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Africa needs vaccines. What would it take to make them here?

For decades, private companies, investors, and public-health leaders have taken a pass on domestic vaccine manufacturing. But a confluence of circumstances may be changing the calculation.

by Andrea Gennari, Tania Holt, Emma Jordi, and Leah Kaplow

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Vaccines: it's safe to say that no one living today has ever thought quite so much about these invaluable substances. Rollouts of COVID-19 vaccines are well underway in some countries, especially those with large domestic manufacturing capacity. Many African countries have received their initial shipments from the COVAX facility[1] and from bilateral deals, in some cases months earlier than in previous pandemics such as H1N1, but on the whole Africa has struggled to secure timely access to adequate supplies. Africa relies heavily on vaccine imports: the continent imports almost 99 percent of its routine vaccines today. The COVID-19 pandemic has revived a long-standing question in African and global circles: What would it take for Africa to manufacture its own vaccines?

The idea has never been far from leaders' minds; outbreaks of Ebola in 2014 and 2018, as well as regular threats from other Africa-specific diseases such as Lassa fever or Rift Valley fever, are vivid reminders. There would be several benefits of homegrown manufacturing: public-health resilience in times like these, of course; greater ability to address Africa-specific diseases rapidly; better preparedness for the next epidemic or pandemic; and, on the economic side, less strain on trade balances, improvement in the skilled labor pool, and an easing of foreign-exchange requirements. Other emerging markets, especially those with large domestic populations such as Brazil, India, and Indonesia, have built successful domestic vaccine industries.

Despite these clear benefits, cost concerns, inconsistent access to capital, uncertainty about demand, and other issues have kept most African countries and companies from venturing into vaccine production over the past decade. Today, however, four factors, spurred by the current pandemic, may be changing the calculus.

The impact of COVID-19 and Africa-specific outbreaks. African and global public-health leaders do not want African countries to be last in line for vital supplies, which has arguably happened recently, as well as during the 2009 H1N1 influenza pandemic. Leaders are increasingly aware of the importance of health security as a critical tool for securing the continent's development of and calls for investments into vaccine manufacturing.[2]

Strong demand growth. In our estimates, the public market for vaccines in Africa could rise from $1.3 billion today to between $2.3 billion and $5.4 billion by 2030, depending on the scenario. While Africa's population is growing faster than that of most other regions, significant immunization coverage gaps remain, and new products, such as vaccines for Lassa fever or malaria, could be introduced and used widely on the continent.

Evolving economics driven by new technologies. Many worry about Africa's production costs, which could indeed be higher than in today's vaccine powerhouse locations (such as India—which makes approximately 70 percent of Africa's vaccines today). But the fast pace of technology innovation that we have seen in recent years at every step of the vaccine-development and -manufacturing value chain may mean that production costs are no longer a showstopper. Small-scale disposable technologies, high-density bioreactors, and innovation in fill-and-finish steps are boosting yields and have the potential to change the business case for newer entrants.

More supportive environments. The past year has seen a deepening of the political and regulatory support required to manufacture vaccines in Africa. Notable shifts include increased political commitments from African and global leaders in steering the local vaccine-manufacturing agenda and improvements in regionalization and the integration of vaccine markets across the continent. This year's launch of the African Continental Free Trade Area (AfCFTA), as well as the promise of greater harmonization of markets offered by the African Medicines Agency (AMA) and regional economic communities, seem to be helping. Still, more work needs to be done across the enabling environment; building a sustainable vaccines industry will require a multidecade commitment—especially once the limelight of COVID-19 has dimmed.

[1] COVAX—an initiative co-led by WHO, the Coalition for Epidemic Preparedness Innovations, and Gavi, the Vaccine Alliance—is working with UNICEF to coordinate the distribution of vaccines to a raft of low- to middle-income countries.

[2] John N. Nkengasong and Sofonias K. Tessema, "Africa needs a new public health order to tackle infectious disease threats," *Cell*, October 2020, Volume 183, Number 2, pp. 296–300, cell.com.

So can Africa now make vaccines for Africa? Many of the manufacturers, global health players, and nongovernmental organizations we spoke with as part of our research are cautiously optimistic. A domestic industry is possible, they say, but only with meaningful cooperation and a long-term (five- to ten-year) commitment from leaders across the private, social, and public sectors. And other stars have to align, too.

To help inform the discussion, this article offers a fact base derived from our modeling of demand, production economics, and the constraints and emerging strengths of the enabling environment. Our conclusion: it's possible to build an industry, but it won't be easy. Among other challenges, in most countries vaccines will require a significant step-up in technical ability from small-molecule manufacturing, which is maturing in only a few countries in Africa. In our view, none of the challenges is insurmountable. Getting them all right will require considerable effort, but with the right level of commitment, it can be done.

Demand: Africa's vaccine market could double in value by 2030

More than 9.4 million African children each year don't receive the third and final recommended dose of the diphtheria, tetanus, and pertussis (DTP) vaccine. This is just one of the current gaps in the continent's vaccination programs. When delivered in full, DTP and other life-saving vaccine programs currently save two million to three million lives annually.[3]

Closing these gaps would be of incalculable value to African societies and would alter the economics of vaccine manufacture and distribution. Today, Africa's total public-market vaccine sales are about $1.3 billion, equivalent to about 25 percent of the $33 billion global market; notably, Africa's demand is about 25 percent of global volumes.[4] Four key drivers could expand the market:

— *Demographic shifts.* Demographers expect the continent's population to grow much more quickly (2.5 percent annually) than the rest of the world's (0.7 percent).[5]

— *Access.* Continued efforts to expand vaccine coverage and access, as well as the introduction of new, critical products such as rotavirus, pneumococcal, and human papillomavirus (HPV) vaccines, to countries that have not routinely used them will boost demand.

— *Pricing.* Although prices for most products are expected to stay the same or decline, the product mix is expected to shift toward relatively higher-priced products (as new products are introduced and some legacy products are phased out). Pricing may also be affected as countries' per capita income grows and they transition from the Gavi system of support.[6]

— *New products.* Emerging products such as those for Lassa fever, malaria, and COVID-19 could find substantial demand in coming years, depending on ongoing need and, for products still in development, licensure and eventual commercial marketing.

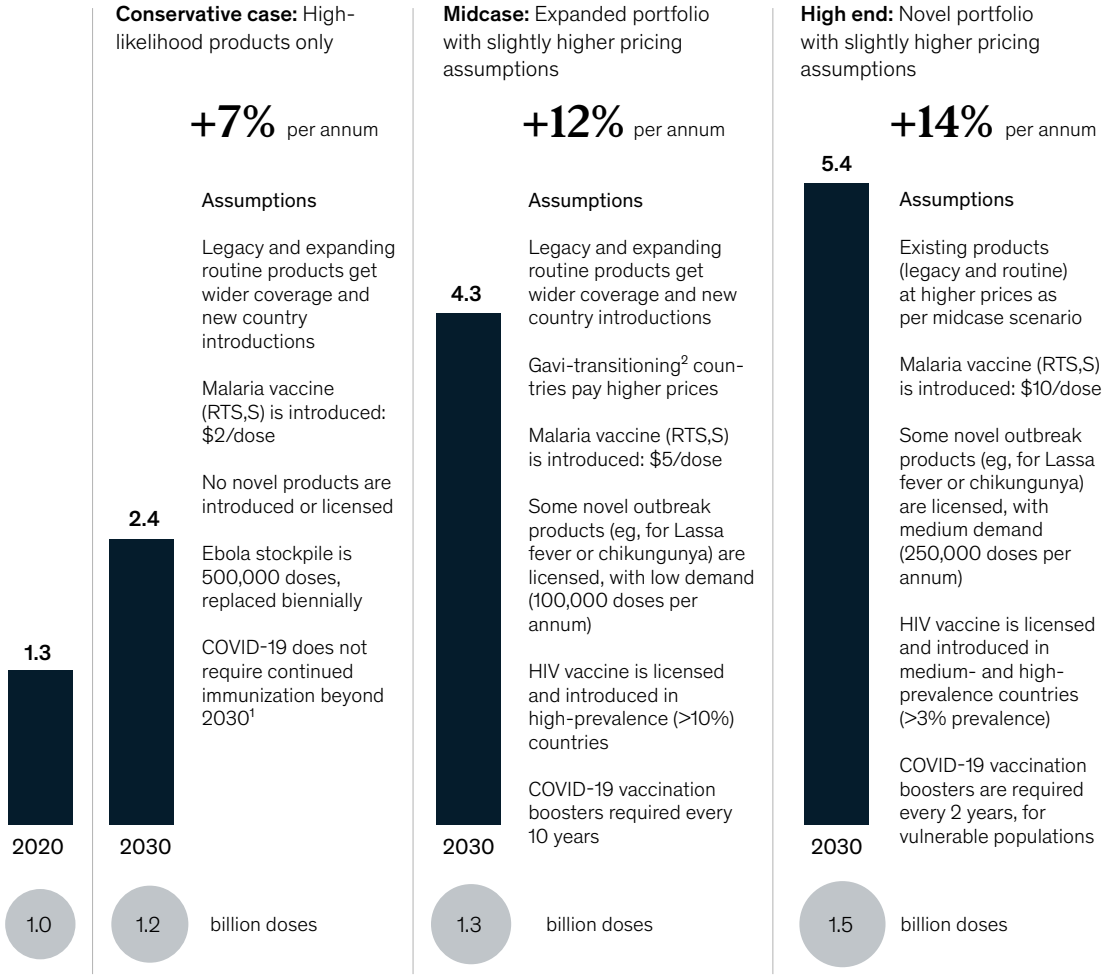
To estimate Africa's 2030 demand for vaccines, we modeled three scenarios for these drivers (Exhibit 1). We estimate that in the low-case scenario, Africa's public-vaccine market could be worth about $2.4 billion by 2030; in a midcase scenario, about $4.3 billion. In an upside scenario, which assumes the approval of and steady-state demand for emerging vaccines (such as COVID-19, HIV, and malaria), the market could be worth about $5.4 billion.

[3] "Immunization," WHO, December 5, 2019, who.int.
[4] In terms of volume, Africa represents about one-third of global demand. The discrepancy between dollar value and volume is due to the low prices that manufacturers typically offer to African countries via Gavi.
[5] *2019 Revision of World Population Prospects*, United Nations, June 17, 2019, un.org.
[6] Africa has two distinct markets for vaccines. Based on gross national income (GNI) per capita, 40 African countries are currently eligible for support from Gavi, the international vaccine alliance. Gavi helps to consolidate their demand, allowing them to buy high volumes at low prices, co-funded by Gavi and managed by the UNICEF Supply Division. Other African countries with higher GNI per capita manage their own procurement. Several countries may transition from the Gavi system of support as their income per capita rises. It is unclear how such a transition could affect prices.

Exhibit 1

By 2030, Africa's public market for vaccines could be worth up to $5.4 billion, depending on scenario.

Estimated potential public-market value by scenario, $ billion



Note: These forecasts are not exhaustive; they do not necessarily incorporate the full range of products in development (such as new dosage forms, or the full range of candidates).
[1]The public market for COVID-19 vaccines may vary significantly from country to country, as there is no global consensus on long-term vaccination strategies. These conservative assumptions were refined with a group of vaccine experts; the actual market may be substantially larger if COVID-19 becomes endemic (and requires repeated vaccinations, for example).
[2]Gavi, the Vaccine Alliance, is a public–private global health partnership focused on providing immunization access to low- and middle-income countries.
Source: Interviews with industry experts; Linksbridge; McKinsey analysis

Our forecasts could be conservative: in the low-case scenario, we assume that herd immunity to SARS-CoV-2 is established among adults and that the virus circulates naturally among younger people, causing milder illness and requiring limited to no vaccination. Our high-end scenario assumes that a booster will be required every two years to reach 60 percent of the older population (aged 65 and over) and healthcare workers. Given the uncertainty in the epidemiological progression of the disease today, including the uncertainty around emerging variants, it is also plausible that the COVID-19-vaccine market could be significantly higher than these estimates under different conditions (for example, if more regular boosters or more extensive coverage is needed, if the total population targeted is larger, or if prices rise).

Factors that can swing the business case

Despite the presence of a few players, vaccine manufacturing in Africa is still nascent, especially in the upstream segments of the value chain, such as antigen production (Exhibit 2). Building on valuable recent research,[7] we looked deeper at the current capabilities of Africa's vaccine manufacturers across products, value-chain steps, and the key dimensions that have the potential to swing business-case assessments.

Only a handful of companies manufacture the drug substance, typically at small scale, which results in relatively high production costs. Fill-and-finish and package-and-label capacity is better established—for example, in South Africa, Egypt, and Senegal; more than ten products are currently filled on the continent. In comparison, Asia and Western Europe each have more than ten established, large-scale vaccine manufacturers, many of which operate across the full value chain, including the higher value-adding steps, and produce high-quality products at low cost. While there is potential to expand the capacities of today's African manufacturers, much of the sector's expansion will likely also come from greenfield investments that carefully consider technological and process innovations and structural realities.

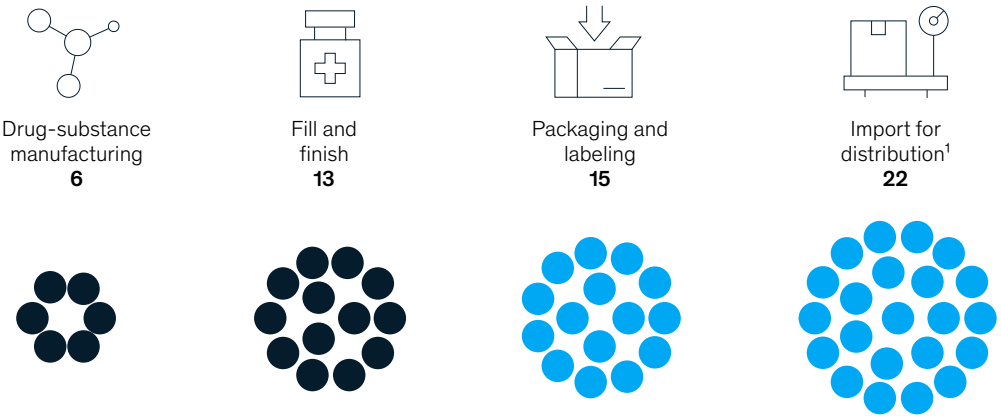
Vaccine-manufacturing strategies and consequent cost implications are complex and multidimensional and cannot be generalized, given that many design choices and cost-influencing factors come into play. The five factors with the greatest potential to swing business-case assessments for vaccine manufacturers include the following:

— *Technology platform.* Manufacturing platforms evolved steadily in recent decades but are changing rapidly in response to the COVID-19 pandemic. Traditional egg-based technologies have historically had low capital-expenditure costs; the equipment is less complex, though it does require more labor and produces lower yields. Bioreactor-based production technologies (such as those for recombinant-protein or viral-vector vaccines) have higher capital costs for the bioreactor and higher operating costs for consumables (bioprocessing material and, where applicable, single-use disposable material). But bioreactors can offer higher productivity due to continued optimization of the cell-expression system.

Exhibit 2

Much of Africa's vaccine capacity is devoted to packaging and distribution.

African vaccine manufacturers' activity, approximate number of products by value-chain step



[1]Does not include branches of foreign companies in Africa that solely import for distribution.

[7] "Vaccine manufacturing and procurement in Africa," African Vaccine Manufacturing Institute, 2017, avmi-africa.org.

Novel mRNA-based vaccines have taken off in the COVID-19 response.[8] They can be synthesized in a chemical reactor and benefit from a more reproducible and less complex manufacturing process than bioreactor-based vaccines. Further, mRNA-based processes might soon become even more accessible through mobile "microfactories" that could further reduce both their footprint and labor requirements.

— *Scale.* Larger facilities allow for large cost improvement as a result of economies of scale, reducing unit costs. Up-front capital-expenditure costs are the main driver of scale requirements, implying that different technology platforms require different-sized plants to reach economies of scale. For example, in our simulation egg-based platforms must produce about 20 million doses per annum to reach economies of scale. Bioreactor-based vaccines require higher production levels to achieve economies of scale. Reaching scale is a challenge and requires demand certainty and secure offtake.

— *Value-chain steps.* A typical vaccine-manufacturing process may clearly separate value-chain steps—for example, with some steps happening at different plants. Each step in the process has different optimization potential and cost implications. Integration of the full value chain offers potential for cost and lead-time synergies but could increase production complexity.

— *Country-specific structural and productivity factors.* Taxes, tariffs, infrastructure costs, and other costs tend to vary from one African country to the next. Labor productivity is typically perceived as a potential constraint, especially in African countries with a limited manufacturing presence. Improvements in labor productivity can offer step-change growth in yields (up to three or four times) and lowered costs; that is the size of the differences we have observed among different operators in the same product set (Exhibit 3). A robust and efficient production system could compensate for structural geographic differences in the cost of goods sold. In other words, excellent productivity by African manufacturers could be sufficient to improve their ability to compete on costs further, provided such excellence can be achieved.

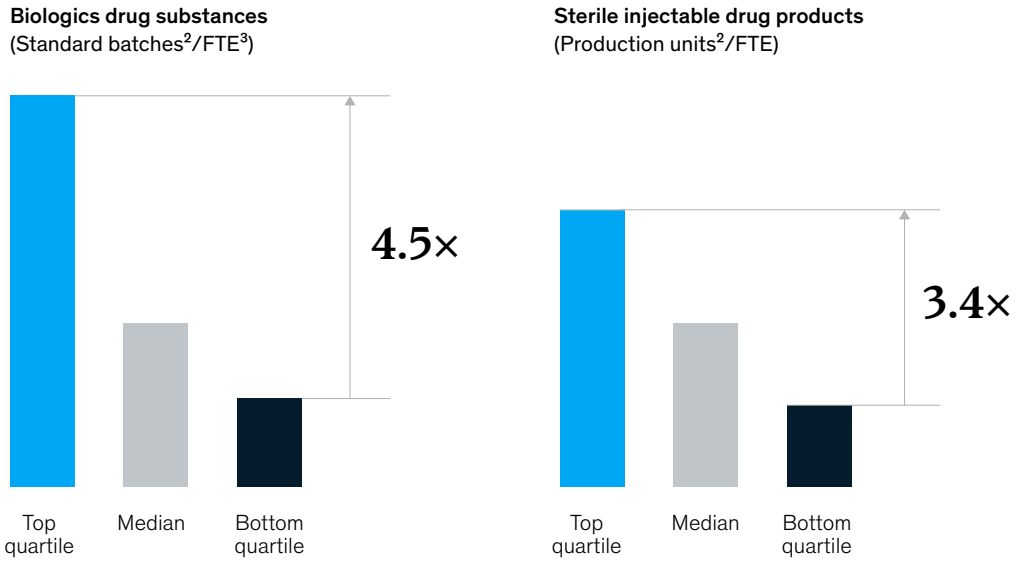
— *Process and manufacturing-model innovations.* Innovations are reshaping the entire process, from drug-substance manufacturing (where miniature-modular-manufacturing platforms can reduce the footprint up to four times and new bioreactors accommodate higher cell density) to fill and finish (where new materials for glass vials allow for faster line speed; going further, disposable blow-fill-seal technologies can eliminate the need for vials). These advances, along with new vaccine technologies, are creating an opening for "multimodality" facilities that can achieve higher utilization and whose fixed costs can be divided across more products. Such plants could play a vital role in the time between the current pandemic and the next. Innovations may not all be applicable for African manufacturing or for all products, and many have not yet been proven at scale. More work is needed to prove technical feasibility and applicability for the African context. If these and other innovations pan out, African manufacturers developing new process lines from scratch may be able to take advantage more readily than companies with established manufacturing facilities in other countries. And should some of these innovations create better unit economies at a smaller scale, they could meaningfully improve Africa's ability to produce locally.

[8] mRNA vaccines encode a disease-specific antigen into "instructions" for the patient's immune system; such standardization avoids the biological variation of viral-vector vaccines, for example.

Exhibit 3

Productivity is a key lever to lower costs and improve yields.

Productivity in pharmaceutical manufacturing,[1] index (median performance = 100)



[1]McKinsey POBOS databases include more than 1,000 manufacturing plants across all regions.
[2]Standard batches and production units are normalized units used in POBOS benchmarking. Units are not comparable across technologies.
[3]Full-time equivalent.
Source: McKinsey POBOS

We simulated several scenarios in which we varied these five swing factors in different countries and found several combinations of manufacturing setup, volume, and cost of capital that, assuming comparable market prices, could yield a positive net present value (NPV). For example, for a bioreactor-based vaccine produced domestically (from drug substance through packaging and labeling), with traditional technology and median to top-quartile productivity performance, we estimate that NPV could turn positive at 20 million to 30 million doses for a high-priced product, and at 40 million to 50 million doses for a moderately priced product (Exhibit 4).

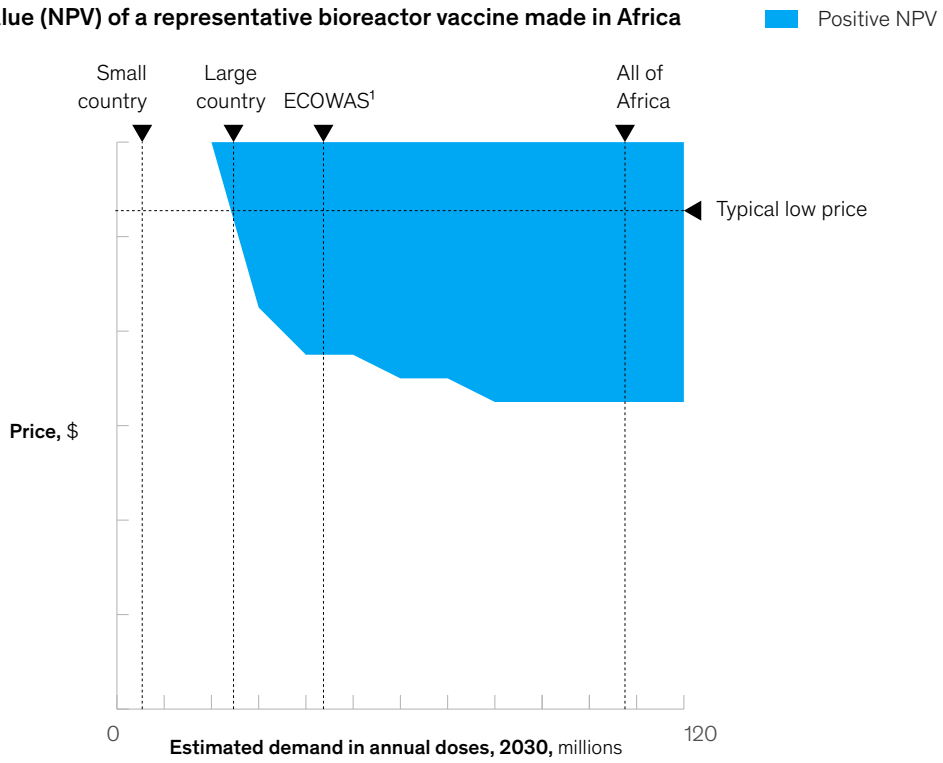
A business case for one of these NPV-positive "corridors" would have to start with the rate of return desired and would need to be assessed and validated carefully against the five swing factors described earlier. In particular, leaders should focus on the fifth factor, of technological and process innovation, and ask whether all the available ideas have been sufficiently deployed to increase the cost-competitiveness of the proposed investment.

Five keys to vaccine manufacturing

The dynamics of supply and demand are subject to myriad influences, as are production costs. But there is another set of factors that is entirely within Africa's power to fix. Our review of the literature and interviews with leaders in the field suggest that five barriers constrain the industry's growth today: lack of a clear agenda or coordination across efforts, restricted access to finance, weak regulatory environments, challenging demand dynamics, and limited local talent. For each, we explore the actions that may be needed to get past these obstacles.

Exhibit 4

Vaccines made in bioreactors can show positive NPV at sufficient scale.



Note: Assumes greenfield plant construction. Excludes costs for R&D, licensing, shipping, and margin. Assumes 10% weighted average cost of capital.
[1]Economic Community of West African States.

Agenda setting and coordination

Several efforts are underway regarding national, regional, and continental coordination and strategic planning around pharmaceutical manufacturing. These include strategies for local vaccine production,[9] national policy agendas that promote domestic pharmaceutical manufacturing, and the establishment of vaccine manufacturing as a priority in pan-African institutions such as the African Union. Economic initiatives, such as the AfCFTA, which launched this year, could also support vaccine manufacturing.

These efforts have accomplished much, but more remains to be done. For vaccine manufacturing to succeed on the continent, a clearly articulated plan that is well syndicated and aligned with stakeholders across national, regional, continental, and global levels will be critical for coordinating efforts. The plan can include clearly defined roles and responsibilities for stakeholders at global, continental, regional, and national levels. Realizing such a strategic plan likely requires long-term commitments, which may span election cycles and thus could require continued engagement from all actors. Furthermore, a coordinated effort may be better positioned to identify regional or continental hubs rather than sporadic development efforts across too many countries on the continent.

Access to finance

Historically, private-sector companies have had trouble securing long-term, patient capital for vaccine manufacturing because of perceptions of high risk and uncertainty about the business case, largely driven by high capital requirements, the need for secured offtake, and technological challenges. Addressing these barriers simultaneously will be important.

[9] For example, "Vaccine manufacturing and procurement in Africa," African Vaccine Manufacturing Institute, 2017, avmi-africa.org; and *Pharmaceutical manufacturing plan for Africa*, AUDA-NEPAD, 2007, nepad.org.

Local vaccine manufacturers might benefit from access to a broader set of funders, including those with missions other than purely commercial returns, such as local and global development-finance institutions, donors, governments, and impact investors, which may support derisking investments with longer time horizons or provide partial subsidies for one-time costs. Nontraditional financing mechanisms (such as public–private partnerships and joint ventures) might also be explored, as these have achieved some success both in Africa and elsewhere.

Regulatory strength

High-performing national regulatory authorities (NRAs) are essential for successful, long-term local vaccine manufacturing. But our interviews suggest that today, many African regulators lack the capacity and capabilities to regulate local vaccine production effectively. Only two NRAs have achieved the World Health Organization's (WHO) maturity level 3,[10] considered a prerequisite to eventual WHO prequalification of local vaccines.

Domestic governments and donors could consider supporting NRAs as they improve capabilities and quality, advance in the WHO certification process, and develop and implement financial sustainability plans.

Greater regional or even continental regulatory harmonization through the AMA could also support African vaccine manufacturing by better enabling exports, thus expanding the market potential and improving the business case. Progress on this front can be seen in efforts to streamline technical activities for vaccine premarket authorization through the African Vaccine Regulatory Forum (AVAREF), promotion and development of a continent-wide medicines agency, and ongoing harmonization efforts for medical products in most of Africa's regional economic communities. Consolidating and sharing regulatory demands could save costs for individual NRAs and avoid duplication of efforts.

Demand and volume certainty

An economically sound approach to vaccine manufacturing requires reliable demand for large volumes to support the production scale required to be cost-competitive. The Gavi and UNICEF Supply Division (SD) procurement mechanism has been developed as a pooling arrangement to meet this requirement, through sizable procurements with well-managed processes. Companies seeking to sell through UNICEF SD are held to the highest bar of quality, an important standard for high-risk products such as vaccines but one that may be a barrier to entry for new players.

Non-Gavi-supported countries often procure at higher prices; they typically do not buy in the volumes that Gavi does nor in the same reliable patterns. Non-Gavi countries could consider pooling their procurement to aggregate demand, a tactic that has worked elsewhere. For example, the Pan American Health Organization, a branch of WHO focused on the Americas, pools demand across countries through a professional organization to build larger procurement volumes. Of course, such an entity allows for more secure and larger offtake for the manufacturers from whom it buys, but it may or may not specifically favor African manufacturers. Africa has seen some success with this tactic, such as for COVID-19-related personal protective equipment and vaccines (most recently, 400 million doses of COVID-19 vaccine[11]). Such procurement mechanisms can be challenging to develop and manage outside a pandemic and will likely require government (and possibly donor) support. Offtake certainty through large, committed, and aggregated markets is challenging to achieve but necessary to strengthen the commercial viability and long-term sustainability of local manufacturers.

[10] WHO benchmarking status for assessing regulatory strength. The two regulators in Africa with ML3 certification (Ghana and Tanzania) have not yet been certified for vaccine production specifically.

[11] "Africa signs historic agreement with Johnson & Johnson for 400 million doses of COVID-19 vaccines," Afreximbank, March 29, 2021, afreximbank.com; "African Union member states accelerates online pre-orders as AMSP adds 300 million Sputnik V doses to its COVID-19 vaccine portfolio," African Medical Supplies Platform, February 21, 2021, amsp.africa.

Expanding vaccine manufacturing in Africa is a complex undertaking, requiring several factors to align. Critically, the nascent industry needs widescale collaboration among a broad range of stakeholders.

Talent and know-how

Vaccine manufacturing requires a significant setup in skills compared with other pharmaceutical manufacturing, particularly in the fields of biopharma, regulatory expertise, quality assurance, and so on. Vaccine expertise is scarce in Africa and is often subject to "brain drain" as newly upskilled employees seek opportunities elsewhere. Thus the continent largely relies on experts from foreign manufacturers through technology-transfer programs.

Tech transfers and rotations of highly skilled people will likely remain important, especially for novel vaccine products, platforms, and technological processes. But governments and local companies could consider other solutions to develop national talent and capabilities. These include programs to repatriate talent from the diaspora, the reskilling and upskilling of workers through training courses (including virtual) or centers of excellence, and efforts with domestic universities to develop programs and degrees to suit industry needs.

There may be other challenges. For example, securing the requisite intellectual-property and production licenses for vaccine products could be challenging for African manufacturers not currently active in research and development. Other challenges might include infrastructural barriers such as inconsistent power supplies, border-clearance delays, and so on. Addressing these challenges is not far from leaders' minds, but further work will be needed to find sustainable solutions.

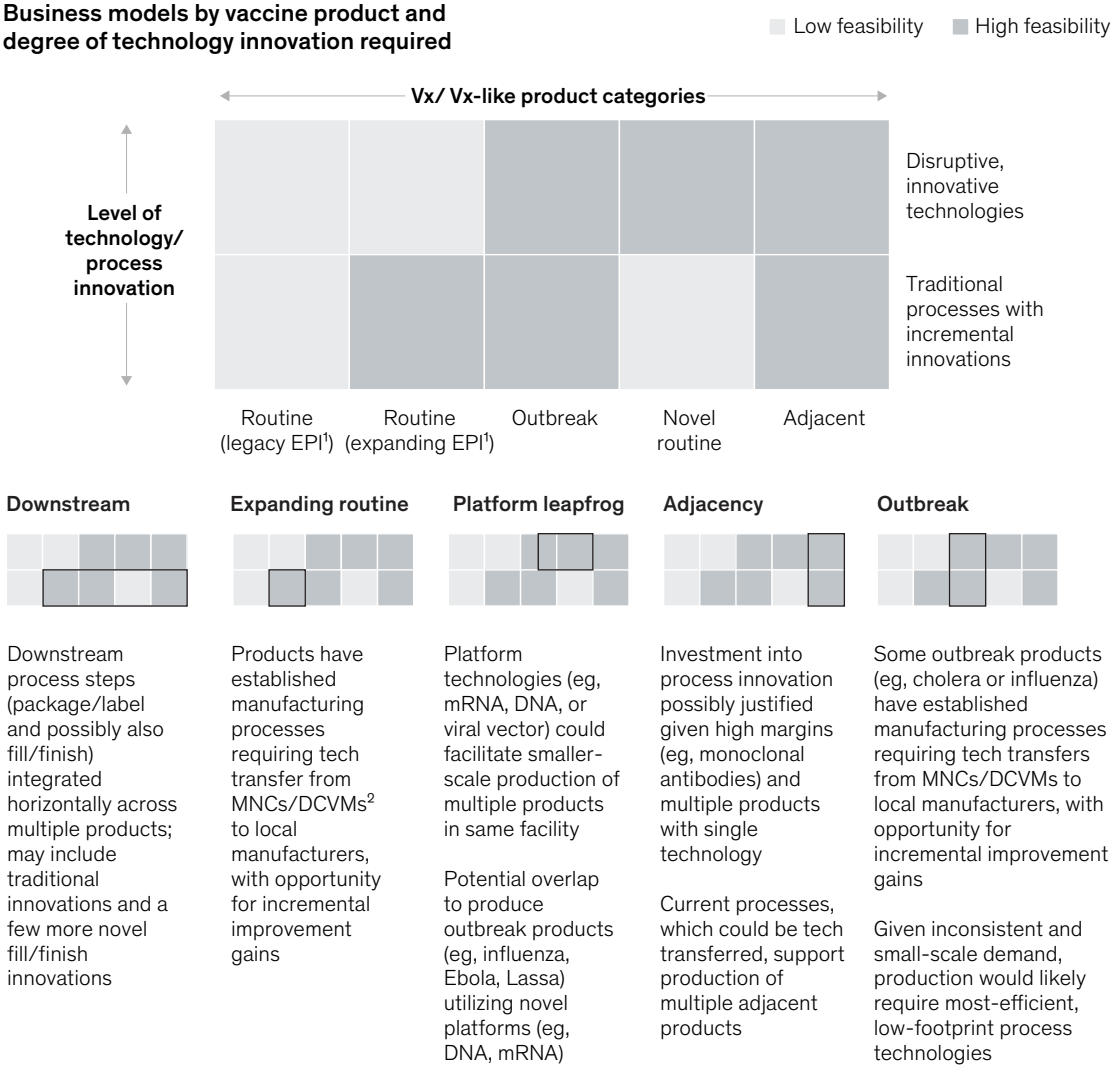
Five business models for success

Simply replicating the models used by other vaccine-producing countries may not work in Africa given the fundamental differences in population sizes, capabilities, and infrastructure. Africa may need creative and complementary approaches for larger regions or the entire continent—for example, by exploring the production of Africa-specific products or leapfrogging technologies to more efficient processes that require smaller scale. Our economic modeling and interviews suggested five potential models for sustainable vaccine manufacturing in Africa (Exhibit 5). Some may be more relevant in certain countries or regions. These models should not be considered mutually exclusive: multiple models could take root simultaneously in different places, and some simpler models may be natural precursors for other more complex ones.

Exhibit 5

Five models for vaccine manufacturing and distribution may be viable.

Business models by vaccine product and degree of technology innovation required



[1]Expanded program on immunization, WHO.
[2]Multinational companies/developing-country vaccine manufacturers.
Source: Expert interviews; McKinsey analysis

1. *Downstream:* In this model, African companies could focus on packaging and labeling, and possibly also fill-and-finish steps, for multiple products. This model may be the most straightforward entry point for vaccine manufacturing, as technical requirements are reasonably low. And, if quality compliance could be assured, it may be the most attractive model in domestic markets that can export regionally.

2. *Expanding routine products:* In this model, a few African companies could focus on end-to-end manufacturing—including drug-substance manufacturing—of some routine products that are marketed but not yet commoditized (such as vaccines for HPV and rotavirus). This model requires economies of scale to be attractive and may be most viable if Gavi markets can be accessed, or if non-Gavi demand can be pooled among regions or continentally. It may take some time for African products manufactured in this model to achieve cost parity with those produced by established players, and stakeholders would need to take a long-term view.

3. *Platform leapfrog:* In this model, African companies could manufacture vaccines based on novel platforms (such as mRNA or DNA). Investing in these platforms could allow African vaccine makers to vault past the technology of some more traditional incumbents and allow for economies of scale at much lower volumes given the smaller production footprint required for mRNA. This might make fragmented African markets more appealing. As these platforms are very new, the model relies on the ability to identify tech-transfer partners willing to bear the risk of transferring less established processes to African manufacturers and being able to attract local talent, develop it, or both. On the other hand, this model could be attractive to smaller companies (such as biotechs) looking to scale mRNA manufacturing capacity globally.

4. *Adjacency:* In this model, African companies that manufacture "vaccine adjacent" products such as monoclonal antibodies or other sterile injectables could expand or pivot to vaccine production on dedicated lines, potentially in the same facility. Producing vaccine-adjacent products has allowed companies and national regulators to build some of the capabilities required for vaccine manufacturing. There are a handful of vaccine-adjacent companies in Africa today that could be a natural starting point for this model.

5. *Outbreak:* In this model, African companies could produce Africa-specific outbreak vaccines (for Ebola, Lassa fever, other viruses). Companies may need to complement production of outbreak products with production of a routine product to ensure full utilization of capacity and to improve the business case. This model might be more viable if sizable offtake for outbreak products (such as to replace a continental stockpile) is guaranteed. Production of multiple products—including more novel outbreak products—is also more technically complex, adding risk and requiring more advanced skills.

One common element across all five models is the difficulty for individual plants to achieve the required scale. Regional hubs may be the best way to accomplish this. Countries could work together to develop a handful of globally competitive industry clusters, which would have a better chance of producing affordable, high-quality vaccines than if efforts were dissipated across a larger number of subscale investment attempts throughout the continent.[12]

Expanding vaccine manufacturing in Africa is a complex undertaking, requiring several factors to align. Critically, the nascent industry needs widescale collaboration among a broad range of stakeholders, including pan-African leadership organizations, regional economic governments, national governments, private-sector players, and global-health actors. For a healthy domestic-vaccines industry of sufficient scale to take root, a regional, if not continental, approach supporting a few regional players could be more sustainable. As a starting point, African leaders can accelerate the necessary actions required to make progress toward the common aspirations to which they have already agreed. The global COVID-19 pandemic presents a unique moment for leaders across the public, private, and social sectors to align on the importance and potential for developing this sector. The case for homegrown vaccine manufacturing is by no means obvious, but with the right level of commitment and support it is not out of reach for some countries.

[12] Michael Conway, Tania Holt, Adam Sabow, and Irene Yuan Sun, "Should sub-Saharan Africa make its own drugs?," January 10, 2019, McKinsey.com.

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