Nigerian Journal of Pharmaceutical and Applied Science Research,
Vol.14 (2): 9-13; June 2025 ISSN: 2971-737X (Print); ISSN: 2971-7388.
Available at www.nijophasr.net https://doi.org/10.60787/nijophasr-v14-i2-593

Addressing the Challenges Hindering Innovations in Pharmacy Practice in Nigeria: A Focus on Research, Education and Manufacturing

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Accepted: 30 May 2025 Published: 30 June 2025

ABSTRACT

Background: This review addresses the current status of pharmacy practice in Nigeria, highlighting the significance of innovation and recognizing obstacles that impede advancement. In Nigeria, the pharmaceutical industry requires additional support in research and development (R&D), education, and manufacturing, despite the country's abundant resources and large population.

Methods: by searching for relevant literatures across various academic databases and repositories, this article provides actionable suggestions to tackle these problems and encourage creativity.

Results: Major areas that need improvement comprise boosting R&D capabilities through digital innovations and Artificial Intelligence (AI), revamping pharmacy education to be more inclined to industry demands, and encouraging domestic pharmaceutical manufacturing, with government policies. Issues like inadequate training in clinical pharmacy, restricted research chances for students, regulatory obstacles, and manufacturing quality assurance are being addressed.

Conclusion: Recommendations provided by the authors include promoting partnerships between academia and industry, integrating subjects such as biotechnology and nanotechnology into pharmacy academic curricula, and enhancing local pharmaceutical manufacturing to reduce the dependence on imported drugs.

***Key words*— Education, Manufacturing, Nigeria, Pharmacy, Research.**

1. INTRODUCTION

Nigeria, located in West Africa, borders Niger to the north, Chad to the northeast, Cameroon to the east, and Benin to the west, covering approximately 923,768 square kilometers. With the largest population in Africa, projected to reach 206 million by 2020 [1], Nigeria is rich in mineral resources, including petroleum and coal [2]. The country has around 115 registered pharmaceutical companies [3], presenting opportunities for growth and development. Despite these resources, Nigeria's pharmaceutical sector faces significant economic challenges, including dependence on imported drugs and limited local manufacturing capacity [4]. Innovative pharmacy practice is crucial for enhancing drug manufacturing quality, medication management, patient care, and the pharmacy workforce. By fostering innovation, Nigeria can improve healthcare outcomes, increase access to essential medicines, and reduce reliance on imported products. The objective of this article is to evaluate challenges hindering innovation in pharmacy practice in Nigeria, focusing on research and development, pharmacy education, and industrial manufacturing, and to provide action-driven recommendations to address these challenges and promote sustainable growth in the pharmaceutical sector.

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2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Literature search.

A comprehensive search was conducted across various academic databases and institutional repositories to identify relevant literature and articles. The search strategy utilized keywords such as "Education", "Manufacturing", "Nigeria", "Pharmacy", and "Research" to capture a broad range of studies.

2.1.2 Studies Focusing on Pharmacy Education in Nigeria

Research articles discussing pharmaceutical manufacturing in Nigeria, Literature reviews highlighting challenges and opportunities in Nigeria's pharmaceutical sector

2.2 Methods

The selected studies were analyzed to identify common themes and challenges facing Nigeria's pharmaceutical sector. Key areas of focus included [4, 9, 11]:

- Development of patient-oriented pharmacy programs
- Need for increased research partnerships and hands-on research opportunities
- Importance of partnerships between academia and industry for sustainable advancements.

3. RESULTS

3.1 Search Results

The search yielded several relevant studies, including [7,8,14]

Pharmacy Education: Research on the impact of learning management systems in pharmacy education in Southern Nigerian universities. Industrial Pharmacy: Studies investigating Nigerian pharmacy undergraduates' interest in industrial pharmacy careers. Academia-Industry Collaboration: Articles discussing the relationship between academia and the pharmaceutical industry in Nigeria.

4. DISCUSSION

4.1 Research and Development

Developing countries now leverage digital innovations and technological advancements like Artificial Intelligence (AI) and Machine Learning (ML) to drive innovations in R&D in drug discovery. This is further supported by the presence of state-of-the-art laboratories accessible to young scientists and post-graduate students, facilitating the growth of pharmaceutical R&D in such countries [5]. With a promising profile for technological advancement, Nigeria can leverage these technological advancements and digital innovation to optimize drug discovery at both academic and industrial levels. Furthermore, R&D laboratories in academic institutions must be nuanced as a positive step towards innovative drug discovery [5]. R&D in the pharmacy business may not be cost-effective and may pose a financial risk, especially when comparing the Return on Investment (ROI). Financial and operational reasons show that they can only operate effectively by big pharmaceutical companies [6], but the need for new medicines is significant [7], especially in a low-resource setting like Nigeria with many unmet health and medical needs. Nigeria, like many other West African countries, faces irregularity as a major setback towards novel drug discovery and delivery. These defects are mainly tied to financial constraints [4], which may affect the technical capacities and performance of their internal R&D departments. A solution would be to create and adopt a model that demands reduced cost of R&D input while increasing productivity [6,7]. Therefore, the Nigerian government needs to create policies that enhance pharmaceutical industries' access to funds for effective R&D involvement, thereby mitigating the financial risks involved in large-scale manufacturing.

4.2 Academia and Pharmacy Education

There is a great need for academic modification in Nigeria that meets the needs and challenges of this ever-changing era, especially by creating an academic-industry collaboration. The Indian pharmaceutical sector, for example, has adopted collaborative research strategies [8], thereby bringing to life advanced pharmaceutical R&D capabilities. In the US, Merck & Co started a similar partnership with academic scientists to create the California Institute for Biomedical Research to bring innovative drugs [9]. Sadly, only a small portion of the 24 pharmacy schools within the country [10] are making efforts to ensure wide academic partnerships with pharmaceutical industries, as others have yet to understand and recognize the importance of these partnerships. Industries also need to bridge this gap by sharing some of their work with academia, as this kind of cooperation brings about innovation [4]. Nigerian pharmaceutical stakeholders should foster and leverage these kinds of innovative strategies, ensuring students occupy the niche of intellectual and academic contribution, and ultimately creating a future where these academic contributions are applicable and sustainable beyond the university walls [4]. A scholarly review of pharmacy education in West Africa, particularly Nigeria, highlights a deficiency in incorporating essential courses like biotechnology, pharmacogenetics, and nanotechnology into the curriculum [11]. This gap inhibits the foundational knowledge necessary for innovative drug design processes from being

taught at the undergraduate level [20]. Hence, there is a need to properly harmonize and update the currently used curricula, making them befit the changing environment of pharmacy education. These adjustments must still be regulated by authorities such as the National Education Regulatory Authorities (NERA), the Pharmacy Council of Nigeria (PCN), scientific advisory councils, and other academic stakeholders [11]. While these novel courses are predominantly considered for postgraduate research, it is necessary to introduce the foundational concepts to spur the interest of undergraduate students and prepare them for industrial experience. Effective pharmacy practice and its support through the curriculum have received minimal attention in Nigeria; therefore, relevant stakeholders and policymakers should focus on these aspects to alleviate the burden of repetitive tasks while finding innovative solutions.

4.3 Industrial Practice, Manufacturing, and Importation

The US Food and Drug Administration (FDA) and the World Health Organization (WHO) aim to develop and support manufacturing pharmaceutical sectors that are efficient and flexible, producing high-quality drugs with minimal regulatory oversight [12]. To fulfill the demands of these regulatory bodies for safe manufacturing, especially of large molecular-based products (vaccines and biopharmaceuticals), the manufacturing processes need to be strictly controlled and operated under a sterilized process environment [13]. Many pharmaceutical firms in developing countries have failed in this regard, and the COVID-19 pandemic has highlighted this unpreparedness, especially for biopharmaceutical manufacturing within the sub-Saharan region of Africa [14]. This COVID-19 outbreak is undoubtedly playing a major role in the global transformation of the healthcare sectors of African states [15], as evidenced by the maturity level 3 for the regulation of imported vaccines attained by the Nigerian medical regulatory agency known as the National Agency for Food and Drug Administration and Control (NAFDAC) [16]. Meeting these standards holds promise for repositioning pharmaceutical manufacturing in Nigeria. However, the current unstable economy of Nigeria may present a challenge to accurately predicting the future of pharmaceutical manufacturing and practice in Nigeria. In addition to meeting standards in pharmaceutical manufacturing, modelling leading pharmaceutical companies like Pfizer, AstraZeneca, Novartis, Moderna, Biogen, Ashington, and Merck & Co. in how they invest in research and development can provide significant benefits. Firms operating within the Indian pharmaceutical sector, for example, have experienced a remarkable shift from importers to innovators of drugs over the past decades [6]. This shift was made possible by the extraordinary focus on innovative research and development, collaboration between academia and industries for research, and strict regulation in pharmaceutical importation.

4.4 Importation Affecting Local Manufacturing

It has been reported that 8 out of 10 drugs distributed for consumption in Nigeria are imported, and some are found on the 14-import prohibition list by the Nigerian Customs Service [17, 18]. The few pharmaceutical products manufactured locally also require the importation of APIs, operational machines, and energy [14]. These factors significantly contribute to the raised cost of manufacturing. Additionally, the cost of and limitations in power generation, which reveals inefficiency in harnessing the country's resources or indicate the deficiency of the petrochemical industries [14], may indirectly boost importation due to the direct impediment on local manufacturing. Local manufacturers may experience unprofitability due to competition for profit maximization and high market prices of drugs brought about by importers [19], over 80% of whom are not pharmacists [17].

To drive innovation in the Nigerian pharmaceutical sector, stakeholders must discourage importation and improve local manufacturing, thereby strengthening the local R&D of manufacturers. Addressing electricity problems in Nigeria and encouraging the local manufacturing of APIs would improve local manufacturing. Thankfully, local manufacturing has received attention as EMZOR Pharmaceutical has partnered with WHO to begin the first-ever local manufacturing of APIs in Africa [21]. This effort should be imitated and adopted by other major local manufacturers on the continent, which would, in turn, increase the level of activities in R&D for innovative drug discovery, drug design, and drug development.

4.5 Recommendations

The ideas expressed in this paper suggest that Nigeria's pharmaceutical sector faces challenges primarily in R&D inefficiency, the academia-industry gap, and poorly regulated pharmaceutical importation. These problems can be resolved by increasing capital investment, expanding research partnerships, and implementing policies to reduce administrative hurdles in pharmaceutical manufacturing and importing. To enhance the alignment between pharmacy education and industry, multiple suggestions have been made. Faculty training should prioritize creative teaching techniques, and current pharmacy programs should be assessed for efficiency. Identifying and addressing curriculum discrepancies that meet industry demands is crucial. Stakeholders are urged to implement suggested solutions to enhance industrial learning experiences for students. The government should promote domestic pharmaceutical production through tax incentives and financial assistance. Improving hands-on research opportunities in pharmacy programs is also essential. Collaboration among stakeholders is vital for sustainable advancements.

5. CONCLUSION

There are significant barriers to innovation in pharmacy practices in areas of research and development, pharmacy education, and industrial manufacturing. The proposed solution and recommendations are aimed at addressing the issues and paving the way for overall improvement in Nigeria's pharmaceutical sector. Future research should focus on sub-sector challenges and how they could be adequately addressed.

Acknowledgement: None

Conflict of Interest: No conflict of interest was observed between the three Authors

Contribution of the Authors:
Douglas Joshua conceptualised the idea. Douglas Joshua and Dike Ujunwa developed the structure of the manuscript. Douglas Joshua, Dike Ujunwa, and Diovu Charles were involved in searching for literature and writing the original manuscript. Dike Ujunwa reviewed the manuscript and made necessary corrections. All three authors reviewed and revised the final manuscript and approved it for submission.

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