

Article

Equitable Vaccine Access in Light of COVID-19 Vaccine Procurement Strategies in Africa

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Abstract: (1) Background: This study addresses two weaknesses in current international efforts to prevent and prepare for the next pandemic: the lack of robust evidence supporting global policy measures and the corresponding extent to which those measures advance equity. (2) Methods: Using UNICEF's publicly available but underused COVID-19 Market Dashboard database, we conducted a cross-sectional analysis of vaccine deliveries as of mid-2022 and vaccine procurement strategies used by African low- and lower middle-income countries (LMICs) over the course of the COVID-19 pandemic. (3) Results: Pooled procurement of the kind typified by COVAX (a clearinghouse for high-income-country contributions of vaccines and financing toward the end of equitable LMIC procurement) crowded out alternative strategies that must be supported in future: regional procurement, donation, and bilateral procurement (binding agreement between two parties: one seller (i.e., a national government or a vaccine manufacturer) and one recipient (i.e., national government)), which showed a significant relationship with technology transfer and advancing local production capacity. (4) Conclusions: Expanding the scope of vaccine procurement alternatives to COVAX such as regional pooled procurement and bilateral procurement can stratify risk of supply agreements not materializing in actual supply. Sharing the technology necessary to produce vaccines with LMICs can mitigate obstacles to bilateral procurement. A pooled purchase alliance to procure vaccine doses on behalf of participating countries within a given region can benefit LMICs by accounting for infrastructure limitations that these countries share. Finally, donations bolster global redistributed supply essential to LMICs.

Keywords: vaccine policy; COVID-19; health disparities

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1. Introduction

1.1. Equity, Evidence, and the (Re)Negotiation of International Pandemic Law and Finance

Inequity was a prominent feature during the COVID-19 pandemic, presenting at nearly every stage of the global health crisis. In the early days of the pandemic, high-income countries hoarded personal protective equipment (PPE), masks, ventilators, and other medical supplies [1]. Furthermore, COVID-19 was marked with great inequity in access to vaccines. As one illustration, high-income countries, which hold only 16 percent of world population, had, by the middle of 2021, bought more than half of all available COVID-19 vaccine doses via bilateral purchase procurement agreement (a binding agreement between two parties (one selling party, commonly a vaccine manufacturer or a national government, and one purchasing party, such as a national government), controlling (and generally not sharing) volumes of doses that exceeded their population needs. Low-income and lower middle-income countries (LMICs), meanwhile, had neither the financial means nor the capacity to manufacture vaccines within their borders [2,3]. In Africa, home to 17.4 percent of the world population and composed nearly entirely of LMICs, the number of total vaccine dose administrations in 2021 made up less than 3 percent of the global total [4]. In fact, by

the time 75 percent of the entire population of western Europe had been vaccinated, only one quarter of African health workers had received the COVID-19 vaccine [5]. Countries left stranded without sufficient equipment, diagnostics, and ultimately vaccines demand that global disparities in access to medical countermeasures, including capacity to manufacture, be addressed in a meaningful and enforceable way.

Currently, the global health diplomatic community is undertaking generation-defining negotiations over two international pandemic preparedness agreements: revisions to the International Health Regulations (IHR) (2005) and the yet-to-be-named “CA+” agreement called for by the World Health Assembly in May 2022 [6,7]. In both sets of negotiations, equity has played a necessary prominent role. Recognizing the impact of inequity and the importance of preventing a recurrence in future health emergencies, in the Zero Draft of the “CA+” agreement, the States Parties express concern at “the gross inequities that hindered timely access to medical and other COVID-19 pandemic-related products, notably vaccines, oxygen supplies, PPE, diagnostics and therapeutics” [6]. This is merely one of many expressions signaling a commitment to equity and the protection of the right to health in the “CA+” agreement.

Separately from these agreements (although they both call generally for sustainable financing), a Pandemic Fund, a successor to the initial fund quickly exhausted in the early months of 2020, has been established with the World Bank as its trustee [8]. Aimed at supporting long-term investments in pandemic preparedness and prevention, the first call from the Fund supported (1) comprehensive disease surveillance and early warning systems; (2) laboratory systems; (3) human resources and public health and community workforce capacity [9,10]. The first of these has been generally criticized for insufficient safeguarding of the interests of countries in the Global South, alongside those in the Global North given capacities to respond [11]. The other two do not directly address the primary equitable concerns expressed by countries as to the IHR (2005) or the CA+ agreement [6,7].

As a more general matter, few of the amendments proposed to the IHR (2005) nor the substantive provisions of the CA+ agreement are informed by robust bodies of evidence. Many amendments to the IHR (2005) appear aimed at one- or two-off diplomatic quarrels over transparency, while CA+ provisions including technology transfer, supply chains, and liability/risk management address complaints raised over the course of COVID-19 but lack sufficient time for investigation and analysis as to what any international agreement should prioritize.

The purpose of this study is to address both gaps, i.e., equity and sustainable financing, in the global discourse around pandemic prevention and preparedness. In a cross-sectional analysis of vaccine deliveries as of mid-2022, the article uses an openly accessible but underused dataset—the UNICEF COVID-19 Market Dashboard—to bring clarity to how African countries obtained vaccines between 2020 and 2022; how those sources may change in the future, especially through complex intermediary institutions like COVAX; and where future investments should be made for effective preparedness. This study focuses on Africa because it is African countries that experienced the most significant disadvantages in access and African countries that have collectively raised the critical priority that must be given to equity in the aforementioned negotiations [12–14]. This study provides evidence and actionable recommendations to guide future action and brings measurable inputs and outcomes to the equity question.

1.2. Future Systems for Addressing Equity in Vaccine Access Must Address Donation, Capacity to Procure Bilaterally, Regional Procurement, and International Facilities like COVAX

In an effort to increase access to vaccines for low- and middle-income countries, the Coalition for Epidemic Preparedness (CEPI), the Global Alliance for Vaccines and Immunization (GAVI), the United Nations Children’s Fund (UNICEF), and the World Health Organization (WHO) created an international sharing facility, COVAX, in June 2020 [15]. COVAX sought to provide vaccine doses equitably among participant countries, initially aiming to reach 20 percent vaccination worldwide (priority to vulnerable populations and

healthcare workers) by the end of 2021. The wealthy countries that entered this facility were “self-financing”—meaning they would pay for their own vaccine doses—and also agreed to contribute funds to be pooled together into financing doses for recipient countries, the so-called AMC (Advanced Market Commitment)-92 [16,17].

The African Vaccine Acquisition Trust (AVAT) was established in August 2020 by the African Union (AU) to complement COVAX. Financed by the African Export-Import Bank, AVAT provided an advance procurement commitment of USD 2 billion to Johnson and Johnson for AU member states [18]. This initiative aimed to secure equitable access to COVID-19 vaccines for the fifty-five AU member states [19]. AVAT aimed to supply enough doses to reach 60 percent herd immunity by 2022. In addition, low- and middle-income countries accepted donations of vaccine doses from large high-income or upper middle-income countries such as the United States, China, Russia, and India, as these and other relatively wealthy countries had procured a disproportionately large share of vaccine doses in circulation [20]. With Africa’s low- and middle-income countries downstream of this supply bottleneck in the vaccine market, vaccination rates in these countries were and remain low—in many African countries, less than 10 percent of the national population was at least partially vaccinated at year-end in 2021 [21]. Today, vaccine shortage is not the only contributing factor to low COVID-19 vaccination in African countries, with vaccine hesitancy also being a significant factor that has varied widely across the continent [22]. However, at year-end in 2021, though present in social discourse, demand and disinformation about vaccines were not yet leading barriers to vaccination: the primary barrier was dose shortages. The number of doses delivered to African countries at this time was sufficient to vaccinate only 17 percent of the population, due partly to India banning exports of doses for COVAX global supply in mid-2021 due to surging COVID-19 Delta variant cases there [23–25].

Though COVAX has received the largest share of media and academic attention, the 92 countries in Africa used COVAX as just one of several strategies for obtaining vaccine doses: AVAT; donation; bilateral procurement; and local manufacturing. These strategies appear in publicly available UNICEF data on national COVID-19 vaccine delivery. However, in this constellation of procurement strategies, no studies to date have interpreted these data as a more comprehensive analysis of how low- and middle-income countries procured vaccines, strategies for which COVAX was only one part. This study considers the Africa region, which is composed nearly entirely of countries with low- or lower middle-income economies and more broadly a majority of the world’s LMICs (24 of the world’s 28 low-income economies and 22 of the world’s 54 lower middle-income economies) [26]. This analysis outlines future directions for international and domestic public health stakeholders to improve these strategies [27].

2. Materials and Methods

This study used data available from UNICEF’s COVID-19 Market Dashboard to assess how African countries procured vaccine doses and characterize the extent to which each of these avenues contributed to total vaccine supply. This enabled a cross-sectional assessment of how effective these procurement strategies were in securing enough doses to vaccinate 70 percent of national population by mid-2022, the target threshold recommended by the World Health Organization [28].

The inclusion criteria were (1) location in the Africa region; (2) status of (a) lower middle-income or (b) low-income economy according to the World Bank Group for the 2023 fiscal year. Income level is based on gross national income (GNI) per capita, as calculated by the World Bank Atlas method [26].

The World Bank currently classifies the following 24 countries in Africa as low-income economies (GNI per capita $\leq$ USD 1085):

- (1) Burkina Faso;
- (2) Burundi;
- (3) Central African Republic;

- (4) Chad;
- (5) Democratic Republic of the Congo;
- (6) Eritrea;
- (7) Ethiopia;
- (8) The Gambia;
- (9) Guinea;
- (10) Guinea-Bissau;
- (11) Liberia;
- (12) Madagascar;
- (13) Malawi;
- (14) Mali;
- (15) Mozambique;
- (16) Niger;
- (17) Rwanda;
- (18) Sierra Leone;
- (19) Somalia;
- (20) South Sudan;
- (21) Sudan;
- (22) Togo;
- (23) Uganda;
- (24) Zambia.

The World Bank classifies the following 22 countries in Africa as lower middle-income economies ($\text{USD } 1086 \leq \text{GNI per capita} \leq \text{USD } 4255$):

- (1) Angola;
- (2) Algeria;
- (3) Benin;
- (4) Cabo Verde;
- (5) Cameroon;
- (6) Comoros;
- (7) Republic of the Congo;
- (8) Côte d'Ivoire;
- (9) Djibouti;
- (10) Egypt;
- (11) Eswatini;
- (12) Ghana;
- (13) Kenya;
- (14) Lesotho;
- (15) Mauritania;
- (16) Morocco;
- (17) Nigeria;
- (18) São Tomé and Príncipe;
- (19) Senegal;
- (20) Tanzania;
- (21) Tunisia;
- (22) Zimbabwe.

This study drew on publicly available data collected by UNICEF regarding the delivery of COVID-19 vaccine doses to respective LMICs in the Africa region [29]. For each country, data from the UNICEF dashboard provided disaggregated quantities of doses delivered to respective countries into the following five categories (The “Unknown” category for each country comprised the number of vaccine doses for which UNICEF was unable to confirm a procurement route: this category was the discrepancy between (a) the total number of administered doses according to Our World in Data plus wastage and (b) the total number of doses confirmed as delivered via four routes: (1) bilateral; (2) donations; (3) COVAX; (4) AVAT. Explanation of the sources and assumptions of data informatics

in the UNICEF dashboard are provided here: <https://www.unicef.org/supply/covid-19-market-dashboard>):

- (1) Bilateral/multilateral purchase agreements;
- (2) Donations (*non-purchased doses delivered through non-COVAX bilateral and/or multilateral donations*);
- (3) COVID-19 Vaccines Global Access (COVAX) initiative;
- (4) African Vaccine Acquisition Trust (AVAT);
- (5) Unknown.

This study measured progress achieved to date on obtaining vaccine supply sufficient for countries' respective population size. To achieve this, we calculated the number of doses procured per person (DPP). Population figures from the United Nations Population Division (UNPD) for 2021 were used to calculate DPP values as follows:

$$\text{Number of doses procured per person} = \frac{\text{Total number of doses delivered (UNICEF, 2022)}}{\text{Country population (UNPD, 2021)}}$$

This study employed DPP as a metric for comparing national vaccine supplies and assessing whether these supplies met population need. Population need was defined as the number of vaccine doses needed to vaccinate the entire population of a country—with the caveat that a subset of the population in a given country may decline vaccination (COVID-19 vaccine adoption has varied widely in Africa) [22]. It is worth noting that the primary aim of vaccine procurement via COVAX and other routes was to expand access rather than to ameliorate vaccine hesitancy [16,17]. Vaccinating an entire population with a 1-dose regimen requires 1 DPP, and approximately half (48 percent) of all vaccine doses delivered to the countries in this study were part of 1-dose regimens. Vaccinating an entire population with a 2-dose regimen requires 2 DPP, and the remaining 52 percent of delivered doses here were part of 2-dose regimens [29]. Considering that the proportion of vaccine dose regimens requiring 1 DPP was roughly equal to the proportion of dose regimens requiring 2 DPP here, 1.5 DPP (the average of 1 DPP and 2 DPP) approximates the number of doses per person needed to vaccinate the population of African countries here on average. For this reason, 1.5 DPP served as a benchmark to assess whether vaccine supplies met population need. This study considered the extent to which each of the 5 categories of vaccine supply sources described above featured in the vaccine supply of African LMICs. For Eritrea, a low-income country in the Africa region, there was no available UNICEF COVID-19 vaccine delivery data.

3. Results

3.1. Frequent Reliance on COVAX Ahead of Other Procurement Routes

Strategies for procuring vaccine doses ranged from near-complete reliance on a single source of vaccine doses to relatively diverse strategies that involved multiple sources in more balanced proportion. Sources included (1) COVAX; (2) bilateral agreements with producers; (3) donations from foreign governments; (4) AVAT.

Across African LMICs, doses obtained via participation in COVAX comprised 66 percent of national COVID-19 vaccine deliveries on average. The second-largest source of vaccine doses for African LMICs on average was donation (15 percent), followed by AVAT (10 percent) and bilateral purchase agreement (5 percent) (Figure 1).

The mean population-adjusted vaccine supply for African LMICs was 0.74 doses per person (DPP). Compared to the benchmark of 1.5 DPP, this figure suggests that on average, across African LMICs, vaccine supply fell well short of meeting population need amid this reliance on COVAX. Prevailing levels of vaccine supply across the region appear lower still when accounting for outliers (African LMICs median DPP = 0.64). In total, 34 of the 45 African LMICs (excluding Eritrea, for which there was no available data) procured less than one dose per person (Figure 2).

National COVID-19 vaccine procurement strategies as share of total doses procured: averages for Africa LMICs

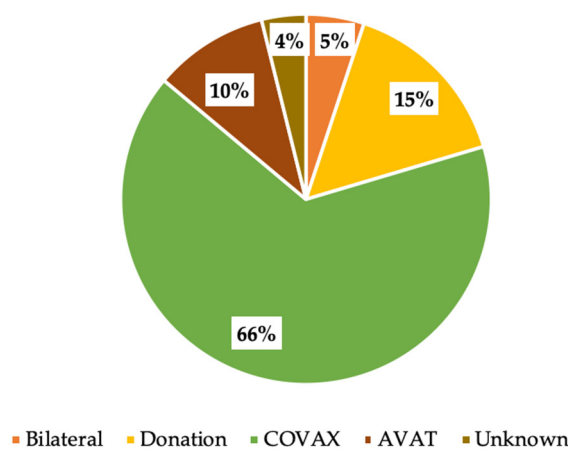


Figure 1. Contribution of vaccine procurement strategies to number of doses received.

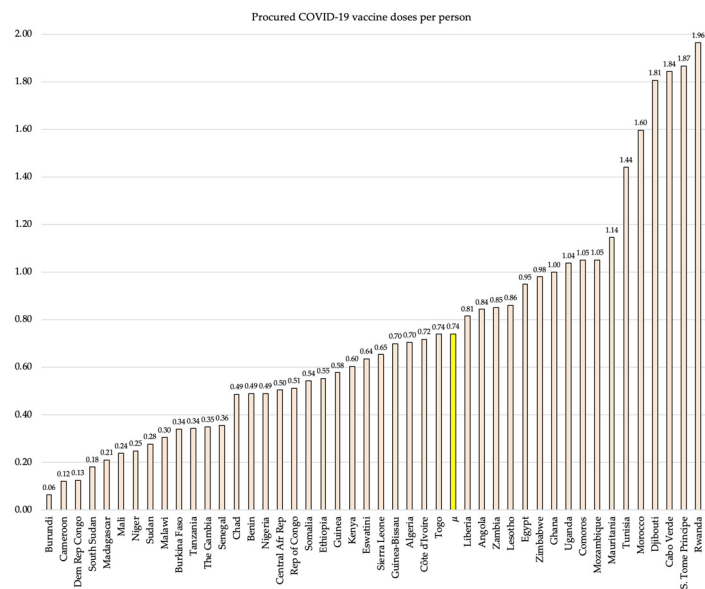


Figure 2. Procured COVID-19 doses per person, African low-income and lower middle-income countries (LMICs). As of July 2022, 76 percent (34 of 45) of all LMICs in Africa had procured less than 1 COVID-19 vaccine dose per person. μ = mean DPP among African LMICs = 0.74 DPP (yellow bar).

The country-by-country overview in Figure 3 does not indicate clear associations between particular strategies for vaccine procurement (e.g., obtaining doses mainly via COVAX vs. doing so mainly via AVAT, or relying more on donations) and higher or lower vaccine supply.

COVAX constituted a majority of vaccine doses in nearly all African LMICs, including both those with relatively high vaccine supply and those with lower vaccine supply. Donations appeared to comprise a large share of total supply in several countries with higher overall vaccine supply (e.g., Cabo Verde (56 percent), Djibouti (76 percent), Tunisia (41 percent), but also comprised a large share of total supply in several countries with lower overall vaccine supply (e.g., Burundi (62 percent), Mali (29 percent), Ethiopia, Kenya (both 21 percent). Doses supplied via AVAT, similarly, comprised a considerable share of total supply in countries with lower overall supply (e.g., Burundi (38 percent), Cameroon (47 percent) but also in those with higher overall supply (e.g., Lesotho (30 percent), Togo (26 percent). Bilateral procurement agreements, meanwhile, contributed the least to vaccine supply (of known sources) among African LMICs on average (5 percent). Doses procured

via bilateral agreement exceeded 20 percent of total supply in only three LMICs in the region, among which DPP varied widely: Algeria (50 percent bilateral; 0.70 total DPP), Zimbabwe (59 percent; 0.98 DPP), and Morocco (46 percent; 1.60 DPP).

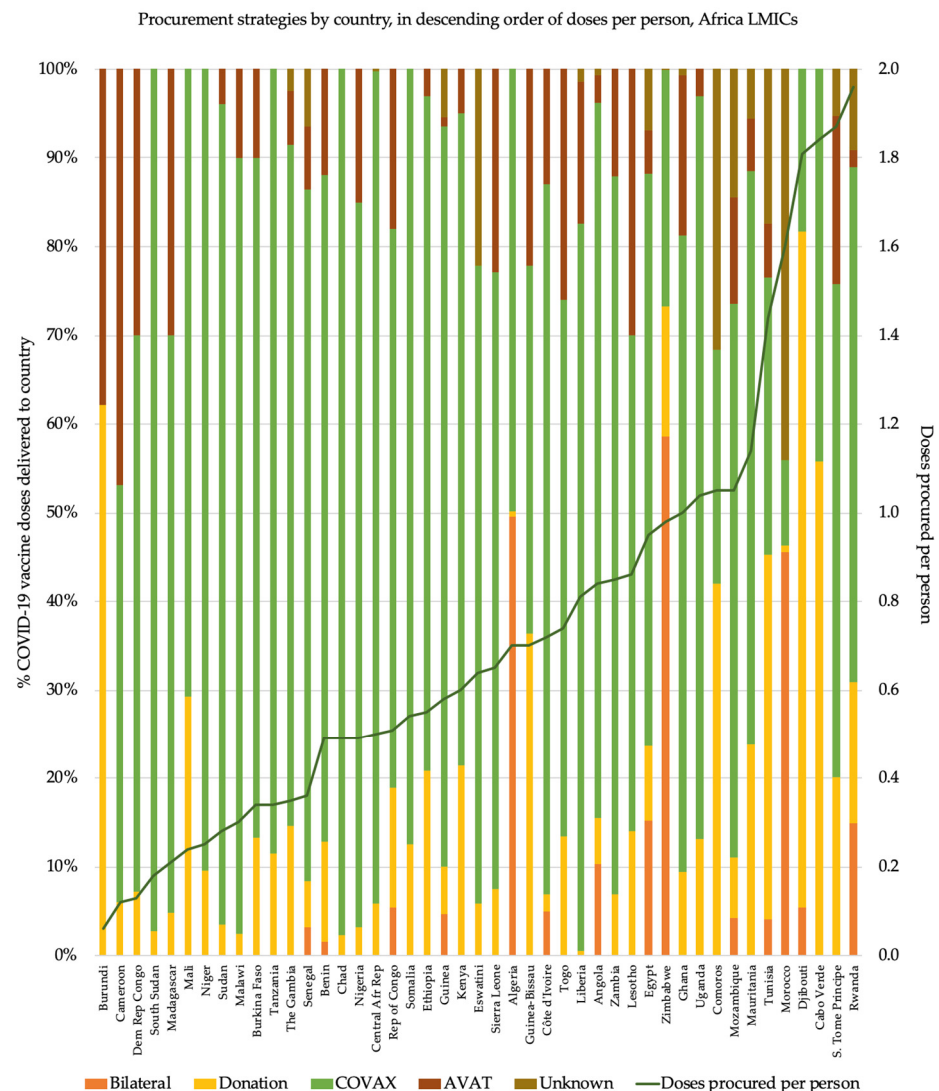


Figure 3. Overview of COVID-19 vaccine procurement strategies by African LMICs (left vertical axis; bar graph) and doses procured per person (DPP), by country (right vertical axis; line graph overlay).

3.2. Amid Greater Reliance on COVAX, Vaccine Supply Often Fell Further behind Population Need

African LMICs that procured a larger percentage of their total quantity of vaccine doses via COVAX tended to have procured fewer doses per person (Figure 4A). Meanwhile, although donated vaccine doses comprised only a small proportion of respective total supply for a vast majority of LMICs (15 percent on average), nearly all countries for which donations comprised 30 percent or less of total doses had procured less than 1 DPP (Figure 4B).

Scatterplots of DPP against the number of doses procured via AVAT (Figure 4C) and bilateral purchase (Figure 4D) as a percentage of total doses, respectively, indicated that these routes for obtaining doses comprised a relatively low percentage of total doses (<20 percent) in a majority of national COVID-19 vaccine procurement strategies among African LMICs. There was no clear trend between greater reliance on AVAT or on bilateral purchase agreements and vaccine supply some of these countries, ostensibly as a result of these procurement routes being underutilized.

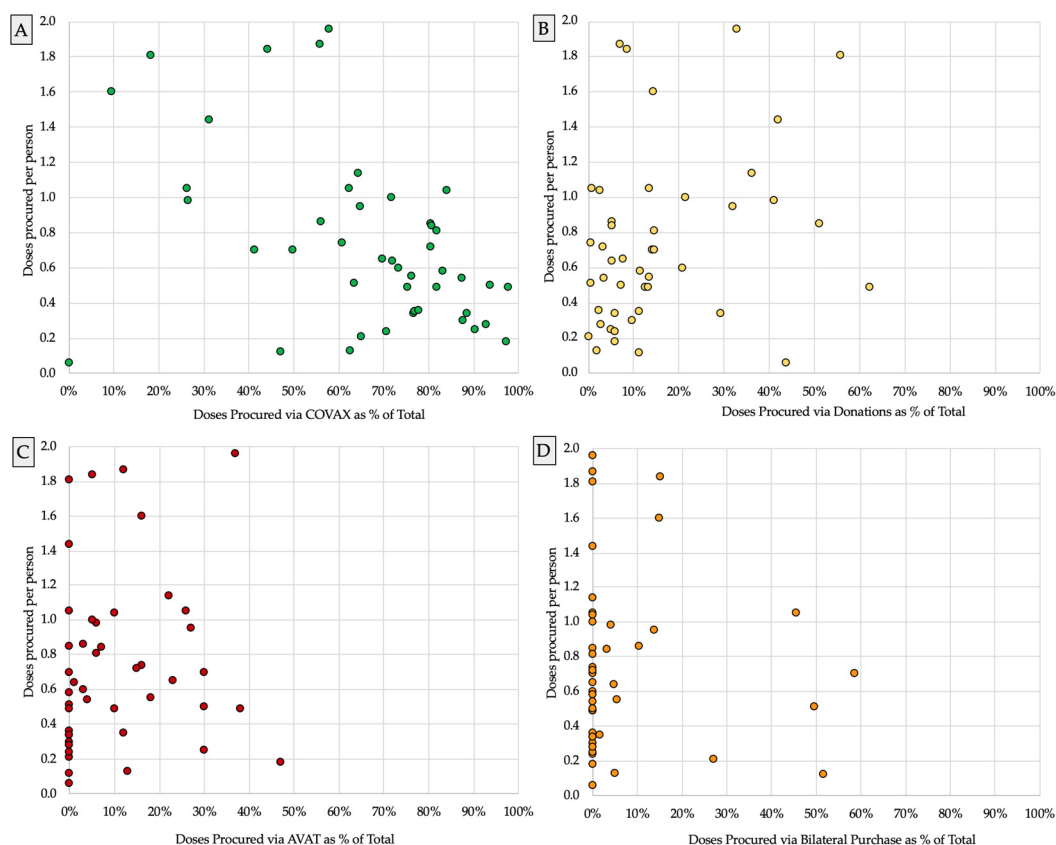


Figure 4. Plot of COVID-19 vaccine doses procured via (A) COVAX; (B) donations; (C) AVAT; (D) bilateral purchase agreement as percentage of total doses procured (horizontal axis) against doses procured per person (vertical axis) for respective African LMICs (e.g., Morocco procured 1.6 doses per person, with 10 percent of the total dose quantity procured via COVAX).

4. Discussion

The significant proportion of COVID-19 vaccine doses that were procured via COVAX by national governments of LMICs across the Africa region demonstrates that obtaining vaccine doses via pooled purchase can help to meet population need for vaccines in developing countries (Figures 3 and 4A). Pooled purchase succeeded in procuring doses for developing countries by design, gathering funds from these countries with large impactful contributions from wealthy countries into a larger sum than developing countries were able to afford themselves. However, there were significant shortages in vaccine supply across African LMICs. Moreover, these shortages were often more pronounced for countries which relied more on COVAX. Meanwhile, other procurement options, even when taken together, comprised only a minority of vaccine deliveries in most African LMICs.

Together, these findings provide the following justifications for action in one or more negotiation over pandemic prevention, preparedness, and financing.

4.1. Ex-Post Pooled Procurement (e.g., COVAX) Must Be Complemented by Dedicated Legal and Logistical Pathways for Donation, Support for Bilateral Procurement, and Regional Procurement

COVAX was never designed to be the leading or main source of doses for LMICs, but, as findings here show, it appeared to take on that role. While this over-reliance on COVAX is partly attributable to the supply bottleneck created by hoarding by high-income countries, the above analysis adds important context: as African LMICs that procured a higher percentage of their total doses via COVAX tended to suffer more severe shortages, the share of total doses obtained from other sources was, on average, below that of COVAX (average AVAT 10 percent, donation 15 percent, bilateral purchase 5 percent). In other words, there is good evidence that the promise of COVAX caused an over-reliance on

COVAX. In future pandemics, if there is over-reliance on a pooled procurement mechanism that breaks, the downstream effects would be calamitous.

This analysis suggests that alternatives to COVAX such as the regional pooled purchase option of AVAT remain vastly under-developed and that expanding the scope of these alternatives can offer a more diverse procurement strategy to LMIC governments. By further avoiding reliance on a single route of procurement, a procurement approach with greater balance between multiple sources would stratify the risk of supply agreements not materializing in actual supply.

Tunisia (northern Africa) and Rwanda (Sub-Saharan Africa) can be instructive of the benefits of a diverse strategy including COVAX or another form of pooled purchase. Tunisia (1.44 DPP) obtained 31 percent of its vaccine supply via COVAX, 41 percent via donation, 4 percent bilaterally, and as much as 17 percent via domestic production [30]. Rwanda (1.96 DPP), meanwhile, procured 58 percent of its vaccine doses via COVAX, 16 percent via donation, 15 percent via bilateral agreement, and as much as 9 percent from domestic production. In 2022, Rwanda was designated as a site for the production of the Pfizer BioNTech vaccine [31].

Further, the execution of more diverse and ostensibly less risky vaccine procurement by individual LMICs can benefit from supra-national coordination via already-proven logistic and delivery service programs such as the AU-founded Africa Medicines Supply Platform (AMSP). When access to medical countermeasures became difficult on the continent, AMSP was developed to aggregate orders for medical supplies and negotiated with suppliers and manufacturers on the back-end. The platform did so successfully, and has since been commended for revolutionizing Africa's response to COVID-19 [32]. Beyond this, AMSP has expanded vaccine access for the Caribbean Community member states [33].

The coordination of a national procurement strategy with agile regional stakeholders as suggested here can play a critical role in responding to future public health emergencies. Yet neither the amendments to the IHR (2005), the CA+, or the early calls for support from the Pandemic Fund envision building global infrastructure for procurement alternatives other than technology transfer and local manufacturing, discussed below [6,7,10].

4.2. Bilateral Procurement Is the Best-Known Path for Technology Transfer

An oft-discussed strategy for mitigating economic obstacles to bilateral procurement for LMICs is to share with LMICs the technology necessary to produce vaccines “end-to-end” (from the bulk production of purified antigens, to formulation using adjuvants to enhance immune responses, to packaging and distribution (also known as “fill-and-finish”) [34]. As an example of this technology transfer, South Africa has become a manufacturing hub for mRNA COVID-19 vaccines. There, WHO has orchestrated a partnership for technology transfer (technical and financial support) to an existing biotechnology company (Afrigen). Meanwhile, the vaccine producer BioNTech is currently constructing an mRNA vaccine manufacturing hub in Rwanda with similar hubs planned in Senegal (aided partly by the European Union and United States government financing) and South Africa [35,36]. Vaccine manufacturers such as BioNTech consider it in their interest to have local presence in LMICs. Bilateral procurement helped to facilitate this, partly through the establishment of fill-and-finish facilities in LMICs such as Rwanda subsequent to these countries purchasing vaccines directly from manufacturers (bilateral purchase) [31,37]. Technology transfer offers the promise of capacity for the resource-limited setting of LMICs amid the advent of mRNA vaccines because these vaccines are less time-intensive and produce less waste and are inexpensive to produce [38–40]. The expansion of local vaccine production capacity in Africa will require considerable time and investment. Africa imported 99 percent of its vaccines in 2021, and only a few African countries currently have the threshold of personnel and infrastructure to produce vaccines; recently announced funding by GAVI and the African Union for African vaccine manufacturing aims to build this capacity [41–43].

Local production did occur in a select few African countries during the roll-out of COVID-19 vaccines. For these countries, domestic vaccine production often also coin-

cided with a large proportion of dose supply procured via bilateral purchase agreement. In such cases where self-production and bilateral procurement played significant roles, vaccine supply often, though not always, met a greater share of population need. Several countries in northern Africa employed this approach. In Morocco, for example, an upper middle-income country where supply was at 1.6 doses per person, the national government brokered an agreement for a domestic pharmaceutical firm, Sothema, to produce 5 million doses per month of the Sinopharm vaccine in a fill-and-finish capacity, effective July 2021, which appeared to account for as much as 44 percent of national vaccine supply [29,44]. Additionally, Morocco obtained 46 percent of its vaccine supply bilaterally, from AstraZeneca and Sinopharm [45,46]. COVAX, meanwhile, comprised just 10 percent of Morocco's vaccine supply [29]. Similarly, Egypt (0.95 DPP) began producing the Sinovac vaccine domestically (both fill-to-finish and end-to-end) in April 2021, which comprised 7 percent of national supply at the time of writing, and obtained 15 percent of its vaccine supply bilaterally, of which a majority was from Sinopharm and Sinovac, and a small percentage was from the Gamaleya Institute (Sputnik V) [29,47]. Meanwhile, in Sub-Saharan Africa, domestic production accounted for as much as 50 percent of national supply in South Africa, although this was uniquely the case [30,48]. Similarly to Egypt and Morocco, bilateral procurement in South Africa also played a prominent role (25 percent of total supply) [29].

4.3. Regional Procurement Channels Are Better Tailored for Resource Constrained Countries

A pooled purchase alliance in the mold of AVAT, intended to procure vaccine doses on behalf of participating countries within a given region, can benefit LMICs by tailoring procurement strategies to account for infrastructure limitations that these countries share. For example, LMICs in Africa and elsewhere largely lack “deepfreeze” (−70 °C) cold storage (termed “cold chain”) required for certain COVID-19 vaccines, like Pfizer's. If expanded, a regional vaccine pooled procurement fund can help LMICs to obtain more doses of vaccines that are distributable amid these limitations, such as—in the case of the COVID-19 pandemic response—the Johnson and Johnson vaccine, which can be stored at typical refrigerator temperatures for up to 3 months [49]. Strengthening regional pooled purchase follows calls by public health stakeholders in African LMICs for the more direct representation of regional interests in the negotiation of procurement agreements between African LMICs and vaccine manufacturers [50]. There already exist some regional coalitions that could be influential in defining regional mechanisms for vaccine procurement for future pandemics, including the East African Community, the South African Development Community, and the West African Health Organization.

4.4. Despite Stigma, Donations Are a Credible and Important Part of Pandemic Preparedness

The detailed legal and logistical requirements imposed by COVAX and its partners for receipt of vaccines hampered its effectiveness. At the same time that conditions were being negotiated (primarily between GAVI and recipient countries), high-income countries with excess supply limited or prohibited their own ability to distribute vaccines they could not use to those countries that needed them. Early U.S. procurement agreements, for example, prohibited onward distribution to anywhere other than the territorial United States. Vaccine donation, as demonstrated here, bolstered COVID-19 vaccine supply in some LMICs [51]. Donation was largely between two parties (donor and recipient) without third-party mediation and did contribute to a significant proportion of vaccine supply in many African LMICs (Figures 3 and 4B). Donations are not, and should not be, a primary mechanism of response, but they are an essential aspect of global redistributed supply [52]. Donations in the African context went to countries in most urgent need [53–55].

Limitations

The strategies recommended above must necessarily be tailored to the resource constraints any one given country experiences. Scaling up mass vaccination operations is a

challenge in many countries for a large number of complex infrastructural, logistical, and political reasons [56]. Some low-vaccination countries, including the Democratic Republic of Congo (DRC), Madagascar, and South Sudan, would require nearly 25 percent of their total health expenditure to vaccinate 40 percent of their citizens [51]. The existing literature on access to vaccines in LMICs illustrates that pooled purchase should be accompanied by extensive technical assistance on decision making for vaccine manufacturing and administration for the adoption of new vaccines to proceed effectively [57]. And, of course, vaccine supply is distinct from demand for vaccination, with low early vaccine readiness in LMICs being a well-documented problem [58–60].

5. Conclusions

Current negotiations over amendments to the IHR (2005), the CA+ pandemic agreement, and early calls by the Pandemic Fund are understandably and laudably committed to broad efforts at access to medical counter measures, improving global supply chains, and enhancing laboratory and workforce capacity, all in whole or in part in the name of equity. Yet if equity is to be achieved in a meaningful and enforceable way, then the policies implemented at the international level must be based on evidence and well-supported local, national, and regional pathways for preparedness. This study has provided an important contribution to that evidence, suggesting that pooled procurement did not work particularly well during COVID-19, that it must be planned as complementary to other channels for support and response, and that a system in which the rapid scale-up of local manufacturing enabled by technology transfer is married with local financing (e.g., AVAT) can help ensure more reliable vaccine supply to LMICs.

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Conflicts of Interest: The authors declare no conflicts of interest.

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