

STEM Development
Impact Memos

Vaccine Innovation in Africa

Plant-Based Vaccines and
Biologics Offer Continue
Low-Cost Health Security

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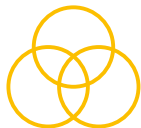
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“Vaccine manufacturing requires its own ecosystem in which it can thrive.”

Faith Osier, Imperial College London

The Challenge

- Africa produces less than 1% of the world’s total vaccine supply¹
- African countries are vulnerable to vaccine shortages and global supply chain disruptions.
- Research institutions in southern Africa hold a large portfolio of plant-based vaccine patents, but are struggling to bridge the gap to clinical trials and large-scale vaccine manufacture.
- Plant-based vaccines offer an agile, low-cost technology that could boost local manufacturing and strengthen existing healthcare systems and future pandemic preparedness.



The Context

Africa produces less than 1% of the world’s total vaccine supply¹. African countries felt this lack of local production keenly when the Covid-19 pandemic hit. Disrupted supply chains, hoarding by wealthier countries and “vaccine nationalism” meant that residents struggled to access these live-saving vaccines.

At the same time, the continent battles many infectious diseases. The death rate of children under five in sub-Saharan Africa is 15 times higher than that in high-income nations, and more than half of those deaths could have been prevented through measures such as access to clean water and food and immunisation.² The most common vaccine-preventable diseases include diphtheria, hepatitis A and B, measles and mumps. Residents of these countries are also vulnerable to outbreaks of ebola and malaria, for which there are vaccines. In fact, the World Malaria Report estimates that around 481,500 children under five in Africa died from malaria in 2020.³ Livestock also suffer under a weighty burden of disease, including avian influenza, African Horse Sickness, and Rift Valley Fever.

Local manufacturing would significantly improve access to vaccines and would buffer African countries against shocks to supply chains and the threat of shortages. The Africa Centres for Disease Control and Prevention’s Partnerships for African Manufacturing Framework for Action calls for 60% of vaccines required for local populations to be manufactured on the continent by 2040.⁴

Plant-based vaccines offer an opportunity to diversify the production landscape with cost-effective and effectively locally manufactured vaccines. This method of vaccine production is growing in popularity. For example, in 2022, Health Canada authorised Medicago’s Covifenz Covid-19 vaccine, which is produced in plants.

An international team, brought together by the Imperial College London-led Chanjo Hub, is working to take laboratory-scale plant-based vaccine manufacture into full-scale production. The Chanjo Hub, part of the UK Vaccines Network and funded by UK Research and Innovation, aims to build a network of development and manufacturing organisations in Africa that offer a range of platforms to rapidly respond to diverse pathogens and disease.

Already, southern Africa has extensive expertise in plant-based vaccine development, and the Chanjo Hub has brought together research institutions and companies – including the University of Cape Town (UCT), South Africa’s Council for Scientific and Industrial Research (CSIR) and biotechnology company Liselo Labs – to create a vaccine manufacturing pipeline.



“Research into plant-based vaccines advanced rapidly in South Africa, partly because researchers could quickly innovate with minimal infrastructure requirements to grow the plants, test the vaccines, and then iteratively repeat that process.”

David Jarvis, Liselo Labs

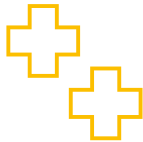


“It’s time to be more creative, more innovative and design low-cost custom solutions, like plant-based vaccines.”

Faith Osier, Imperial College London

The Method

- Plant-based vaccines, which are produced in plants instead of mammalian cell cultures, are growing in popularity. Researchers make the plants produce vaccine proteins, which mimic viruses. The vaccine proteins are extracted and purified.
- When introduced into humans or animals, the target’s immune system mounts a defence against the particles vaccine proteins. This gives them immunity from the disease-causing pathogen. Different plants can be used to express vaccine proteins.
- UCT, the CSIR and Liselo Labs already hold a broad portfolio of plant-based vaccine patents. These include vaccines for avian influenza, African Horse Sickness, and Rift Valley Fever. Each partner occupies a unique position in the vaccine supply chain: UCT produces academic knowledge; the CSIR specialises in industrial-pilot testing; while Liselo Labs has industrial manufacturing facilities in South Africa and Lesotho.
- The collaboration aims to have vaccines for zoonotic diseases in clinical trials within the next two years, and move to full-scale manufacture in five years.



“Instead of using large stainless steel tanks with cells to grow vaccines, we use plants, that are factories in themselves. We introduce the genes temporarily and once the plant has expressed the desired protein, we harvest them”

David Jarvis, Liselo Labs

“The upstream operations are relatively simple and amenable to job creation for a relatively unskilled workforce, which for some governments is an important factor to consider.”

Tsepo Tsekoa

Benefits

- **Large market:** Africa’s existing human vaccine market is worth about \$1.3 billion and it is expected to grow to about \$2.4 billion by 2030.⁵ Meanwhile, analysts anticipate that the animal vaccine market on the continent will expand from \$470 million in 2023 to \$712 million by 2032.⁶
- **Cost-effective:** Plant-based vaccines are cheaper to produce than those developed through traditional methods.
- **Enhanced safety:** Mammalian cells, which are used to produce traditional vaccines, are prone to viral infections and contain many proteins against which human immune systems mount an allergic response. Plants, on the other hand, do not get diseases that infect humans.
- **Health security:** Local vaccine manufacturing capacity will make African countries less vulnerable to global supply chain shocks and vaccine supply shortages.
- **Diversify resources required:** When outbreaks strike, input resources such as chemicals and reagents, become scarce. By embracing a variety of vaccine platforms with different inputs, such as plants, manufacturers can avoid supply shortages.
- **Local manufacturing and job creation:** Plant-based manufacturing in African countries is an engine of job creation and economic growth.
- **Different diseases:** Plant-based vaccine technology can be used to produce a variety of vaccines and biologics for both animals and humans.
- **Responsiveness to future pandemics:** Vaccine manufacturing in plants is twice as fast as common traditional methods. This empowers researchers, manufacturers and health authorities to respond quickly to potential future pandemics and disease outbreaks – both by testing potential vaccine candidates and ramping up manufacturing.



“We saw supply bottlenecks during the pandemic; we saw global value chains shut down. Having different modalities for producing vaccines that require different resources, such as plants, means that we stand a better chance of responding to threats when they happen.”

Tsepo Tsekoe

For more information

Chanjo Hub

www.chanjohub.com

The University of Cape Town's Biopharming Research Unit

<https://science.uct.ac.za/departments-mcb/biopharming-research-unit>

The Council for Scientific and Industrial Research

www.csir.co.za

Liselo Labs

<https://liselo.com>

The Impact

- **For patients:** The technology offers a cost-effective way to increase access to vaccines and biologics. Immunisations save lives, particularly for children under five, and reduce Africa's infectious disease burden.
- **For farmers:** Livestock diseases and losses have a significant economic impact on farmers. Reducing livestock death through vaccination will boost livelihoods, agricultural sustainability and regional economic growth and protect humans from zoonotic diseases.
- **For healthcare systems:** Low-cost locally manufactured vaccines reduce the vulnerability of healthcare systems to geopolitical shocks, and give governments greater immunisation options in the face of disease outbreaks. Access to vaccinations reduces illness and downstream healthcare costs. They also offer an avenue of economic development and employment.

Notes

1. GAVI, 'Expanding sustainable vaccine manufacturing in Africa', November 2022. www.gavi.org/sites/default/files/document/2022/Gavi-Expanding-Sustainable-Vaccine-Manufacturing-in-Africa-2022.pdf
2. Tesfa, D. et al, 'Time to death and its determinants among under-five children in Sub-Saharan Africa using the recent (2010–2018) demographic and health survey data: country-based shared frailty analyses', BMC Pediatrics, Vol. 21 (2021). <https://bmcpediatr.biomedcentral.com/articles/10.1186/s12887-021-02950-3>
3. World Health Organisation, 'World Malaria Report', 2021. <https://malaria.who.int/sites/default/files/978924004049-eng.pdf>
4. African CDC, 'Partnerships for African Vaccine Manufacturing Framework for Action', 2022. <https://africacdc.org/download/partnerships-for-african-vaccine-manufacturing-pavm-framework-for-action>
5. GAVI, 'Why Africa needs to manufacture its own vaccines', (2021) www.gavi.org/vaccineswork/why-africa-needs-manufacture-its-own-vaccines
6. Credence Research, 'Middle East and Africa Veterinary Vaccines Market', 2024. www.credenceresearch.com/report/middle-east-and-africa-veterinary-vaccines-market#:~:text=Market%20Overview,5.3%25%20from%202024%20to%202032

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