Available online www.worldscientificnews.com

World Scientific News

An International Scientific Journal

WSN 206 (2025) 100-112 EISSN 2392-2192

Achieving Vaccine Equity and Access in Africa: Challenges and Recommendations

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ABSTRACT

Vaccines are indispensable tools for public health, significantly reducing disease burden and mortality globally. However, their benefits are not equitably distributed, with African nations facing persistent challenges in accessing life-saving vaccines, a disparity starkly highlighted during the COVID-19 pandemic. This paper analyzes the multifaceted barriers hindering vaccine equity in Africa and proposes strategies for sustainable improvements. The primary challenges identified are economic, infrastructural, political, and socio-cultural. Economic constraints include high procurement costs, insufficient healthcare budgets, and the impact of intellectual property rights limiting local production. Infrastructural and logistical hurdles involve fragile cold chain systems, poor transportation networks, and human resource shortages, particularly in rural areas. Politically, vaccine nationalism by wealthier nations and regulatory inefficiencies in Low- and Middle-Income Countries (LMICs) exacerbate inequities. Furthermore, social and cultural factors such as vaccine hesitancy, fueled by misinformation and historical distrust, impede vaccine uptake. To address these complex issues, the paper advocates for a multi-pronged approach.

(Received 18 June 2025; Accepted 15 July 2025; Date of Publication 13 August 2025)

Key recommendations include increased domestic investment in healthcare by African governments, strengthening supply chain management through modern energy solutions and digital technologies, and enhancing national regulatory capacities to ensure vaccine quality and safety. Promoting local vaccine production through supportive policies and international partnerships is crucial for self-sufficiency. Additionally, tackling socio-cultural barriers via community engagement and culturally sensitive public health campaigns, alongside a broader strengthening of primary healthcare systems, is essential. Ultimately, achieving vaccine equity in Africa requires a concerted effort to dismantle systemic barriers and foster regional collaboration. This will not only protect the health of African populations but also contribute to economic stability and the realization of fundamental human rights, ensuring the continent is better prepared for future health crises.

Keywords: Vaccine equity, Africa, COVID-19, Cold chain, Vaccine hesitancy, Public health.

1. INTRODUCTION

Vaccines have historically played a crucial role in preventing and controlling life-threatening diseases in both humans and animals [1]. Their importance as life-saving tools is demonstrated in public health milestones such as the eradication of smallpox in humans and rinderpest in cattle [2–3]. Over the past five decades, vaccines are estimated to have saved at least 154 million lives, with about two-thirds of these being infants, thereby significantly reducing infant mortality rates and improving child health outcomes [1].

In numerous African economies, vaccines are also essential for maintaining economic stability and food security by protecting the health and welfare of livestock. This protection is especially vital for smallholder farmers, as it enhances agricultural productivity, secures food supplies, and prevents financial losses caused by widespread animal diseases, including Newcastle Disease in poultry, Contagious Bovine Pleuropneumonia (CBPP) in cattle, and Peste des Petits Ruminants (PPR) in sheep and goats [4–6]. Moreover, by controlling diseases such as rabies and anthrax in animals, vaccines have also reduced the risk of zoonotic transmission to humans, thereby contributing to improved public health [7].

Given the importance of vaccines as life-saving tools, the concept of vaccine equity emphasizes fair allocation based on health needs, irrespective of a country's economic status [8]. However, the benefits of vaccines remain inequitably distributed. Low- and middle-income countries (LMICs), particularly in sub-Saharan Africa, continue to face persistent barriers to accessing life-saving vaccines [9]. The COVID-19 pandemic, much like the influenza epidemic before it, highlighted these disparities. Wealthier nations prioritized their populations by stockpiling vaccines, in direct contradiction to the principles of global vaccine equity. As a result, LMICs, especially those in Africa, experienced severe shortages in vaccine supply and distribution [9,2].

Despite accounting for approximately 18.8% of the global population, Africa received only about 8.3% of all COVID-19 vaccines administered globally as of 2023 [9–10]. Historically, many African countries have encountered delayed and unequal vaccine distribution [10]. These inequities have largely been attributed to high global demand, prohibitive costs, limited local manufacturing capacity, and ineffective international and regional allocation mechanisms [11].

The COVID-19 pandemic served as a stark reminder of these vulnerabilities, reinforcing the need for African nations to invest in the development of local capabilities for producing essential medical supplies, diagnostic kits, and vaccines.

This article examines the complex challenges hindering vaccine equity in Africa, identifies emerging opportunities to address these obstacles, and outlines strategic approaches for sustainable vaccine access. It argues that solving vaccine inequity on the continent requires an integrated approach, one that goes beyond economic and infrastructural challenges to also address political, social, and cultural barriers. Moreover, innovative technologies and community-based initiatives present promising solutions that can be leveraged for progress. In doing so, the article presents a new framework for understanding vaccine equity in the African context and offers practical policy recommendations. The following sections will explore, in detail, the specific barriers to vaccine equity in Africa, innovative strategies to overcome them, and policy interventions necessary to ensure long-term, equitable vaccine access across the continent.

Table 1. Vaccine-producing countries in Africa and the key vaccines produced.

Country	Vaccine Producer(s)	Key Vaccines Produced	References
Senegal	Institut Pasteur de Dakar (IPD)	Yellow Fever, COVID-19 (planned)	[12-13]
Nigeria	Biovaccines Nigeria Ltd, Innovative Biotech Ltd (IB) National Veterinary Research Institute (NVRI)	Childhood vaccines (planned), Newcastle Disease, Anthrax, Ebola Anthrax spore vaccine, Black Quarter vaccine, Brucella vaccine (S.19), Contagious Bovine Pleuropneumonia vaccine, Haemorrhagic Septicaemia vaccine, Fowl Cholera vaccine, Fowl Typhoid vaccine,HantaVac, Newcastle Disease vaccine (NDV), Fowl pox, Infectious Bursal Disease vaccine, Rabies, *Peste des Petits* Ruminant (PPR) vaccine, and thermostable Newcastle Disease vaccine (Strain I2).	[14]
South Africa	Biovac Institute, Aspen Pharmacare	COVID-19, Rift Valley Fever, Tuberculosis, Bluetongue, Hepatitis B, Oral Cholera Vaccine (OCV), OPV, Group B Streptococcus (GBS)	[12]

Egypt	**VACSERA** **MEVAC**	**Hepatitis B, Influenza, Rabies, BCG, Cholera, COVID-19, IPV, OPV, Typhoid, Yellow Fever, MMR** **Avian Influenza, Newcastle disease, Infectious bronchitis, Infectious coryza, Infectious bursa disease, Foot and Mouth Disease (FMD), Lumpy Skin Disease (LSD)**	**[14]**
Tunisia	Institut Pasteur de Tunis	Rabies, Hepatitis B, BCG	[12,14]
Ethiopia	Ethiopian Public Health Institute (EPHI) National Veterinary Institite	Newcastle Disease, PPR, CBPP, LSD, Rabies Anthrax, Pasteurellosis, Blackleg, Newcastle Disease, PPR, CBPP, CCPP, Sheep and Goat Pox, LSD, FMD, African Horse Sickness, Fowl pox, Fowl typhoid, IBD, Marek's, Camel Pox, Rabies	[13]
Kenya	Kenya Veterinary Vaccines Production Institute (KEVEVAPI)	Foot and Mouth Disease (FMD), LSD, Rabies	[13]
Morocco	Pasteur Institute Casablanca, Biopharma Laboratory in Rabat	Rabies IBD, Avian Influenza, NDV, Camel Pox, Rabies, Rift Valley fever, Anthrax, Clostridial diseases, Pasteurellosis, Blue tongue, Sheep and Goat Pox, PPR	[14]
Algeria	Institut Pasteur of Algeria	Rabies	[12,14]

2. BARRIERS TO VACCINE EQUITY

Vaccine inequity in Africa is a complex issue shaped by a combination of interconnected factors. These factors create significant obstacles that hinder many people from accessing the vaccines they need.

2.1. Economic Barriers

Economic barriers remain among the most formidable obstacles to vaccine equity in Africa, affecting both human and animal health interventions. The high cost of vaccine procurement, especially for new and advanced vaccines, has placed enormous strain on already overburdened health budgets in low- and middle-income countries (LMICs), because vaccines developed in response to public health emergencies, such as those for COVID-19, are often priced beyond the reach of African countries, which must simultaneously address longstanding endemic diseases like malaria, tuberculosis, and HIV/AIDS [15-17]. Budgetary constraints create difficult choices for policymakers, who may be forced to reallocate limited funds from essential services or rely on global aid mechanisms, often with uncertain or delayed outcomes [18-19]. High out-of-pocket expenses for healthcare can also deter individuals from seeking vaccination services. In many African countries, patients are required to pay for healthcare services, including vaccinations. These costs can be a significant burden for low-income households, potentially leading to delays or avoidance of vaccination, especially for those in marginalized communities.

The problem is not limited to the cost of vaccines alone but extends to the structural economics of vaccine access. Structural adjustment policies (SAPs) imposed by international financial institutions (IFIs) such as the International Monetary Fund (IMF) and the World Bank also indirectly affect vaccine equity. These policies often require governments to reduce public spending, including on healthcare, which can lead to decreased funding for immunization programs [20-21]. Intellectual property rights and patent protections, particularly for newer vaccines, have limited the ability of African countries to engage in local production or secure affordable generic alternatives [15]. Despite global advocacy for mechanisms like the Trade-Related Aspects of Intellectual Property Rights (TRIPS) waiver, progress has been slow and politically contested because pharmaceutical companies, citing innovation costs and quality control concerns, often restrict licensing agreements, effectively reinforcing dependency on external suppliers and limiting Africa's capacity to build a self-sustaining vaccine manufacturing ecosystem [15,17].

Even when global pledges for vaccine donations are made, economic asymmetries continue to disadvantage African countries. During the COVID-19 pandemic, for instance, wealthy nations made large-scale pre-purchase agreements that allowed them to secure the majority of the initial vaccine supply, leaving African countries to depend on donations through multilateral mechanisms like the COVAX Facility. Unfortunately, COVAX has been hindered by underfunding, export restrictions, and limited negotiating power; of the 1.3 billion additional doses promised to Africa through COVAX, only 194 million were delivered promptly, and some of these arrived close to their expiry dates, rendering them unusable [15]. This phenomenon not only wasted scarce resources but also eroded public confidence in vaccination programs.

Additionally, vaccines for economically important diseases such as Foot-and-Mouth Disease (FMD), Rift Valley Fever, Newcastle disease, and brucellosis are often imported at high costs, making sustained vaccination campaigns difficult to implement across large and often remote pastoral regions [21-22]. In many countries, animal vaccination is not prioritized in national budgets, and livestock owners are expected to bear the cost. This model is unsustainable in rural areas, where poverty and limited awareness hinder uptake.

Moreover, the absence of well-funded, continent-wide strategies for veterinary vaccine procurement and production has stymied the establishment of routine preventive programs, resulting in persistent outbreaks that negatively impact food security, livelihoods, and trade [21-23].

The fact that market-based vaccine production models are driven by profit rather than need also creates imbalances that contribute to inequity in Africa; hence, vaccine manufacturers tend to favor high-income countries that can offer volume-based contracts and predictable markets [24]. This incentive structure means that diseases prevalent in low-income settings receive less attention, resulting in delays in vaccine development and lower investment in technologies tailored to Africa's epidemiological context. Consequently, African countries often face higher per-dose costs, limited vaccine choices, and increased reliance on donor-funded supplies [24]. These multifaceted economic barriers reveal the deep structural inequalities embedded in the global vaccine ecosystem, and without a deliberate shift toward sustainable financing models, regional manufacturing capacity, and reform of global intellectual property regimes, vaccine equity in Africa will remain aspirational rather than achievable [25].

2.2. Infrastructure and Logistical Barriers

Infrastructure and logistical limitations represent some of the most enduring challenges to achieving vaccine equity in Africa. These barriers affect not only the delivery of COVID-19 vaccines but also the routine administration of essential human and animal vaccines across the continent. At the heart of this issue is the fragility of cold chain systems, particularly in rural and underserved regions. Many vaccines, such as those developed using mRNA platforms, require ultra-cold storage conditions ranging between -20°C to -70°C, and such temperature requirements far exceed the capabilities of the existing cold chain infrastructure in many African countries [18,25]. Frequent power outages, lack of backup generators, and inadequate refrigerated storage and transport vehicles contribute to vaccine spoilage, wastage, and suboptimal coverage [14,17]. Additionally, the availability of essential vaccination supplies, such as syringes, has been inconsistent and has constantly been a threat to immunization campaigns in several African countries [13,15].

Moreover, these logistical gaps are not confined to storage alone, vaccine distribution also relies heavily on road transport, which is often hindered by poor road conditions, limited geographic accessibility, and political or security instability in certain regions [25-30]. These challenges are especially pronounced in hard-to-reach communities where populations may be separated by long distances, mountains, rivers, or conflict zones, and in such areas, even when vaccines are available, delivering them on time and in potent condition is a formidable task.

Additionally, human resource shortages have also compounded these logistical issues, as many African health systems face chronic understaffing, especially in rural health facilities, and the few trained personnel capable of administering vaccines, managing cold chains, and conducting surveillance are often unavailable or overstretched. This is further complicated by a lack of training in the handling and administration of newly developed vaccines, which may have more complex dosage schedules or handling requirements [23]. In some countries, community health workers fill this gap, but they frequently operate with minimal support and training, limiting the scale and effectiveness of immunization programs [22].

More so, weak health information systems hinder efforts to track vaccine distribution, monitor coverage rates, and manage supply chains efficiently. Data gaps and manual record-keeping systems lead to mismatches between supply and demand, resulting in either vaccine wastage or stockouts. In contrast, high-income countries (HICs) benefit from digitalized systems that support real-time monitoring, efficient logistics planning, and rapid response to supply chain disruptions [12-14]. The absence of such systems in many African countries continues to hamper the responsiveness and accountability of vaccination efforts.

The issue of "vaccine nationalism" during the COVID-19 pandemic further illustrates how infrastructure intersects with broader geopolitical dynamics [25-26]. By August 2020, the United States had secured 800 million doses, the United Kingdom had procured 340 million, and Canada had purchased more than enough to cover its population multiple times over [20]. African nations, on the other hand, were left to rely on pooled procurement mechanisms through the African Union and the COVAX facility, only beginning their vaccine purchases in early 2021 [25]. These delays were not just a result of economic constraints but also stemmed from the inability to scale up infrastructure rapidly enough to absorb large vaccine volumes, even when donations were made. Adding to the inequity, vaccine donations to Africa often came in the form of doses with short shelf lives, requiring rapid deployment and consumption [13]. Without adequate cold storage, transport, and human resources, many of these doses expired unused, undermining public confidence and wasting scarce resources. Hence, the logistical pressure of deploying such doses at short notice places additional strain on already overwhelmed systems.

In veterinary health, similar infrastructural constraints limit vaccine coverage for livestock and companion animals, as many rural veterinary clinics lack basic equipment for cold storage and proper vaccine administration. Livestock owners may live far from veterinary service providers, and in the absence of mobile vaccination units, outbreaks of preventable diseases such as rabies, anthrax, and foot-and-mouth disease remain common. These persistent infrastructure deficits reduce herd immunity, increase zoonotic spillover risks, and compromise both animal and public health.

2.3. Political and Regulatory Barriers

Vaccine equity is further undermined by political dynamics and regulatory inefficiencies. High-income countries (HICs) during global health crises secure their own populations through vaccine nationalism by acquiring large quantities of doses via advance purchase agreements [13,31]. This practice of stockpiling disproportionately limits access for low- and middle-income countries (LMICs), effectively sidelining them during critical phases of vaccine distribution. While HICs typically benefit from streamlined and well-resourced regulatory systems that accelerate vaccine approval, LMICs often face delays due to bureaucratic inefficiencies, dependence on external approvals (such as those from WHO or EMA), and limited institutional capacity, which not only affect the speed of vaccine deployment but can also fuel public skepticism about the safety and reliability of vaccines [13,14]. Although the Global governance mechanisms were intended to promote equity, such as the COVAX initiative, it was ultimately hampered by structural weaknesses, funding shortages, and the failure of some countries to commit fully [13,17,31]. These systemic shortcomings highlight the need for more enforceable and equitable global health governance frameworks capable of ensuring fair allocation and penalizing non-cooperative behaviors.

2.4. Social and Cultural Barriers

Vaccine hesitancy has been fueled by misinformation, fear, and historical distrust, and it remains a major obstacle to uptake in many communities [13-14]. Misinformation, often spread via social media and informal networks, can distort public understanding of vaccine safety, effectiveness, and intent, leading to reluctance or outright refusal to get vaccinated. Trust in health systems is another critical determinant, especially in regions where healthcare has historically been inaccessible or inequitable. Skepticism toward government-led health interventions may persist because of previous negative experiences, such as coercive medical campaigns or neglect, which can breed resistance, particularly when vaccine rollout lacks meaningful community engagement. Sociocultural dynamics, including gender norms, religious beliefs, and traditional healing practices, can further influence vaccine acceptance. For example, in some settings, women and children may face barriers in accessing healthcare due to cultural restrictions, while reliance on non-biomedical approaches may deter vaccination altogether. Moreover, systemic gaps in health system capacity, including shortages of trained personnel, weak vaccine supply chains, and insufficient cold chain infrastructure, worsen the situation and pose substantial logistical hurdles in LMICs, particularly in rural areas with unreliable electricity [16,32-34]. The effectiveness of vaccination efforts is also contingent on frontline health workers, whose performance hinges on adequate training, remuneration, and institutional support. Without sustained investment in health workforce development, vaccination campaigns in LMICs are likely to remain fragile and inefficient [17,33,35].

3. RECOMMENDATIONS FOR SUSTAINABLE VACCINE ACCESS IN AFRICA

To ensure equitable and sustainable vaccine access across Africa, a holistic and multi-layered approach is essential. This approach must address existing systemic weaknesses while seizing opportunities for growth, innovation, and regional collaboration. The recommendations below provide a guiding framework for policymakers, public health institutions, and global partners working toward long-term vaccine security on the continent.

3.1. Increased Domestic Investment in Healthcare

One of the most critical steps toward sustainable vaccine access is increasing domestic investment in healthcare. African governments need to make health a national priority by committing a substantial portion of their annual budgets to the health sector, including immunization programs. Increased funding will enable countries to procure adequate vaccine supplies, improve cold chain infrastructure to maintain vaccine efficacy, and develop a robust healthcare workforce capable of reaching underserved communities. Additionally, investing in health education and public awareness campaigns will strengthen community engagement and reduce reliance on external funding sources, which are often unpredictable and inconsistent.

3.2. Strengthening Supply Chain Management

Another vital area of focus is the improvement of supply chain management systems. For vaccines to be effective, they must be delivered in a timely manner and stored under optimal conditions. Strengthening vaccine logistics requires investment in modern energy solutions, such as solar-powered refrigeration for maintaining cold chains, especially in rural and off-grid areas. Upgraded storage facilities and the adoption of digital technologies, like electronic immunization registries and mobile applications, will also help track vaccine stocks, monitor distribution, and ensure transparency and accountability within the supply chain.

3.3. Enhancing Regulatory Capacity

Strong national regulatory agencies are essential to guarantee the quality, safety, and efficacy of vaccines circulating within each country. This calls for the modernization of vaccine approval processes, harmonization of regulatory standards across the continent, and the development of regional frameworks to facilitate collaboration. Strengthened post-market surveillance systems will further ensure that any adverse effects or quality issues are promptly identified and addressed. Capacity building in this sector will enable African countries to exercise greater autonomy and oversight over their immunization programs.

3.4. Promoting Local Vaccine Production

Promoting local vaccine production stands as a long-term strategy for ensuring self-sufficiency and reducing dependency on foreign manufacturers. African governments should create a supportive environment for local pharmaceutical industries by offering financial incentives, technical training, and infrastructure development. Partnerships with international vaccine producers can facilitate knowledge transfer and technology-sharing initiatives, which are essential for establishing and scaling up local manufacturing capabilities. In the long run, this will not only increase supply security but also create jobs and stimulate economic growth.

3.5. Addressing Social and Cultural Barriers

Vaccine hesitancy, driven by misinformation, distrust in the health system, or religious and cultural beliefs, continues to undermine immunization efforts. Governments and health organizations must work closely with community leaders, religious figures, and traditional healers to communicate accurate, evidence-based information about vaccines. Community engagement and culturally sensitive public health campaigns can significantly improve trust and encourage vaccine acceptance, especially in rural and marginalized communities.

3.6. Strengthening Health Systems

Finally, sustainable vaccine access cannot be achieved without robust health systems. Strong primary healthcare infrastructure is the backbone of effective immunization programs. This involves ensuring the availability of trained health professionals, particularly in rural and remote areas, as well as consistent supplies of essential medicines and equipment. Investments in health system resilience will not only support vaccine delivery but also enhance the overall capacity to manage future public health threats.

4. CONCLUSIONS

The lessons learned from recent pandemics highlight the urgent need for robust health systems and proactive measures to prevent future outbreaks by prioritizing vaccine equity in Africa. While it is a complex but essential undertaking, investing in research and development, strengthening local manufacturing capacity, and building a resilient healthcare workforce are essential steps towards achieving long-term vaccine security in Africa.

By addressing the challenges and seizing the opportunities outlined in this article, it is possible to move closer to a future where vaccine equity is a reality, and the health and well-being of all Africans are protected. Vaccine equity will contribute to overall economic growth, social stability, and the realization of fundamental human rights. The African community, therefore, has a moral and pragmatic imperative to work together to ensure that all people, regardless of their location or socioeconomic status, can benefit from the transformative power of vaccination.

Conflicts of Interest

The authors declare no conflict of interest.

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