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Empowering Africa's healthcare future: The crucial role of human capital development in bio- and pharmaceutical manufacturing

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Introduction

Africa, a continent of immense potential and diversity, has long grappled with complex healthcare challenges. The COVID-19 pandemic has accentuated the urgency of fortifying the continent's healthcare infrastructure. The Africa Union has since set a target to manufacture 60% of vaccines used on the continent locally by 2040 (1), and established the Partnership for African Vaccine Manufacturing (PAVM) to carry out this mandate. At the heart of this transformation lies the imperative of human capital development in bio- and pharma-manufacturing.

The recently unveiled African Union's Bio-manufacturing Workforce Development Workshop Report 2023 (2) and the United Nations Economic Development in Africa Report 2023 (3) spotlight the critical role of a skilled and adaptable workforce. Additionally, the commitment of BRICS member states, Africa CDC, and WHO (4) to collaborate with the business sector on pandemic prevention, preparedness, and response underscores the importance of a robust pharmaceutical industry and workforce. The Framework for Action (FFA) (5) further cements the need for strategic collaboration.

Vaccine manufacturing and R&D talent needs

Preliminary estimations indicate that as of 2020, Africa had between 2000-3000 Full Time Equivalents Employees (FTEs) in the vaccine manufacturing, Research and Development

(R&D) institutions. The majority (48-54%) of the FTEs are in vaccine manufacturing, and 46-52% in R&D.

In order to meet the 60% goal of regional vaccine manufacturing by 2040, approximately 9,000-14,000 FTE in vaccine manufacturing companies, R&D institutions, and start-up biotech companies will be required (5). These are expected to be distributed as 7,000-8,800 in vaccine manufacturing, 3,000-5,000 in R&D, and 300-500 in biotech companies (5).

Education and training: Nurturing the seeds of expertise

The journey towards developing a resilient pharmaceutical manufacturing sector in Africa will commence with a robust education and training system. A comprehensive educational frame-work, spanning from primary to tertiary levels, is indispensable. Science and technology education, particularly in areas relevant to biopharmaceutical and pharmaceutical manufacturing, must be prioritized.

The African Union's Bio-manufacturing Workforce Development Workshop Report (2) emphasizes the pivotal role of partnerships between educational institutions and the pharmaceutical industry. For this reason, the Africa CDC PAVM has adopted the Regional Capability and Capacity Centre Network (5) (RCCCN) concept that fosters partnerships between educational institutions (African and Global), the vaccine manufacturing industry, and research and development (R&D) institutions (Fig. 1) (2).

The recent Memorandum of Understanding signed by The University Of Zambia (UNZA), the University of the Witwatersrand (South Africa), the Saint Luke Foundation-Kilimanjaro School of Pharmacy (Tanzania), Intellectus Campus (Zimbabwe), Chemical Processing Technologies (CPT) of South Africa, and Avacare Health Group (South Africa), supported by the Southern Africa Development Community Secretariat and the Support towards Industrialization and Productive Sectors (SIPS) project is a testament to the importance of collaboration in education and training (6).

The case study of the partnership between these institutions showcases the practical application of collaborative initiatives through the development of the Regional SADC Industrial Pharmacy Fellowship Program (6). Such programs bridge the

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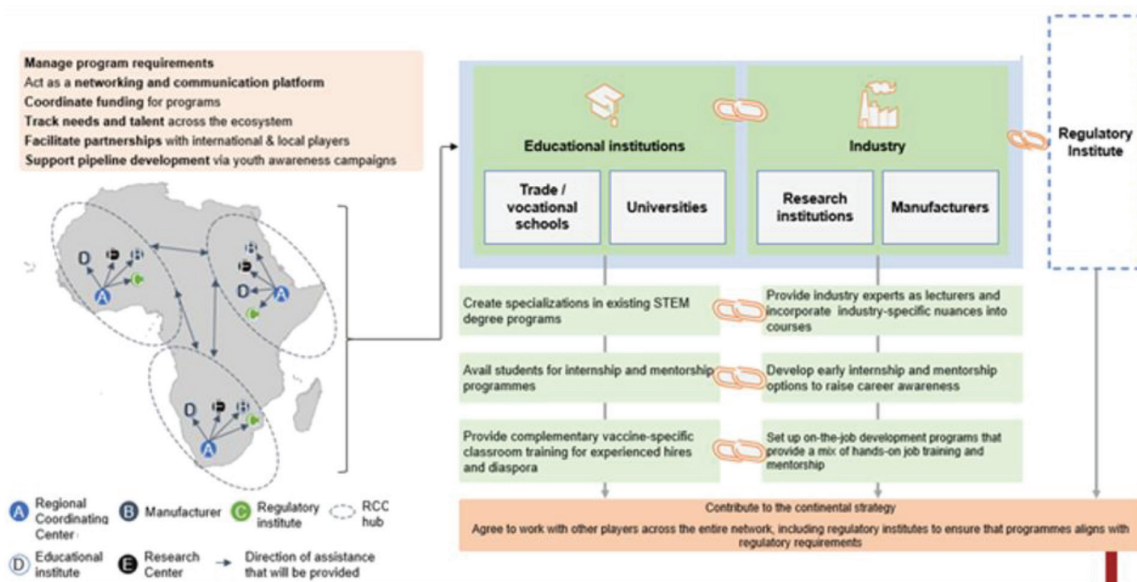


Figure 1. Concept illustration by the Regional Capability and Capacity Centre Network (RCCCN).

gap between academic knowledge and practical skills, equipping the workforce with the expertise and skills development needed for the pharmaceutical manufacturing sector.

Educational institutions that can collaborate with industry in this regard can help forge the type of symbiotic alliance that is crucial for the sustainable development of human capital in this sector. Universities act as knowledge hubs, providing theoretical foundations. This collaboration, which is well exemplified by the RCCCN (5), ensures practical application through internships, industry-sponsored projects, and expert insights. Efforts in technology transfers, regulation, R&D, and infrastructure will strengthen the enabling environment required for success. Regional Capability and Capacity Centres (RCCCN) will be established to enhance human capital in the ecosystem, ensuring adequate skilling along all key enablers.

In February 2023, the Africa Centers for Disease Control and Prevention (Africa CDC) launched the RCCCN, focusing on talent development for manufacturing and research, and selected Institute Pasteur of Dakar as its inaugural centre (7).

Graduates, equipped with a blend of academic and practical expertise, can become a skilled workforce tailored to industry needs. This interlinking of academia and industry not only fosters innovation but propels holistic human capital development, laying the groundwork for a workforce adept at navigating contemporary challenges.

Cross training, competency framework, and skills assessment: Adapting to the evolving landscape

The commitment of BRICS member states, Africa CDC, and WHO (4) to collaborate with the business sector on pandemic prevention and response further underscores the need for a versatile and cross-trained workforce.

As such, cross-training emerges as a pivotal strategy in an industry as dynamic as biopharmaceutical and pharmaceutical manufacturing. It not only ensures the adaptability and versatility of the workforce but also reinforces the sector's

resilience. A workforce skilled in multiple facets of pharmaceutical manufacturing can seamlessly adapt to changing roles and evolving industry standards.

Training programs need to navigate the lack of clarity regarding the most pressing training needs across the continent, the absence of a comprehensive training needs catalog, and the inconsistent use of nomenclature used by various training programs. As a result, the Africa CDC PAVM has developed vaccine manufacturing and R&D competency frameworks to support these training initiatives in the development of their programs.

The competency frameworks outline the mapping of all vaccine manufacturing roles, including R&D organisational functions and sub-functions to constituent roles, common role nomenclature, responsibilities within the vaccine manufacturing and R&D organisational structure, qualifications required and competency proficiency for each role (*i.e.*, variations in capabilities between basic-skilled, semi-specialist and specialist employees).

Skills assessment is the compass guiding organizations in this training journey. Regular skills assessments enable organizations to identify areas where additional training or cross-training is necessary. This ensures that the workforce remains aligned with the evolving demands of the biopharmaceutical and pharmaceutical manufacturing sector.

As such, the Africa CDC PAVM has conducted a comprehensive vaccine manufacturing training needs assessment to support the development of appropriate training curricula and the establishment of training programs.

Similarly, the establishment of the Regional SADC Industrial Pharmacy Fellowship Program, is also undertaking an industrial pharmacy skills needs assessment (8,9).

Technology adoption: Catalyzing innovation

In the 21st century, pharmaceutical manufacturing is inseparable from cutting-edge technology. The African Union's Bio-manufacturing Workforce Development Workshop.

Report and the United Nations Economic Development in Africa Report have also emphasized the critical role of technology adoption (2,3).

Africa's biopharmaceutical and pharmaceutical manufacturing sector must embrace technological innovations to enhance efficiency, quality, and compliance. The case study of the use of novel Virtual Reality (VR) technology by the Developing Countries for Vaccine Manufacturing Network (DCVMN) to provide training in the vaccine manufacturing field is an example (8,9).

Collaborating institutions should leverage the strengths of artificial intelligence to implement needed training programs effectively and ensure that the workforce is well-versed in the latest technological advancements, positioning Africa's biopharmaceutical and pharmaceutical manufacturing sector on the global stage.

African skilled labor force: Catalyst for research and development

An African skilled labor force creates an enabling environment for research and development and product discovery of new medicines that can benefit Africa. The continent's unique challenges and healthcare needs necessitate a workforce intimately familiar with the local context.

The commitment of BRICS member states, Africa CDC, and WHO to collaborate with the business sector on pandemic prevention, preparedness, and response underscores the relevance of a skilled workforce in addressing any healthcare crisis (4).

A workforce rooted in Africa's realities is better equipped to drive research and development initiatives that address the continent's specific healthcare challenges. The vaccine R&D competency framework developed by the Africa CDC will support training institutions to implement appropriate programs for vaccine R&D workforce development.

The framework for action: A roadmap for collaboration

The Framework for Action (FFA) established by the Partnerships for African Vaccine Manufacturing (PAVM) serves as a comprehensive roadmap for collaborative efforts. PAVM's commitment to fostering partnerships between public and private sectors, academia, and international organizations is a testament to the belief that collective action is vital for the pharmaceutical manufacturing sector's growth (5).

By providing a structured framework for collaboration through the RCCCN concept, PAVM ensures that efforts are coordinated and synergized, maximizing the impact on human capital development in biopharmaceutical and pharmaceutical manufacturing.

Challenges and opportunities: Navigating the landscape

Developing a skilled biopharmaceutical and pharmaceutical manufacturing workforce in Africa faces challenges, notably resource constraints hindering investment in education and training. Most of the related training programs on the continent have focused on clinical aspects, largely due to the lack

of investment in purpose-built infrastructure, laboratories, and equipment.

However, innovative financing mechanisms, exemplified by the Memorandum of Understanding between educational institutions and private sector companies, and commitments by governments can offer solutions.

Despite limited research funding, collaboration commitments underscore the importance of allocating resources for biopharmaceutical and pharmaceutical sciences. Access to cutting-edge infrastructure and technology, highlighted in a partnership case study, showcases how collaborations can bridge gaps, ensuring Africa's biopharmaceutical and pharmaceutical manufacturing sector thrives globally.

Brain drain, where skilled professionals migrate for better opportunities, necessitates retention strategies as emphasized by BRICS member states, Africa CDC, and WHO collaboration. The adoption of the vaccine manufacturing competency framework by the vaccine manufacturers presents an opportunity to retain their staff through a clear career progression pathway which acts as motivation for employees.

Overcoming complex regulatory environments involves simplifying processes and promoting transparency, fostering investment and growth.

The way forward: A resilient future

The healthcare challenges in Africa present a unique opportunity for growth and development by investing in human capital. This strategic approach not only reduces dependence on imported health products but also stimulates economic growth and enhances healthcare access. Investing in human capital is not merely an obligation but a transformative opportunity to empower individuals, drive economic prosperity, and build a healthier future for Africa.

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Conflict of interest

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