The last-mile manufacturing of vaccines
Recommendations for scaling-up production of COVID-19 vaccines in Africa

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Abbreviations

AMC advanced market commitment
BCG Bacille Calmette-Guérin
Biovac Biologics and Vaccines Institute of Southern Africa
BVNL Biovaccines Nigeria Limited
CEPI Coalition for Epidemic Preparedness Innovations
COVAX COVID-19 Vaccines Global Access
COVID-19 Coronavirus Disease of 2019
DTP diphtheria, tetanus toxoid, and pertussis
EUA emergency use authorization
GAVI Global Alliance for Vaccines and Immunizations
GMP good manufacturing practices
IFC International Finance Corporation
IFFIm International Finance Facility for Immunization
IDP Institut Pasteur de Dakar
LMICs low-and-middle income countries
RNA ribonucleic acid
WHO World Health Organization
I. Background

Before the SARS-CoV-2 pandemic, Africa was facing an increased demand for vaccines due to a growing population, which is set to double by 2050.¹ This increase in demand further stresses the supply chain because Africa continues to depend on external manufacturers and donors for its vaccines.

Notably, Africa imports an excess of one billion doses of vaccines per annum while producing less than one percent of its vaccines. Consequently, African countries are vulnerable to supply shortages, unavailability of the vaccines of interest due to their economic unattractiveness to major pharmaceutical producers, and inability to promptly respond to a pandemic outbreak, especially during a high-demand surge for vaccines from resource-rich countries. These vulnerabilities were highlighted with the unavailability of vaccines against Ebola in 2014² and further crystallized with the Coronavirus Disease of 2019 (COVID-19) pandemic.

Currently, while some high-income countries have secured an average of three times the COVID-19 vaccine doses required to immunize their populations through bilateral agreements with vaccine developers,³ most low- and middle-income countries cannot afford to negotiate directly with vaccines developers and lack the resources for advanced market commitments (AMCs).

The COVID-19 Vaccines Global Access (COVAX) facility is a risk-sharing mechanism established to help ensure fair and equitable access of COVID-19 vaccines to all countries. COVAX is co-led by the Global Alliance for Vaccines and Immunizations (GAVI), the Coalition for Epidemic Preparedness Innovation (CEPI), and the World Health Organization (WHO). To date, 190 countries have joined the COVAX facility, including 92 low-income economies that are eligible to have their participation in the facility supported via GAVI COVAX Advance Market Commitment mechanism. The mechanism allows COVAX to leverage the participation of higher income countries to ensure that the lower income countries will have access to vaccines. GAVI estimates this effort will cost approximately $2 billion to purchase and distribute the vaccines to the 92 LMICs.⁴ Despite its efforts, COVAX is struggling to secure enough vaccines to meet its target of vaccinating 20 percent of the population in low-income countries by the end of 2021. COVAX, thus far, has secured 1.1 billion doses while the Africa Union has approximately 600 million doses. At this pace, herd immunity may not be achieved until 2023 or 2024.⁵ Further, the local vaccine manufacturing industry in the LMICs continues to lack adequate capacity to respond to their markets' urgent needs. It is critical to take the necessary steps, such as the adoption of last-mile manufacturing, to reverse the current status quo and improve Africa’s vaccine manufacturing capacity to respond to the current pandemic and build a more robust preparedness for future outbreaks.
Vaccine manufacturing is highly regulated and expensive due the high cost of development and production. This paper explores the potential for scaling up last-mile manufacturing in Africa and, in particular, expanding production capacity related to processing, filling, finishing, packaging, and distributing finished product from manufacturers to retailers. The advantages of last-mile manufacturing include:

- Bringing supply closer to the point of use
- Reducing length of the supply chain thereby mitigating, for instance, risks to quality degradation associated with longer supply chains
- Diversifying and increasing the number of sources of vaccines products and contributing to supply chain resiliency
- Improving preparedness to respond to future pandemics

With the recent report of multiple SARS-CoV-2 mutations, increasing immunization coverage worldwide is urgently needed to avoid the spread of variants that may negatively impact the efficacy of potential vaccines. In South Africa, for instance, the roll-out of the AstraZeneca vaccine was paused because of reports that the vaccine is less effective against the B.1.351 mutant. Expanding last-mile manufacturing to LMICs could help close the gap of the current COVID-19 vaccine needs and improve countries’ readiness to respond to future disease outbreaks.

II. COVID-19 Vaccines

a. Vaccine market and current demand

Recently, governments and public health officials alike have intensified their effort to inoculate their population to mitigate the spread of SARS-CoV-2. Current projections suggest that 5.2 billion people need to be immunized globally, of which 535.9 million are in Africa. This translates into approximately 10 billion doses globally, given that most vaccines will require a second or third dose. This unprecedented scale of worldwide immunization in record time exposes the vulnerabilities in vaccine manufacturing and the supply chain, as many people may not receive the needed doses in time to meet those goals due to limited manufacturing capacity.

The combined projected production capacity of the leading manufacturers still falls short of the immediate demand. Further, few countries possess the internal capacity to produce their own COVID-19 vaccines, albeit those who do still need active knowledge, technology, and data sharing with domestic manufacturers. Furthermore, inadequate cold chain capacity, insufficient availability of ancillary goods (e.g., syringes) and services (e.g., biohazard waste disposal), lack of trained professionals, and vaccine hesitancy are hurdles that must be overcome to achieve effective vaccine distribution. These issues are more pronounced in countries with weak health systems.

b. COVID-19 vaccine development and approval status

A significant number of the COVID-19 vaccines were developed in a span of a year after the initial outbreak began. This is an unprecedented achievement, considering that typically the development of new vaccines takes an average of 10 years. This achievement was enabled by the prioritization of actions to end the pandemic because of its intense and devastating nature, the development enabling vaccine platforms pre-COVID-19, the publication of the genetic sequence of the SARS-CoV-2 early in the pandemic in January 2020, and the extraordinary public support for basic research and early-stage vaccine and drug development. In fact, governments and non-profits have heavily financed the development of COVID-19 vaccines, clinical trials, expansion of production capacities, as well as established contract manufacturing and distribution networks to enable the rapid roll-out of approved vaccines.
At the of end January 2021, WHO reported that 63 vaccines were in clinical development with 174 more in the pre-clinical phase, all being developed on a wide range of vaccines platforms. These platforms in clinical development include protein subunit (26), non-replicating viral vector (12), ribonucleic acid (RNA) (12), DNA (deoxyribonucleic acid) (9), inactivated virus (9), replicating viral vector (9), virus-like particle (2), and live attenuated virus (Figure 1). The diverse vaccine platforms offer flexibility for production while posing challenges. Currently, 11 of these candidates are authorized for emergency use in various countries, with most of the vaccine candidates originating in the United States, United Kingdom, China, Russia, and India. As of February 2021, three COVID-19 vaccines have received emergency use authorization (EUA) in the United States from the U.S. Food and Drug Administration: Pfizer-BioNtech, Moderna, and Janssen and in the European Union from Pfizer-BioNtech, Moderna, and AstraZeneca.

**III. Vaccine Manufacturing and Distribution**

Biological products such as vaccines are characterized by their inherent complex natures involving multifaceted and costly production operations. The extreme complexity and high costs associated with vaccine manufacturing will continue to limit the number of new manufacturers in LMICs. The main cost drivers include the high fixed costs associated with obtaining and, oftentimes, importing new manufacturing equipment, technologies, and materials. Plotkin et al. estimated that the cost for product research and development alone is more than $500 million, depending on the vaccine platform; the cost of facilities and equipment ranges between $50–700 million depending on size.
a. Bioprocessing and formulation

Generally, vaccine preparation starts with upstream and midstream bioprocessing (i.e., antigen expression), followed by a downstream separation and purification process to produce an antigen capable of inducing an active immune response to prevent, ameliorate, or treat infectious diseases (Figure 2). The steps and the complexity of the bioprocessing may vary depending on the vaccine platform employed. Extra precautions must be taken during production requiring a highly controlled manufacturing environment to minimize any risks of cross-contamination to produce a sterile quality product free from microbial growth and undesirable particulate matters. The antigen is then formulated to: maintain the structure and stability of the active ingredient(s), thereby preserving the potency of the vaccine; increase the shelf life of the vaccine product; enhance the potency of the vaccine by adding adjuvants to stimulate immune response; and, in the case of RNA vaccines, improve cellular uptake of RNA to stimulate production of the antigen.20

b. Fill, finish, and packaging

The final downstream steps in the manufacturing of vaccines consist of fill, finish, and packaging, where the vaccines are filled in vials or syringes and packaged for distribution. Although these steps are less complex than bioprocessing and formulation, they present challenges depending on the product characteristics and behavior. The filling stage involves specialized equipment and is influenced by the cost of operation and product characteristics such as solubility, viscosity, and foaming tendency. The finish and packaging stages include preparing the vial, stoppers, and other container closure components and arrangements for filling, sealing, validating, cleaning, and sterilizing. These critical steps follow specific guidelines outlined by regulatory authorities.21

c. Vaccine regulation

In principle, vaccine regulation includes non-clinical and clinical trial monitoring; assessment of suitability upon completion of clinical stages; authorization for use; and routine monitoring of safety, quality, and efficacy throughout the supply chain distribution system. Upon approval for use, routine lot-release authorization, tracking of cold chain storage, and post-market surveillance (including monitoring of adverse events following immunizations) are conducted to monitor the vaccine’s safety and quality.

To support United Nations agencies and other international procurement organizations, the WHO vaccine prequalification procedure is based on similar principles: review of manufacturing processes, quality control procedures, and lot testing. A process for continuous vaccine acceptability is also incorporated to ensure product quality is maintained throughout the product lifecycle. However, given the current limited capacity of national regulatory authorities in LMICs, the adoption of the principle of regulatory reliance is key to successful regulatory oversight of vaccines.

IV. Vaccine Manufacturing in Africa

a. Overview of vaccine manufacturing in Africa

Large-scale vaccine manufacturing in Africa has largely failed to launch, and the COVID-19 pandemic highlights the urgent need to for transfer of technology for the adoption of new technologies for vaccine production. African vaccine manufacturers currently produce less than 1 percent of the vaccines that are used across the continent.22 Currently, there are only four active vaccine manufacturers in Africa, and only two are performing all aspects of the vaccine manufacturing process from active ingredient production through packaging (Table 1). Several facilities ceased production...
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over the last 25 years due to multiple factors, including the inability to compete with imported vaccines. The few available facilities are not suited to production of COVID-19 vaccines.

For example, Institut Pasteur de Dakar (IDP), one of the four global vaccine yellow fever vaccines manufacturers, began its egg-based vaccine program in 1932. To date, its capacity is limited to producing 5 million doses of one single vaccine. Efforts are underway to expand the capacity to 30 million doses. IDP has a decade of experience in the manufacturing of sterile biological medical products. This existing know-how could be leveraged to extend localizing of future last-mile manufacturing.

In addition, the Biologicals and Vaccines Institute of Southern Africa (Biovac) model is proving to be an ongoing backward integration success. The public-private partnership was established in 2003 to reduce South Africa’s dependency on external manufacturers and improve its preparedness to respond to pandemic disease outbreaks. This partnership ensures Biovac access to the South African market. The company began with sourcing, importing, and distributing vaccines for the national immunization program before integrating filling and formulation. Biovac has since developed multiple technology transfer partnerships.

Notably, Biovac has technology transfer agreements with Pfizer for the production of Pneumovax and with Sanofi for the production of Hexaxim, the complex 6-in-1 vaccine given to children to prevent diphtheria, tetanus, pertussis, hepatitis B, poliomyelitis, and Haemophilus influenzae type b. Biovac has begun commercial production of Hexaxim for the South Africa market, while the technology transfer for Pneumovax is in the final stages with commercial production expected in 2022. These technology transfers are proof that African companies like Biovac have the technical and scientific expertise to manufacture complicated vaccines and are a stepping stone to developing the requisite vaccine manufacturing capacity to meet current and future threats like COVID-19. Biovac’s recent plan to distribute 25 million doses of Covishield vaccines manufactured by the Serum Institute in India under license from Oxford-AstraZeneca reveals the potential of future backward integration for COVID-19 vaccine manufacturing in Africa.

Several plans to invest in vaccine manufacturing in Africa are focused on shortening the supply chain; improving the continent’s readiness to respond to current and future needs, including pandemics; and slowly building critical local capacities for sustainable production. Significant efforts are underway in Ghana, Ethiopia, Kenya, Nigeria, and South Africa. Although their mission is similar, they differ in scope, entry point, and strategy. For instance, Biovaccines Nigeria Limited (BVNL) is a joint public-private partnership launched to revive the defunct National Vaccine Production Laboratory in Nigeria. Its ambitious plan aims to build local capacity to produce vaccines against cerebrospinal meningitis, yellow fever, tetanus toxoid, hepatitis B, and COVID-19, while also developing a center of excellence for research and development of vaccines and other biologics. To bridge the knowledge gap, BVNL is pursuing strategic partnerships for technology transfer. It is still unclear whether Biovaccines will produce antigens or whether their focus will be the downstream production steps.

<table>
<thead>
<tr>
<th>Country</th>
<th>Manufacturer / Vaccines Produced</th>
<th>Manufacturing Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senegal</td>
<td>Institut Pasteur de Dakar / yellow fever</td>
<td>Egg-based</td>
</tr>
<tr>
<td>South Africa</td>
<td>Biovac institute / BCG*, Measles, Pneumococcal conjugate, Hepatitis B, Hexavalent, Tetanus</td>
<td>Fill/finish and packaging and distribution</td>
</tr>
<tr>
<td>Egypt</td>
<td>Vacsera / DTP**, cholera, Typhoid</td>
<td>Bacterial fermentation, end-to-end</td>
</tr>
<tr>
<td>Tunisia</td>
<td>Institut Pasteur de Tunis / BCG</td>
<td>Bacterial fermentation</td>
</tr>
</tbody>
</table>

Table 1: Vaccine Manufacturers in Africa

*BCG: Bacille Calmette-Guérin; **DTP: diphtheria, tetanus toxoid, and pertussis
b. Finance

Recognizing that access to finance has been one of the main hurdles to achieving sustainable manufacturing in Africa, the Africa Export-Import Bank has committed to a vaccine-financing framework that will support pooled procurement of medical products and vaccine production in Africa. The financial mechanism being established will require some level of contribution from host countries. This announcement may be a landmark in improving the supply of the vaccines on the continent.

GAVI and its partners projected that approximately $15.9 billion is required to scale up COVID-19 vaccine distribution in LMICs. This financial resource is to support research and development of vaccines in various countries, increase manufacturing capacity for the highly needed vaccines, and procurement and delivery of approved vaccines in LMICs. Building a manufacturing facility is costly. Without a well-structured and ambitious plan, vaccine manufacturing will remain elusive in Africa. Some of the financing mechanism include:

- Public-private partnerships: For example, Biovac shares ownership of the government, 47.5 percent, and the private sector, 52.5 percent (Biovac Consortium). In this case, the partners inject initial capital, handling, and supply by government and UNICEF support. Other support and finance come from local development loans, bilateral grants, WHO technical support, and international development financiers.
- Public financing: Some manufacturers can be funded or subsidized by the government and coupled with revenue streams from ongoing businesses.
- The International Finance Corporation (IFC) is working with the implementing partners to mobilize funding for COVID-19 vaccine production and estimates that a $60 billion investment is needed to expand manufacturing capacity to meet the expected demand.
- The International Finance Facility for Immunization (IFFIm) receives long-term, legally binding pledges from donor countries and, with the World Bank acting as treasury manager, turns these pledges into bonds. The money raised via Vaccine Bonds provides immediate funding for GAVI. IFFIm issues its Vaccine Bonds on the international capital markets. Capital market investors buy these bonds for an attractive return rate, making funds immediately available to IFFIm.
- African Development Bank and IFC issued bonds in 2020 to mitigate the impact of COVID-19. It might be a good opportunity for the African Development Bank to issue bonds to support vaccine production in Africa.

V. A Case for Last-mile Manufacturing

Moving the downstream steps of vaccine manufacturing (fill, finish, and packaging) closer to the point of use will facilitate effective and efficient distribution. With the current supply limitation, extending the manufacturing capacity closer to the population will improve the response to COVID-19 and future pandemics. This will also allow LMICs to better respond to their growing vaccine demand, strengthen their economies, and build internal capacity for a more robust vaccine industry. Additional advantages offered by last-mile manufacturing include streamlined regulatory requirements, shorter project durations, and flexibility to process more types of vaccine than a one-bulk facility could process.

Emerging pharmaceutical technologies (e.g., barrier isolation, single-use technologies, automation, and smart digital packaging technologies), strategic partnerships for technology transfer, and regulatory systems strengthening are important considerations in the implementation of last-mile manufacturing to speed up the fill, finish, and packaging operations at facilities closer to the point of use.
a. Partnering to expand manufacturing capacity

Partnering is a proven tool to accelerate availability of medical products. For example, partnerships between BioNTech and Pfizer; and Moderna and Lonza has accelerated the availability of the first authorized COVID-19 vaccines in the United States and across Europe. Similar partnerships with original vaccine developers and potential local recipients of transfer of technology in LMICs is the critical enabling factor for successful implementation of last-mile manufacturing. Expanding fill, finish, and packaging to increase production capacity is a well-known practice in the United States and elsewhere. For example, Catalent, a contract development and manufacturing organization, recently signed an agreement with several vaccine developers, such as Johnson & Johnson, Moderna, and AstraZeneca to provide fill and finish capabilities to address the surge of vaccine demand.28 This scale-up of production capacity to deliver large-scale volume requires an effective collaboration among innovators, secondary and tertiary manufacturers, regulators, procurement agencies, governments, and non-governmental organizations. A similar effort for manufacturing is ongoing between the CEPI foundation and GAVI. However, these efforts need to be ramped up to meet current and future demands.

Cold chain requirements and the associated logistical challenges throughout the supply chain are another major barrier to supplying vaccines to LMICs. Therefore, moving manufacturing closer to the point of use through local manufacturing becomes an attractive alternative to scale up vaccine delivery to mitigate distribution challenges. Prefabricated clean rooms with a modular design have been in use for pharmaceutical manufacturing for several years, and the COVID-19 pandemic has accelerated the use of modular designs to expand the fill, finish, and packaging capacity.27 Moving to turnkey facilities with predesigned modular units designed and assembled onsite and then installed at carefully selected facilities closer to the point of use with flexible vaccine manufacturing could result in fast delivery of large-volume doses.

A successful establishment of last-mile manufacturing necessitates cooperation between vaccine developer and a technology recipient in LMICs. Ideally, a complete end-to-end flexible modular fill, finish, and packaging facility with a full-fledged turnkey operation system is a technology that should be explored to speed up large-volume dose delivery in resource-limited regions. To this end, the modular design should have a physically segregated, dedicated unit operations system equipped with barrier isolators (preferably closed barrier) and the required utility system to assure aseptic sterilization of the product and its components. The surge of capacity to deliver a billion doses involves a combination of various factors, including production facility establishment at multiple sites, robust and qualified technological equipment, good manufacturing practices (GMP)-compliant facilities, acquisition of required raw materials, development of knowledge, and expertise needed to run the process.24 Vaccines stakeholders could further explore these modular platforms and enable their uptake in LMICs by facilitating partnerships with the innovators of these technologies.

b. Technology transfer

Many LMICs are primarily reliant upon international donors and procurement agencies to supply vaccines. And, while it may be too time- and resource-intensive to build full-fledged manufacturing capacity in major African manufacturing hubs to impact the availability of COVID-19 vaccines, technology transfers on the continent have already demonstrated the potential to improve capacity for fill, finish, and packaging and pave the way for a more resilient and responsive supply chain. Pharmaceutical companies such as AstraZeneca and Johnson & Johnson already have established technology transfer partnerships in LMICs to produce cutting-edge vaccines. This affords companies in LMICs and beyond to circumvent challenges associated with financing, manufacturing, distribution, accessing raw materials and other infrastructural elements, and gaps in knowledge and expertise. Additional similar partnerships need to be established to expand the manufacturing capacity.

c. Optimizing vaccine distribution

Vaccine storage is controlled and is critical for the last-mile distribution to protect the product’s integrity throughout the supply chain and distribution system. Cold chain logistics have been a challenge in vaccine distribution, especially in LMICs, and may present a challenge for the newly developed COVID-19 vaccines. Manufacturers are currently utilizing uniquely designed storage devices equipped with thermal sensors connected to a central data logger to monitor temperature tracking and inventory management. For instance, Pfizer’s COVID-19 vaccine comes with temporary storage units to protect the vaccine for up to 30 days outside refrigeration; or the vaccines can be stored in refrigeration between 2 and 8 degrees Celsius for five days. Meanwhile, Moderna’s vaccines can be kept only in ultra-low temperature freezers, minus 20 degrees Celsius, for up to six months. The transportation of vaccines from production facilities to the final retailers and/or point of use involves a complex
Last mile manufacturing process mapping

- Inactivated/live attenuated micro-organisms
- Derived from r-DNA/mRNA
- Seed lot determination
- Cell bank + bulk antigen

- Pre-formulation/characterization
- Scale-up + clinical trial
- Scale up to commercial production

Enablers
- Partnership: Joint ventures, training, tech transfer, contract manufacturing, etc.
- Modular Design/Selection

Figure 3. Vaccines last-mile manufacturing process mapping
system consisting of storage conditions in factories, cargo situations, airplanes, retailers’ warehouses, and the like. In addition to the existing coordinated efforts to facilitate seamless vaccine transportation throughout the supply chain system, moving the last-mile manufacturing closer to the point of use offers an opportunity to mitigate vaccine stability challenges. Dai et al. highlighted the impact of decision delay time and the influence of decision adjustment speed that affects vaccine stability in the supply chain system. As several organizations are beginning to speed up the supply of COVID-19 vaccines, multiple distribution challenges create confusion over the cold chain requirements and information technology systems needed to bring the vaccines to the user safely. Upfront investments and the integration of new technologies into the production process will ensure vaccine manufacturing viability in LMICs. Adopting the last-mile manufacturing could significantly reduce current vaccines storage and transportation demands. The scale-up of capacity to meet the demand for COVID-19 vaccine doses requires addressing the challenge from a combination of various angles, including establishing production facilities at multiple sites, expanding availability of robust and qualified technological equipment, supporting facilities to become GMP-compliant, acquiring required raw materials, and developing knowledge and expertise required to run the process.

Figure 3 summarizes the vaccine manufacturing process mapping, including a summary of the current COVID-19 vaccines landscapes, which is developed to define the last-mile manufacturing stages.

VI. Recommendations

Strengthening last-mile manufacturing capacity in Africa and other LMICs could help expand availability of COVID-19 vaccines, and potentially many other vaccines using a variety of platforms for other priority diseases. A backward integration approach could be adopted to introduce last-mile manufacturing with various entry points, depending on existing capacity (Figure 4). A recent survey conducted by CEPI suggests expanding fill and finish capacity by using capacity of current sterile manufacturers as one potential solution. Such expansion could result in expedited improvements in current capacity and faster introduction of new manufacturing steps. In the case of COVID-19 vaccine manufacturing, one of the major bottlenecks in the production is the fill and finish step. As such, the availability of capable local manufacturing could significantly improve access to COVID-19 vaccines in LMICs. Expanding manufacturing capacity in this way, requires significantly improving technical readiness, strengthening regulatory systems, and guaranteeing market access to manufacturers to ensure sustainability. Key steps and recommendations are outlined on page 12.

Figure 4. Last-mile manufacturing entry points and potential expansions

No Existing Capacity

- Fully rely on external manufactures for vaccines

Existing Capacity

- Import for distribution
- Portfolio limited to single vaccine in case of antigen production
- Limited fill/finish/packaging capacity

Legend

- No Existing Capacity
- Existing Capacity

Entry point
Future expansion
Key steps and recommendations

Technical Readiness

- Assess existing vaccine manufacturing capacity to determine infrastructure and technical needs for aseptic/sterile manufacturing and fill/finish capacity.
- Identify the appropriate entry point of last-mile manufacturing (i.e., distribution, packaging, or fill/finish) for successful local production.
- Establish and maintain a vaccine manufacturing clearinghouse to enable technology transfer between vaccine developers and manufacturers to expedite local production while assuring leapfrog.
- Build local capacity through partnerships and training to reduce dependence on external expertise.
- Provide technical assistance to manufacturers to comply with regulatory requirements for quality.

Regulatory Strengthening

- Assist countries in developing robust regulatory frameworks to accommodate new vaccine technology.
- Support the use of harmonization and convergence initiatives to strengthen vaccine regulatory review and facilitate the use of mutual reliance principles.
- Enhance capacities to carry out active surveillance and information sharing.
- Advise national regulatory authorities on how to properly conduct vaccine post-market surveillance for quality and safety.

Policies and Market Access

- Perform market research to support the business case for regional manufacturing.
- Advise countries on how to leverage public-private partnerships to support market access of local manufacturers.
- Facilitate the development of policies incentivizing local production of quality vaccines.
- Prioritize vaccine production through collaborations and consultations with global and local stakeholders (i.e., WHO and Africa Centers for Disease Control).
- Support and facilitate advanced market commitments to help de-risk investment in technical improvement and timely production during health emergencies.
- Encourage national stockpile of finished vaccines, raw materials, and ancillary equipment while incentivizing the manufacturers to stay current on regulatory requirements and technological changes.
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References


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