. 2020 Oct 1;10(10):e041936.
- <sup>^</sup> Oleribe O, Miller R, Wadzeck M, Mendez N, Tibay J, Langford T, Devine A, Taylor-Robinson SD. Klamath tribal

- response to the pandemic of COVID-19 among Klamath tribal community in Oregon, USA. *Global Advances in Health and Medicine*. 2021 Jul;10:21649561211034470.
9. <sup>a, b, c, d</sup>Oleribe OO, Suliman AA, Taylor-Robinson SD, Corrah T. Possible reasons why sub-Saharan Africa experienced a less severe COVID-19 pandemic in 2020. *Journal of Multidisciplinary Healthcare*. 2021 Nov 25;14:3267-3271.
  10. <sup>^</sup>Taylor-Robinson SD, Morgan MY, Spearman CW, Suliman AA, Corrah T, Oleribe OO, Taylor-Robinson AW. Why SARS-CoV-2 vaccination still matters in Africa. *QJM: An International Journal of Medicine*. 2022 Mar 1;115(3):191-192.
  11. <sup>^</sup>World Health Organization. WHO Coronavirus (COVID-19) Dashboard. <https://covid19.who.int/>. Accessed November 24, 2023.
  12. <sup>^</sup>Yong SJ. Long COVID or post-COVID-19 syndrome: putative pathophysiology, risk factors, and treatments. *Infectious Diseases*. 2021 Oct 3;53(10):737-754.
  13. <sup>^</sup>Sykes DL, Holdsworth L, Jawad N, Gunasekera P, Morice AH, Crooks MG. Post-COVID-19 symptom burden: what is long-COVID and how should we manage it? *Lung*. 2021 Apr;199:113-119.
  14. <sup>a, b, c</sup>Hsiang S, Allen D, Annan-Phan S, Bell K, Bolliger I, Chong T, Druckenmiller H, Huang LY, Hultgren A, Krasovich E, Lau P. The effect of large-scale anti-contagion policies on the COVID-19 pandemic. *Nature*. 2020 Aug 13;584(7820):262-267.
  15. <sup>^</sup>Mossa-Basha M, Medverd J, Linnau KF, Lynch JB, Wener MH, Kicska G, Staiger T, Sahani DV. Policies and guidelines for COVID-19 preparedness: experiences from the University of Washington. *Radiology*. 2020 Aug;296(2):E26-E31.
  16. <sup>a, b, c, d</sup>Dergiades T, Milas C, Panagiotidis T, Mossialos E. Effectiveness of government policies in response to the COVID-19 outbreak. *SSRN Electronic Journal*. 2020 May 19;2(4):e0000242.
  17. <sup>a, b</sup>Sabahezain MM, Hartigan-Go K, Larson HJ. The politics of COVID-19 vaccine confidence. *Current Opinion in Immunology*. 2021 Aug 1;71:92-96.
  18. <sup>^</sup>Jones DR, McDermott ML. Partisanship and the politics of COVID vaccine hesitancy. *Polity*. 2022 Jul 1;54(3):408-434.
  19. <sup>^</sup>Albrecht D. Vaccination, politics and COVID-19 impacts. *BMC Public Health*. 2022 Dec;22(1):1-2.
  20. <sup>^</sup>Bolsen T, Palm R. Politicization and COVID-19 vaccine resistance in the US. *Progress in Molecular Biology and Translational Science*. 2022 Jan 1;188(1):81-100.
  21. <sup>^</sup>Cao J, Ramirez CM, Alvarez RM. The politics of vaccine hesitancy in the United States. *Social Science Quarterly*. 2022 Jan;103(1):42-54.
  22. <sup>^</sup>Cameron-Blake E, Tatlow H, Andretti B, Boby T, Green K, Hale T, Petherick A, Phillips T, Pott A, Wade A, Zha H. A panel dataset of COVID-19 vaccination policies in 185 countries. *Nature Human Behaviour*. 2023 Aug;7(8):1402-1413.
  23. <sup>^</sup>Nguyen A, Catalan-Matamoros D. Anti-vaccine discourse on social media: an exploratory audit of negative tweets about vaccines and their posters. *Vaccines*. 2022 Dec 1;10(12):2067.
  24. <sup>a, b</sup>Ballano I. Corporate moral responsibility, distributive justice, the common good, and Catholic social teaching: the case of Gilead Sciences and Remdesivir. *Linacre Quarterly*. 2023 Nov;90(4):437-451.



25. <sup>^</sup>Kondilis E, Benos A. *The COVID-19 pandemic and the private health sector: Profiting without socially contributing. International Journal of Social Determinants of Health and Health Services. 2023 Oct;53(4):466-477.*
26. <sup>^</sup>Quan NK, Anh NLM, Taylor-Robinson AW. *The global COVID-19 vaccine surplus: tackling expiring stockpiles. Infectious Diseases of Poverty. 2023 Mar 20;12(1):21.*
27. <sup>^</sup>Barua S. *Understanding Coronanomics: the economic implications of the coronavirus (COVID-19) pandemic. 2020 Apr 1. Available at: <https://dx.doi.org/10.2139/ssrn.3566477>*
28. <sup>^</sup>Deb P, Furceri D, Ostry JD, Tawk N. *The economic effects of COVID-19 containment measures. Open Economies Review. 2022 Feb;33(1):1-32.*
29. <sup>^</sup>Holpuch A. *Pandemic profits: top US health insurers make billions in second quarter. 2021 Aug 6. Available at: <https://www.theguardian.com/us-news/2021/aug/06/us-healthcare-insurance-covid-19-coronavirus>.*
30. <sup>^</sup>Taylor-Robinson SD, Morgan MY, Olupot-Olupot P, Taylor-Robinson AW. *Societal reopening after the COVID-19 pandemic. Public Health. 2022 Apr;205:e5.*
31. <sup>^</sup>Zeilinger EL, Brunevskaya N, Wurzer J, Oberleiter S, Fries J, Fuchs A, Herscovici A, Kum L, Masel EK, Pietschnig J. *Effectiveness of cloth face masks to prevent viral spread: a meta-analysis. Journal of Public Health. 2023 Nov 2:fdad205. doi: 10.1093/pubmed/fdad205. Epub ahead of print.*
32. <sup>^</sup>Muurlink OT, Taylor-Robinson AW. *COVID-19: cultural predictors of gender differences in global prevalence patterns. Frontiers in Public Health. 2020 Apr 30;8:174.*
33. <sup>^</sup>Coker M, Folayan MO, Michelow IC, Oladokun RE, Torbunde N, Sam-Agudu NA. *Things must not fall apart: the ripple effects of the COVID-19 pandemic on children in sub-Saharan Africa. Pediatric Research. 2021 Apr;89(5):1078-1086.*
34. <sup>^</sup>Chibwana MG, Jere KC, Kamn'gona R, Mandolo J, Katunga-Phiri V, Tembo D, Mitole N, Musasa S, Sichone S, Lakudzala A, Sibale L, Matambo P, Kadwala I, Byrne RL, Mbewe A, Henrion MYR, Morton B, Phiri C, Mallewa J, Mwandumba HC, Adams ER, Gordon SB, Jambo KC. *High SARS-CoV-2 seroprevalence in health care workers but relatively low numbers of deaths in urban Malawi [version 2; peer review: 2 approved]. Wellcome Open Research. 2020 Dec 18;5:199.*
35. <sup>^</sup>Musa HH, Musa TH, Musa IH, Musa IH, Ranciaro A, Campbell MC. *Addressing Africa's pandemic puzzle: perspectives on COVID-19 transmission and mortality in sub-Saharan Africa. International Journal of Infectious Diseases. 2021 Jan;102:483-488.*
36. <sup>^</sup>Bright B, Babalola CP, Sam-Agudu NA, Onyeaghala AA, Olatunji A, Aduh U, Sobande PO, Crowell TA, Tebeje YK, Phillip S, Ndemi N, Folayan MO. *COVID-19 preparedness: capacity to manufacture vaccines, therapeutics and diagnostics in sub-Saharan Africa. Global Health. 2021 Mar 3;17(1):24.*
37. <sup>^</sup>Afolabi MO, Folayan MO, Munung NS, Yakubu A, Ndow G, Jegede A, Ambe J, Kombe F. *Lessons from the Ebola epidemics and their applications for COVID-19 pandemic response in sub-Saharan Africa. Developing World Bioethics. 2021 Mar;21(1):25-30.*
38. <sup>^</sup>Owoyemi A, Okolie EA, Omitiran K, Amaechi UA, Sodipo BO, Ajumobi O, Nnaji CE, Okedo-Alex IN. *Importance of community-level interventions during the COVID-19 pandemic: lessons from sub-Saharan Africa. American Journal of Tropical Medicine and Hygiene. 2021 Aug 9;105(4):879-883.*
39. <sup>^</sup>Omukuti J, Barlow M, Giraud ME, Lines T, Grugel J. *Systems thinking in COVID-19 recovery is urgently needed to*

*deliver sustainable development for women and girls. Lancet Planetary Health. 2021 Dec;5(12):e921-e928.*

40. <sup>a</sup>Nguyen KQ, Nguyen LMA, Taylor-Robinson AW. *Global "flu-ization" of COVID-19: A perspective from Vietnam. Frontiers in Public Health. 2022 Oct 3;10:987467.*
41. <sup>a, b</sup>Taylor-Robinson S., Olupot-Olupot P., Morgan M., Edwards C., Corrah T., O'Donoghue J. & Taylor-Robinson A. *Africa is successfully developing its own science initiatives. Growing efforts toward sustainable training and access to funding. Nature Africa. 2022 July 24. Available at: <https://www.nature.com/articles/d44148-022-00104-w>*