www.directivepublications.org

Advances in Vaccines

ISSN 3068-3734

Review article

Unequal Protection: Rising Infectious Diseases and the Global Vaccine Equity Gap.

Barbara W. K. Son, Ph.D, Wamukota Francis Wambalaba, PhD., AICP.

- *Akio Morita School of Business Anaheim University, 1240 South State College Blvd, Anaheim, CA 92806, USA.* ***Email:*** *bson@anaheim.edu.*
- *Development Economics Chandaria School of Business United States International University, Kenya USIU Road Nairobi, Kenya.* ***Email:*** *Fwambalaba1@gmail.com or fwambalaba@usiu.ac.ke*

Abstract

Human exposure to pathogens and the transmission of viruses have been increasing due to a more interconnected world, rising global mobility, growing urban population density, and the effects of climate change. As these trends continue, societies are experiencing more frequent and successive outbreaks of infectious diseases, which pose significant threats to global health, healthcare infrastructure, and both economic and social stability. The persistent vaccine equity gap leaves countries in sub-Saharan Africa especially vulnerable to the severe consequences of modern epidemics. Addressing this complex challenge requires recognizing the multifaceted barriers—ranging from healthcare and socioeconomic disparities to cultural, educational, technological, geographic, political, regulatory, and environmental obstacles—that limit equitable access to resources [1, 2, 3]. In the context of behavioral epidemiology, transparent and open risk communication by governments is critical to building public trust, encouraging participation, and reducing vaccine hesitancy. This paper explores the intricate web of constraints contributing to vaccine inequity and outlines a comprehensive, multi-pronged strategy to help close the global vaccine equity gap.

Keywords : Healthcare Policy, Infectious Disease, Sub-Saharan Africa, Vaccine Awareness, Vaccine Diplomacy, Vaccine Distribution, Vaccine Equity Gap, Vaccine Hesitancy.

RISING INFECTIOUS DISEASES AND UNEQUAL PROTECTION

Although Africa bears a disproportionate burden of infectious diseases, the vaccine equity gap has persisted for decades. Countries experiencing extreme poverty typically report lower immunization rates [2]. The DTP vaccine (which protects against diphtheria, tetanus, and pertussis) is widely used as a benchmark for global immunization coverage since it is a strong indicator of access to routine vaccination services. Between 2020 and 2023, about 5.31 million children missed pneumococcal immunization, and 4.94 million did not receive the polio vaccine [4]. Lower DTP coverage is evident in poorer countries [5]. Nearly all zero-dose children—those who have not received any routine vaccinations—reside in low- and middle-income countries, predominantly in Africa and South-East Asia [6]. Although the measles virus vaccine was licensed in the U.S. in 1963, outbreaks of vaccine-preventable measles continue to rise in under-immunized areas of Africa [7]. The COVID-19 pandemic further widened the gaps in vaccination coverage. By 2020, wealthy countries, which represented only 14% of the global population, had secured over 53% of the available COVID-19 vaccine doses [8]. Consequently, developing nations received only a small share of these vaccines, deepening the divide between high- and low-income regions [9]. In 2023, most global regions exceeded 80% single-dose COVID-19 vaccination coverage, whereas many countries in sub-Saharan Africa remained below 50% [10].

BARRIERS TO THE VACCINE EQUITY GAP IN AFRICA

Low-income countries, particularly in Africa, continue to face a complex array of challenges that contribute to the global vaccine equity gap. These challenges are shaped by interwoven barriers related to vaccine production, distribution, mobilization, and public hesitancy [1, 2, 3]. Underlying these obstacles are deeper structural issues,

***Corresponding Author:** **Barbara W. K. Son, Ph.D,** Akio Morita School of Business Anaheim University 1240 South State College Blvd. Anaheim, CA 92806, USA.
Email: bson@anaheim.edu.
Received: 13-August-2025, Manuscript No. AIV-5048 **; Editor Assigned:** 15-August-2025 **; Reviewed:** 28-August-2025, QC No. AIV-5048 **;**
Published: 09-September-2025, **DOI:** 10.52338/aiv.2025.5048.
Citation: **Barbara W. K. Son, Ph.D.** Unequal Protection: Rising Infectious Diseases and the Global Vaccine Equity Gap. Advances in Vaccines. 2025 September; 13(1). doi: 10.52338/aiv.2025.5048.
Copyright © 2025 **Barbara W. K. Son, Ph.D.** This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

including inadequate healthcare infrastructure, economic hardship, socio-cultural and educational limitations, constrained vaccine manufacturing capacity, logistical hurdles, geopolitical tensions, regulatory complexities, and environmental factors. These interconnected challenges demand an integrated approach. This section examines eight key barrier categories, along with corresponding vaccine equity strategies, as outlined in **Table 1**.

Table 1. Overcoming Vaccine Equity Challenges in Africa: An Integrated Approach

	Barriers to Vaccine Equity Gap	Constraints to Overcome	Recommend
1	Inadequate Healthcare Infrastructure	- Healthcare Facilities - Healthcare Workers - Cold-Chain Constraints	- Improvement of the National Health Insurance System - Comprehensive Healthcare Resource Mobilization Strategies
2	Economic Hardship	- Low Income and Poverty - Inadequate Nutrition - Unaffordable Vaccines	- Affordable Vaccine Pricing - Foreign Aid - Subsidies - Vaccine Donations
3	Socio-Cultural and Educational Limitations	- Vaccine Hesitancy - Vaccine Mistrust and Miscommunication	- Open, Transparent Vaccine Communication - Community Involvement - Engagement with Opinion Leaders - Vaccine Education - Vaccine Awareness Campaigns - Educational Policy
4	Constrained Vaccine Manufacturing & Technology	- Limited Vaccine Production Capacity - Vaccine Monopoly - Limited Technology and Knowledge Transfers	- Expansion of Vaccine Manufacturing - Intellectual Property Rights - Localized Vaccine Manufacturing - Vaccine Technology & Knowledge Transfers
5	Logistical & Geographic Huddles	- High Logistic and Geographic Barriers to Rural Residents	- Mobile Vaccine Clinics
6	Geopolitical Tensions	- Civil Unrest - Vaccine Nationalism	- Global Vaccine Alliances
7	Regulatory Complexities & Trade Policy	- Regulatory Constraints - Complex Supply Chains	- Multi-lateral Agreements - Role of WHO, WTO, World Bank - Role of NGOs and Foreign Aid
8	Environmental Hurdles	- Access to Clean Water & Sanitation	- Public-Private Partnership

Source: Compiled by Authors

Inadequate Healthcare Infrastructure

The limited healthcare infrastructure in many African nations is further strained by the growing burden of vaccine-preventable infectious diseases. Challenges in vaccine storage and distribution stem from insufficient cold-chain capabilities, inadequate healthcare facilities, and shortages of trained healthcare personnel [1, 2, 11, 41]. These constraints underscore the urgent need to enhance national health insurance systems and implement comprehensive resource mobilization strategies to reinforce the region's fragile healthcare infrastructure.

Economic Hardship

Low-income countries often lack the financial capacity to purchase costly vaccine supplies from global manufacturers. Consequently, only about half of the nations with reported monkeypox cases accessed the vaccine [12]. During the COVID-19 pandemic, profit-driven pharmaceutical companies prioritized sales to wealthier nations, exacerbating global vaccine inequities [13]. By mid-2021, high-income countries—home to just 16% of the global population—had secured the majority of all available COVID-19 vaccine doses [14]. In addition, widespread poverty in African nations hinders efforts to improve nutrition, contributing to an increased disease burden. To close this vaccine equity gap, national prioritization of vaccine budgets, along with foreign

aid and subsidies for affordable vaccines, is critical [15]. The World Health Organization (WHO), World Trade Organization (WTO), World Bank, and International Monetary Fund (IMF) have urged wealthy countries and vaccine manufacturers to donate vaccines [16]. Although low-income countries have relied on vaccine donations, these contributions have often been limited in quantity, with many doses arriving close to expiration before reaching vulnerable populations [16]. This calls for improved local vaccine distribution systems.

Socio-Cultural and Educational Limitations

Sociocultural and educational barriers significantly hinder vaccination efforts across African nations. Misinformation, religious and cultural opposition, mistrust in vaccines, and negative past healthcare experiences all contribute to widespread vaccine hesitancy [17, 18]. In low-income countries, these issues are compounded by structural obstacles and limited health education, creating a challenging environment for effective immunization [16]. These circumstances underscore the urgent need for increased investments in awareness, transparency, and science-based information about vaccine safety and efficacy [19].

Targeted public health campaigns that encourage routine childhood immunizations and promote vaccine confidence, especially in local languages on locally-based media, are especially critical [4]. Effective approaches include engaging with community mobilizers and opinion leaders, who play a critical role in reducing stigma, raising awareness, and disseminating accurate information [2, 15]. The WHO and GAVI's COVID-19 Vaccine Delivery Partnership underscores the importance of culturally relevant health literacy initiatives to combat misinformation. Achieving global vaccine equity requires coordinated campaigns that address not only misinformation but also religious and cultural resistance and deep-seated mistrust in vaccines [2, 3, 20].

Constrained Vaccine Manufacturing Capacity & Technology

The surge in epidemics and the high mortality rates associated with infectious diseases underscore the critical need for local vaccine production across Africa. Currently, the continent produces less than 1% of the vaccines it requires [21]. In response to this shortfall, the African Union introduced a policy aiming to produce 60% of the vaccines used within the region [12]. However, vaccine manufacturing in low-income countries faces substantial barriers, including medical, financial, and technological limitations [22]. Additional challenges include restrictive intellectual property rights and the limited transfer of vaccine technology and expertise, as most major vaccine and pharmaceutical companies are headquartered in high-income countries [8]. For instance, Danish-based Bavarian Nordic remains the sole producer of the Mpox vaccine for the U.S. and the EU, creating a monopolistic structure that resulted in significant deadweight loss [15, 23]. The vaccine's high cost—at the time estimated at $141 per dose by the WHO—further hindered access for low-income countries and complicated efforts to procure millions of doses for Africa [24]. Historically, the transfer of vaccine technology in the 1970s enabled high-risk nations to produce freeze-dried vaccines locally [2]. Building on that legacy, in 2021, the WHO advanced vaccine diplomacy by selecting a South African consortium to lead a global mRNA technology transfer hub, which subsequently led to the establishment of mRNA vaccine production facilities in South Africa, Senegal, and Argentina [25].

Logistical and Geographic Hurdles

Beyond barriers to vaccine access, logistical and geographic challenges further complicate vaccine storage and delivery across Africa [2, 10, 12]. These difficulties have particularly hindered distribution efforts among vulnerable, high-risk populations. In sub-Saharan Africa, where a large portion of the population resides in rural areas with limited healthcare infrastructure, the lack of reliable transportation and medical facilities significantly impedes equitable vaccine access. Effective vaccine distribution depends on robust logistics, accessible transportation networks, the proximity of vaccination sites to communities, and mobile vaccine clinics [26, 27].

Geopolitical Tensions

In addition to the complex challenges previously discussed, vaccine distribution in Africa is further hindered by geopolitical tensions [28]. Vaccine nationalism has allowed higher-income nations to secure preferential access, leaving low-income countries at a disadvantage [2, 29, 30]. The global supply of monkeypox vaccines remains heavily concentrated in high-income regions, particularly the United States and Europe, mirroring the inequities observed during the COVID-19 pandemic [31]. By August 2022, the United States—despite representing only 36% of reported cases—controlled roughly 80% of the global vaccine stockpile, while Africa, with far fewer cases, accounted for 45% of all case-related deaths [27]. Although initiatives such as the Vaccine Alliance (GAVI) and COVAX aim to improve vaccine access in low-income countries, their overall impact has been limited. Expanding these alliances, while creating similar continental multinational initiatives remains essential to reducing global vaccine inequity.

Regulatory Complexities and Trade Policy

Regulatory complexities and export restrictions are among the underpinning factors of global vaccine inequity, especially in Africa [8]. Testing and quality control of noncommercial

vaccine samples in foreign laboratories follow the same trade procedures as commercial shipments. Vaccine nationalism, export curbs, complex regulatory frameworks, and supply chains have exacerbated the critical vaccine shortage of low-income nations while resulting in wasted vaccines [16]. Bilateral agreements between high-income countries and vaccine manufacturers further restricted vaccine distribution to low-income countries under the COVID-19 Vaccines Global Access (COVAX) program [32]. In 2022, bilateral and multilateral agreements accounted for 56.4% of vaccines procured in low- and middle-income countries, compared with 21.4% via COVAX [33]. Foreign aid, NGOs, and grassroots initiatives also contributed to vaccine access [34]. WHO is strengthening regulatory authorities through its global benchmarking tool and establishing a biomanufacturing workforce training hub to expand research and production capacity. The WHO, WTO, and World Bank advocate reducing complex vaccine supply chain regulations, with the WTO facilitating international vaccine export cooperation [16, 25]. In addition, local regulatory barriers should not be an added burden.

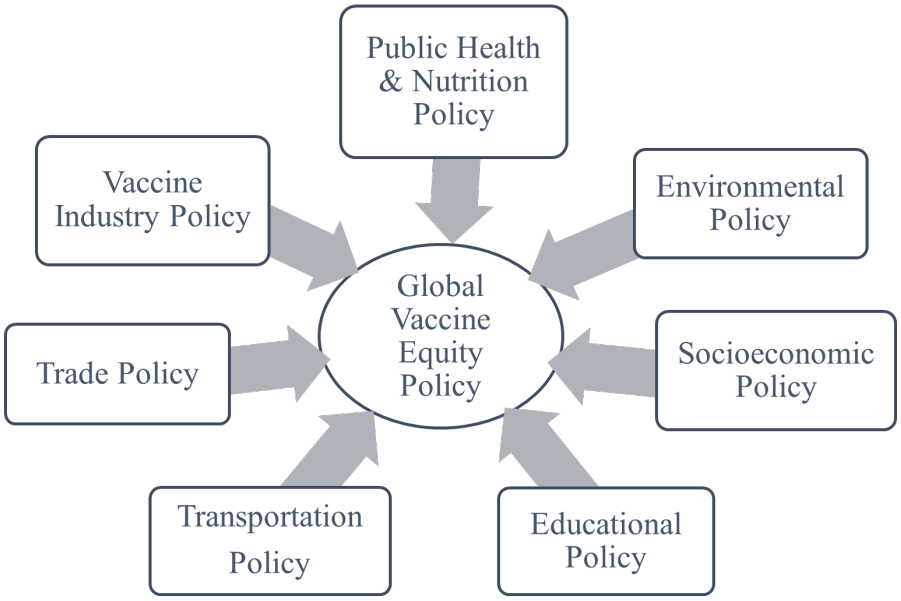
Environmental Hurdles

Environmental hurdles, the final category in Table 1, highlight how Africa's fragile climate resilience exacerbates limited access to clean water, sanitation, and hygiene, thereby increasing waterborne disease incidence [35, 36, 37]. Addressing these challenges requires innovative strategies for climate change–induced health risks, including enhanced public–private partnership, multisectoral cooperation among climate change stakeholders and policymakers, all guided by the One Health approach [38]. Further, local awareness of best practices similar to COVID-19 public education would be invaluable.

TOWARD GLOBAL VACCINE EQUITY: A UNIFIED AND MULTI-PRONGED SOLUTION

As discussed in the preceding section, addressing the complex and interwoven challenges driving the global vaccine equity gap requires an integrated approach. As shown in **Figure 1**, advancing global vaccine equity calls for a coordinated, multi-pronged strategy targeting disparities across seven key policy areas.

Figure 1. Toward Global Vaccine Equity: A Unified and Multi-Pronged Solution.



Low-income countries, particularly in Africa, face interrelated challenges in health infrastructure, poverty, nutrition, clean water, hygiene, and sanitation that contribute to the global vaccine equity gap [1, 35–37]. Addressing these issues requires integrated and coordinated public health, nutrition, environmental, socioeconomic, and transportation policies, alongside corresponding vaccine equity strategies, as outlined in Table 1. In Africa, vaccine rollout has been hindered by barriers including limited access, affordability, distribution capacity, mobilization, and vaccine hesitancy, with marginalized communities facing severe resource shortages. High-income nations can help close this gap by investing in preventive measures such as healthcare infrastructure, mobile vaccine units, nutrition, water treatment, sanitation, waste management, and transportation systems [1, 2, 39].

As illustrated in Figure 1, educational policy is vital to addressing global vaccine inequity. Vaccine education, awareness, and communication form key components of a multi-faceted strategy to tackle the root causes of vaccine hesitancy, including low health literacy, misinformation, and public distrust [20]. Establishing trusted communication channels through local leaders and

healthcare providers is essential to counter misinformation effectively [2, 40].

Beyond the challenges already discussed, global vaccine inequity persists due to manufacturing, pharmaceutical R&D, regulatory, and trade obstacles [2, 16, 22]. Addressing these issues requires that vaccine industry practices and trade policies, as outlined in Figure 1, promote equitable vaccine allocation to ensure timely access for vulnerable populations in low-income countries. Most importantly, developing countries must embrace and strengthen local capacities in anticipation of continued vaccine equity gaps.

CONCLUSION

We examined a complex set of factors contributing to the global vaccine equity gap and proposed corresponding strategies across eight key categories, summarized in Table 1. Addressing these intertwined challenges demands a unified, multipronged approach spanning seven critical policy areas, as illustrated in Figure 1. The WHO plays a central role in coordinating this strategy, drawing on its successful experience with the global smallpox eradication campaign, which involved vaccine production, technology transfer, international funding, donations, mobilization, and distribution [2]. Achieving global vaccine equity requires collaboration among all stakeholders, led by global alliances and the WHO. Key organizations—including the WHO, WTO, World Bank, and the Africa CDC—should coordinate efforts in multilateralism, vaccine financing, cold chain infrastructure, mobilization, and distribution, applying lessons learned from previous global vaccine initiatives.

REFERENCES

1. Son, B.W.K. Introduction to the Landscape of Global Health Inequity. In: Son, B.W.K. (eds) The Landscape of Global Health Inequity. Integrated Science. 2024, 22, 1-9. Springer, Cham. https://doi.org/10.1007/978-3-031-60502-4_1.

2. Son, B.W.K.; Wambalaba, O.W.; Wambalaba, W.F. A Multi-pronged Approach to Addressing Global Poxviruses Vaccine Inequity: A Case of Monkeypox. In: Rezaei, N. (eds) Poxviruses. Advances in Experimental Medicine and Biology. 2024, 1451. 317330. Springer, Cham. https://doi.org/10.1007/978-3-031-57165-7_20.

3. Son, B.W.K. A Multipronged Approach to Combat COVID-19: Lessons from Previous Pandemics for the Future. In: Rezaei, N. (eds) Integrated Science of Global Epidemics. Integrated Science. 2023, 14, 73-92. Springer, Cham. https://doi.org/10.1007/978-3-031-17778-1_4.

4. Geddes, L. Study: Tackling equity gaps and misinformation key to meeting global vaccine targets. Gavi. 2025. Available Online: https://www.gavi.org/vaccineswork/study-tackling-equity-gaps-and-misinformation-key-meeting-global-vaccine-targets (accessed on 21 July 2025).

5. Vanderslott, S.; Dattani, S.; Spooner, F.; Roser, M. Vaccination. Our World in Data. 2024.

6. CDC. Fast Facts on Global Immunization. 2025. Available Online: https://www.cdc.gov/global-immunization/fast-facts/index.html (accessed on 17 July 2025).

7. WHO. Vaccine-preventable disease outbreaks on the rise in Africa. 28 April 2022. Available Online: https://www.afro.who.int/news/vaccine-preventable-disease-outbreaks-rise-africa (accessed on 5 February 2023).

8. Singh B; Kaur J; Chattu VK. Global vaccine inequities and multilateralism amid COVID-19: Reconnaissance of Global Health Diplomacy as a panacea? Health Promot Perspect. 2022 Dec 31, 12(4), 315-324. doi: 10.34172/hpp.2022.41. PMID: 36852205; PMCID: PMC9958236.

9. United Nations. UN analysis shows link between lack of vaccine equity and widening poverty gap. UN News. 2022. Available Online: https://news.un.org/en/story/2022/03/1114762 (accessed on 10 February 2023).

10. Dagovetz, M; Momchilov, K; Blank, L.; Khorsandi, J.; Rizzo, A.; Khabbache, H., Sitibondo, A.; Gómez Salgado, J.; Chirico, F.; Batra, K. Global COVID-19 vaccination challenges: Inequity of access and vaccine hesitancy. Journal of Medicine, Surgery, and Public Health. 2025, 6, 100197. https://doi.org/10.1016/j.glmedi.2025.100197.

11. Siani, A. A Review of Global Inequities in COVID-19 Vaccination Access and Uptake. In: Son, B.W.K. (eds) The Landscape of Global Health Inequity. Integrated Science. 2024, 22, 57-69. Springer, Cham. https://doi.org/10.1007/978-3-031-60502-4_6.

12. Zarocostas J. Monkeypox PHEIC decision hoped to spur the world to act. The Lancet. 2022, 400(10349), 347.

13. Dey, S.; Kusuma, Y.S.; Kant, S.; et al. COVID-19 vaccine acceptance and hesitancy in Indian context: a systematic review and meta-analysis. Pathog. Glob. Health, 2024, 118 (2), 182-195. 10.1080/20477724.2023.2285184.

14. Sheikh, A.B.;Pal, S.; Javed, N.; Shekhar, R. COVID-19 vaccination in developing nations: challenges and opportunities for innovation. Infect. Dis. Rep. 2021, 13 (2), 429-436. 10.3390/idr13020041.

15. Son, BWK. Ending the Mpox Endemic: Beyond Declaring a Public Health Emergency. Integr J Vet Biosci. 2025, 9(1), 1-3.

16. Gill, I.; Ruta, M. Why global vaccine equity is the prescription for a full recovery. Brookings. 2022. Available Online: https://www.brookings.edu/articles/why-global-vaccine-equity-is-the-prescription-for-a-full-recovery/(accessed on 11 March 2023).

17. Cha, M; Lima, G; Singh, K; Cha, C; Ahn, YY; Kulshrestha, J; et al. Prevalence of misinformation and factchecks on the COVID-19 pandemic in 35 countries: Observational infodemiology study. JMIR Human Factors. 2021, 8(1), e23279. doi: 10.2196/23279.

18. Puri, N.; Coomes, E.A.; Haghbayan, H.; Gunaratne, K. Social media and vaccine hesitancy: new updates for the era of COVID-19 and globalized infectious diseases. Hum. Vaccin Immunother. 2020, 16 (11), 2586-2593, 10.1080/21645515.2020.1780846.

19. Runde, D.F.; Savoy, C.M.; Staguhn, J. Global COVID-19 Vaccine Distribution Handbook. Center for Strategic and International Studies. Available Online: https://www.csis.org/analysis/global-covid-19-vaccine-distribution-handbook (accessed on July 10, 2025).

20. Gagneur, A.; Gutnick, D.; Berthiaume, P.; Diana, A.; Rollnick, S.; Saha, P. From vaccine hesitancy to vaccine motivation: a motivational interviewing based approach to vaccine counselling. Hum. Vaccin. Immunother. 2024, 20 (1), 2391625. 10.1080/21645515.2024.2391625.

21. Nweneka, C. V.; Disu, T. The future of vaccine manufacturing in Africa. Brookings. 2022. Available Online: https://www.brookings.edu/articles/the-future-of-vaccine-manufacturing-in-africa/ (accessed on 1 December 2022).

22. Khan, MI; Ikram, A; Hamza, HB. Vaccine manufacturing capacity in low- and middle-income countries. Bulletin of the World Health Organization. 2021, 99(7), 479-479A.

23. Hart, R. Mpox Vaccine Maker Bavarian Nordic Shares Soar Amid Concern Over Virus Outbreak. Forbes. 2024.

24. Wass, S.; Kew, J. Higher price of mpox vaccine to pose key hurdle in Africa order talks. Business Standard. 2024.

25. World Health Organization. WHO announces first technology recipients of mRNA vaccine hub with strong support from African and European partners. 2022. Available Online: https://www.who.int/news/item/18-02-2022-who-announces-first-technology-recipients-of-mrna-vaccine-hub-with-strong-support-from-african-and-european-partners (accessed on 7 December 2022).

26. Hall, S.; Kaplow, L.; Sun, YS.; Holt, TZ. 'None are safe until all are safe': COVID-19 vaccine Rollout in Low-and middle-income countries. McKinsey & Company. 2021.

27. Molteni, M.; Branswell, H.; Joseph, A.; Mast, J. 10 key questions about monkeypox the world needs to answer. Statnews August 30, 2022. Available Online: https://www.statnews.com/2022/08/30/10-key-questions-about-monkeypox-the-world-needs-to-answer/ (accessed on 7 December 2022).

28. Yadete, T.; Batra, K.; Netsk, D.M.; Antonio, S.; Patros, M.J.; Bester, J.C. cross-sectional study. Vaccines. 2021, 9 (12), 1424. 10.3390/vaccines9121424.

29. Kuehn, M.; LaMori, J.; DeMartino, K.; et al. Assessing barriers to access and equity for COVID-19 vaccination in the US BMC Public Health. 2022, 22, 2263. 10.1186/s12889-022-14636-1.

30. Zhou YR (2022) Vaccine nationalism: contested relationships between COVID-19 and globalization. Globalizations, 19(3), 450-65.

31. Lancet Editorial Board. Monkeypox: a global wake-up call. [Editorial]. The Lancet. 2022, 400, 337.

32. World Health Organization. Achieving 70% COVID-19 immunization coverage by mid-2022. World Health Organization. 2021. Available Online: https://www.who.int/news/item/23-12-2021-achieving-70-covid-19-immunization-coverage-by-mid-2022 (accessed on 20 November 2022).

33. Das, J.K.; Lakhani, S; Khan, M.H.; Bhutta, Z.A.; Muhammad, S.; Chee, H.Y.; et al. COVID-19 Vaccines: How Efficient and Equitable Was the Initial Vaccination Process? Vaccines. 2023, 11(1), 11.

34. Levine, A.C.; Park, A.; Adhikari, A.; Alejandria, M.C.P.; Bradlow, B.H.; Lopez-Portillo, M.F.; et al. The role of civil society organizations (CSOs) in the COVID-19 response across the Global South: A multinational, qualitative study. PLOS global public health, 2023, 3(9), e0002341.

35. Moore, S.; Colwell, R. Climate change and the resurgence of waterborne diseases: Focus on Sub-Saharan Africa. Field Actions Sci. Rep. 2025, 27, 66–70.

36. Agyarko, R.K.D.; Kithinji, D.; Nsarhaza, K.B. Climate Change and the Rise of Emerging and Re-Emerging Infectious Diseases in Africa: A Literature Review. Int J Environ Res Public Health. 2025 Jun 6, 22(6), 903. doi: 10.3390/ijerph22060903.

37. Jinnefält, D. Inequality of Clean Water in Africa. In: Son, B.W.K. (eds) The Landscape of Global Health Inequity. Integrated Science. 2024, 22, 91-103. Springer, Cham. https://doi.org/10.1007/978-3-031-60502-4_8.

38. Yasobant, S.; Yadav, M.; Saxena, D. Inequity Versus Inequality in the One Health: Are We Doing Justice and to Whom?. In: Son, B.W.K. (eds) The Landscape of Global Health Inequity. Integrated Science, 2024, 22, 243-255. Springer, Cham. https://doi.org/10.1007/978-3-031-60502-4_16.

39. Na, L.; Banks, S.; Wang, P.P. Racial and ethnic disparities in COVID-19 vaccine uptake: A mediation framework. Vaccine. 2023. 41 (13), 2404-2411, 10.1016/j. vaccine.2023.02.079.

40. Petersen, M.B.; Bor, A.; Jørgensen, F.; Lindholt, M.F. Transparent communication about negative features of COVID-19 vaccines decreases acceptance but increases trust. Proc. Natl. Acad. Sci. 2021, 118 (29), e2024597118. 10.1073/pnas.2024597118.

41. Wambalaba,F.W.; Son, B.; Wambalaba, A.E.; Nyong'o, D.; and Nyong'o,A. Prevalence and Capacity of Cancer Diagnostics and Treatment: A Demand and Supply Survey of Health-Care Facilities in Kenya. Cancer Control. 2019 Jan-Dec, 26(1),1073274819886930. doi: 10.1177/1073274819886930.