

Strategic Alignment of Saudi Pharmacy Education and the Pharmaceutical Industry: A Document-Based SWOT and Matrix Evaluation under Vision 2030

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ABSTRACT

Objectives: This study aimed to conduct a comprehensive strategic evaluation of Saudi Arabia's pharmaceutical industry in relation to pharmacy education, with a focus on industrial localization, regulatory capacity, and curricular alignment. The objective was to identify structural strengths, performance gaps, and opportunities for harmonizing academic outputs with industrial demands. **Materials and Methods:** A document-based Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis framework was employed, incorporating Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) matrices. Primary source documents were purposively selected, including national policy strategies such as Vision 2030, the National Industrial Development and Logistics Program (NIDLP), and the Health Sector Transformation Program (HSTP); pharmacy college curricula from 27 institutions; regulatory reports; and pharmaceutical market forecasts. Thematic extraction and qualitative scoring were used to construct matrices and generate actionable strategies. **Results:** The IFE and EFE scores were 2.82 and 2.84 respectively, reflecting moderate internal and external readiness. Strengths included strong governmental support, regulatory reforms, and market expansion forecasts. Weaknesses were concentrated in the academic sector, including limited industrial content in pharmacy curricula, low student interest in non-clinical careers, and fragmented academia-industry linkages. External opportunities included import substitution, export growth, and investment in biosimilars, while threats involved limited capacity for biologics manufacturing, workforce shortages, and regional competition. **Conclusion:** Saudi Arabia's pharmaceutical sector demonstrates clear momentum toward self-sufficiency and industrial growth. However, academic institutions, particularly pharmacy colleges, must undergo structural reform to better support this transition. Aligning curricula with industrial competencies, embedding experiential learning, and strengthening research-industry collaboration are critical for sustaining long-term development.

Keywords: Pharmaceutical Industry, Pharmacy Education, Saudi Arabia, Strategic Analysis, SWOT, Curriculum Alignment.

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INTRODUCTION

The pharmaceutical industry is a vast, innovation-driven global enterprise, with annual revenues exceeding \$1.6 trillion worldwide (Ilhan, 2025). This sector plays a crucial role in public health and economic development by discovering, manufacturing, and supplying medicines, vaccines, and biotechnological therapies. In recent years, Saudi Arabia's pharmaceutical industry has emerged as the largest in the Arab region, fueled by a growing population, a rising burden of chronic diseases, and substantial government investment in healthcare. Saudi pharmaceutical expenditure expanded from SAR 14 billion in 2012 to SAR 40 billion in

2023, reflecting robust market growth. Despite this expansion, Saudi Arabia historically relied on imports for roughly 70% of its medicinal needs, with local manufacturers meeting only about 30% of domestic demand. This import dependence has been recognized as a strategic vulnerability - especially evident during global crises - and a missed economic opportunity for local value creation (Alshehri *et al.*, 2023). As a result, the Saudi government has designated the pharmaceutical and biotechnology sectors as priority areas for localization and development under its national transformation agenda, Vision 2030 (International Trade Administration, 2024).

Launched in 2016, Vision 2030 is a comprehensive blueprint for diversifying Saudi Arabia's economy and fostering a "thriving economy" built on knowledge and innovation (Global Business Outlook, 2024). Within this framework, the pharmaceutical and biotech industries are seen as strategic sectors for achieving



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self-sufficiency in healthcare and for contributing to non-oil GDP growth (Arab News, 2024). To catalyze progress, Vision 2030 is supported by a set of Vision Realization Programs and initiatives that directly or indirectly bolster the life sciences domain. Notably, the Health Sector Transformation Program (HSTP) aims to modernize healthcare services and infrastructure, creating demand for high-quality medicines while encouraging private-sector participation in health care. The National Industrial Development and Logistics Program (NIDLP), launched in 2019, focuses on developing Saudi Arabia into an industrial powerhouse and global logistics hub. It explicitly including the pharmaceutical industry as a target for industrial localization and cluster development (Fathelrahman *et al.*, 2022). Aligned with this, the government has set ambitious localization targets: for example, increasing domestic pharmaceutical manufacturing from roughly 20% of the market to 40% by 2030, thereby reducing import dependency from 70% to 30% (Global Business Outlook, 2024). Achieving a 40% local production share is expected to enhance national drug security and stimulate the growth of local manufacturers, which as of the 2020s number over 40 companies but previously supplied only a quarter of the country's medicines (Alshehri *et al.*, 2023). To support these goals, extensive investment incentives and local manufacturing support have been introduced. The Saudi Food and Drug Authority (SFDA) has streamlined regulatory pathways. For instance, granting priority review and faster registration for locally made drugs (often under one year) compared to imported products. Furthermore, government procurement via the National Unified Procurement Company (NUPCO) now favors companies with higher local content, encouraging multinationals to localize production in order to win tenders (IQVIA Me Consulting, 2022). These policies have already attracted leading multinationals: companies like Pfizer, GlaxoSmithKline, Novartis and Sanofi have established joint ventures or local manufacturing facilities, signalling confidence in Saudi Arabia's vision to become a regional pharmaceutical hub (Global Business Outlook, 2024). The Public Investment Fund (PIF) has also launched Lifera, a state-owned pharma and biotech investment company, to produce essential drugs (e.g. insulin, vaccines, monoclonal antibodies) domestically via partnerships with global firms (London Premier Centre, 2023). Such initiatives underscore the high-level strategic importance placed on building an indigenous pharmaceutical and biotechnological capacity.

Another pillar of this transformation is the development of human capital and research capabilities. The Human Capability Development Program (HCDP) under Vision 2030 is aligning education and training with the needs of emerging industries, including pharmaceuticals (Fathelrahman *et al.*, 2022). Saudi Arabia's number of pharmacy colleges has expanded dramatically in the past two decades from 1 college in 2000 to nearly 30 by the late 2010s, producing hundreds of pharmacy graduates annually to supply the workforce (AlRuthia *et al.*, 2018). These academic institutions and their affiliated research centers are expected to

play an important role in advancing Vision 2030 goals, not only by graduating skilled pharmacists and pharmaceutical scientists, but also by contributing to drug research and innovation. Indeed, Vision 2030's emphasis on a knowledge economy has spurred universities to improve program quality and pursue international accreditation (e.g. several pharmacy programs are now certified by the US Accreditation Council for Pharmacy Education) to ensure graduates meet global standards. Critically, the Vision 2030 programs collectively direct pharmacy education toward greater industry engagement: stakeholders recognize that pharmacy schools must incorporate industrial pharmacy training, entrepreneurship, and RandD skills so that graduates can effectively work in pharmaceutical manufacturing, regulation, and research roles, not only in clinical settings (Fathelrahman *et al.*, 2022). In parallel, the newly established Research, Development and Innovation Authority (RDIA) coordinates national R&D efforts and funding, with health and biotechnology identified as top priority domains (UK Science and Innovation Network, 2021). By strengthening research collaborations and supporting innovation grants, the RDIA and initiatives like the National Biotechnology Strategy (NBS) aim to enhance local biotechnology capacity, for example by achieving self-sufficiency in vaccines and biomanufacturing, and by creating thousands of high-skilled jobs in the life sciences (Arab News, 2024).

Collectively, these national strategies and support mechanisms provide a strong foundation for advancing Saudi Arabia's pharmaceutical sector. The government's multi-faceted approach, which includes reforming regulations, incentivizing local production, investing in talent and innovation, and integrating healthcare reforms, is designed to cultivate a competitive pharmaceutical and biotech industry that serves national health needs and contributes to economic diversification. Academic institutions, especially colleges of pharmacy, are both beneficiaries of and key contributors to this agenda: through updated curricula, research initiatives, and partnerships with industry and regulators, they are instrumental in developing the human capital and knowledge base required for a thriving local industry (PriceWaterhouseCoopers, 2025) (Fathelrahman *et al.*, 2022).

This study aims to conduct a strategic evaluation of Saudi Arabia's pharmaceutical industry in relation to pharmacy education, with a particular emphasis on the alignment between academic curricula and national industrial priorities. In this context, the analysis focuses on how pharmacy colleges are contributing, or need to adapt, to support key national goals such as industrial localization, regulatory capacity building, and workforce readiness. By identifying structural strengths, performance gaps, and opportunities for harmonizing academic outputs with evolving market demands, the study provides insights into the role of pharmacy education in enabling sustainable pharmaceutical sector development. The findings are interpreted

in light of Vision 2030 and its associated initiatives, including NIDL, HSTP, HCDP, and RDIA, ultimately offering strategic recommendations to guide future academic reform and national policy alignment.

MATERIALS AND METHODS

This study employed a structured, multi-stage strategic evaluation model, adapted from prior frameworks applied in educational sector analyses (Almeman, 2020). The methodology was designed to systematically extract, assess, and synthesize Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) elements influencing the pharmaceutical and biotechnological industries in Saudi Arabia within the national Vision 2030 framework.

Document-Based Data Collection

A purposive sampling strategy was used to select official national strategy documents, educational curriculum datasets, regulatory publications, and pharmaceutical market forecasts. These included but were not limited to:

- Vision 2030 Foundational documents,
- HSTP reports,
- NIDL plans,
- NBS (2024),
- RDIA initiatives,
- A consolidated analysis of BSc pharmacy curricula across 27 Saudi colleges,
- SFDA Academy training program outlines,
- Market intelligence from IQVIA, Future Market Insights, and others.

Inclusion criteria required documents to be: (1) issued by government entities, regulatory bodies, or peer-reviewed sources, (2) published within the last ten years, and (3) directly relevant to pharmaceutical or biotechnological sector development in Saudi Arabia.

Analytical Framework

The analysis followed three stages:

Input Stage - SWOT Construction

Full-text document reviews were conducted using thematic coding to identify strategic factors. These were categorized into internal factors (e.g., regulatory capacity, academic programs, industrial infrastructure) and external factors (e.g., policy enablers, investment climate, market trends). Each factor was assigned a weight (0.0-1.0) based on relevance and prevalence in the reviewed sources.

Matching Stage - IFE and EFE Matrices

The identified internal strengths and weaknesses were organized into IFE matrix. Similarly, external opportunities and threats were structured into EFE matrix. Each factor was rated on a 1-4 scale (1=poor, 4=excellent performance or opportunity exploitation). Weighted scores were then calculated. A total IFE score of 2.82 and EFE score of 2.84 indicated moderate strategic alignment and external responsiveness.

Decision Stage - Strategic Matrix Synthesis

- The SWOT matrix was constructed by cross-mapping internal and external factors to generate actionable strategies:
- **SO (Strength-Opportunity):** e.g., utilizing government programs to expand biopharma ecosystems,
- **WO (Weakness-Opportunity):** e.g., reforming pharmacy curricula to align with industry demands,
- **ST (Strength-Threat):** e.g., using infrastructure investments to reduce biologics import reliance,
- **WT (Weakness-Threat):** e.g., embedding experiential industry rotations in academic programs.

All matrices were developed through qualitative matrix mapping rather than survey-based consensus scoring, distinguishing this approach as a policy-driven strategic document analysis.

RESULTS

IFE Matrix

IFE Matrix was constructed using data extracted from national policy documents, strategic plans, institutional reports, and scientific literature to assess internal strengths and weaknesses relevant to the Saudi pharmaceutical and biotechnological sectors. A total of ten factors, five strengths and five weaknesses, were identified and assigned weights based on their relative importance. Each factor was then rated on a scale of 1 to 4 to reflect the degree of effectiveness in addressing the factor (1=major weakness, 4=major strength). The total weighted score for internal factors was calculated as 2.82, indicating a moderate level of internal strategic advantage (see Table 1).

External Factor Evaluation (EFE) Matrix

The External Factor Evaluation (EFE) Matrix was developed using insights from national transformation programs, economic reports, and pharmaceutical market forecasts to identify external opportunities and threats affecting the sector. Each factor was weighted based on its potential impact and rated on a scale of 1 to 4 (1=major threat, 4=major opportunity). The total EFE score was 2.84, suggesting the presence of multiple promising opportunities, albeit moderated by external risks (see Table 2).

SWOT Matrix

The SWOT matrix was developed by matching internal and external factors to generate strategic insights (Table 3). Key opportunities were aligned with strengths (SO strategies), while weaknesses were mapped against opportunities (WO), strengths (ST), and threats (WT).

This multi-dimensional matrix offers insights that may support ongoing efforts to align pharmaceutical development with Vision 2030's industrial, healthcare, and human capital priorities.

DISCUSSION

Vision 2030 Alignment and Government Support as a Sector Strength

Saudi Arabia's pharmaceutical and biotechnology sectors are being reshaped by the strategic vision and policy frameworks laid out in Vision 2030. The Vision prioritizes economic diversification, local manufacturing, and healthcare transformation, which are key enablers for pharmaceutical growth. Government-led initiatives such as the Health Sector Transformation Program (HSTP), the National Industrial Development and Logistics Program (NIDLP), and the National Biotechnology Strategy offer institutional support that distinguishes Saudi Arabia from regional peers (Saudi Vision 2030, 2016) (Saudi Vision 2030,

2021) (NIDLP, 2021). For instance, the NIDLP's contribution to pharmaceutical industrial zones and GMP-certified readiness directly addresses infrastructure gaps, as highlighted in the EFE Matrix findings. The National Biotechnology Strategy's focus on biosimilars, vaccines, and genomics reflects alignment with global pharmaceutical trends (Saudi Vision 2030, 2024).

The Health Sector Transformation Program has contributed significantly to reshaping the health and pharmaceutical landscape by integrating drug manufacturing into healthcare system development, establishing oncology centers, and building clinical research hubs (Saudi Vision 2030, 2024). Furthermore, the SFDA's institutional strengthening through initiatives such as the SFDA Academy reflects growing regulatory maturity (SFDA, 2025). These findings, drawn from document analysis, confirm that high-level government alignment with Vision 2030 enhances both market attractiveness and readiness for advanced therapeutic innovation.

Industrial Localization and Sector Performance in Light of Vision 2030 Goals

The findings indicate that while 70% of drugs are still imported, localization efforts have gained momentum. The Saudi pharmaceutical market is forecasted to expand from USD 10.1 billion in 2024 to USD 16.8 billion by 2034, fueled by chronic

Table 1: IFE Matrix for the Saudi Pharmaceutical and Pharmacy Education Sectors: Strengths and Weaknesses Analysis.

Internal Factors	Weight	Rating	Weighted Score
Strategic alignment of the national pharmaceutical sector's policy direction, industrial objectives, and regulatory reforms with Vision 2030 and its sectoral programs (NIDLP, HSTP, NBS).	0.15	4	0.60
Strong governmental support through national initiatives (NIDLP, HSTP, and NBS), facilitating investment and infrastructure development.	0.12	4	0.48
Expansion of SFDA Academy programs and increased regulatory capacity to support domestic industry standards and compliance.	0.10	3	0.30
Robust pharmaceutical market growth forecast (USD 10.1B to 16.8B by 2034), indicating increased investment potential and sector confidence.	0.10	3	0.30
Establishment of advanced pharmaceutical manufacturing zones and provision of financial incentives to attract local and multinational firms.	0.08	3	0.24
Limited incorporation of industry-relevant content (e.g., Good Manufacturing Practice (GMP), regulatory sciences) in pharmacy college curricula.	0.12	2	0.24
Low student interest in industrial pharmacy careers (only 10.9%), reflecting educational and awareness gaps.	0.08	2	0.16
Shortage of academic faculty specialized in biopharmaceutical manufacturing and regulatory sciences.	0.08	2	0.16
Inconsistent implementation of the national pharmacy competency framework across institutions.	0.09	2	0.18
Weak coordination mechanisms between academia and pharmaceutical industry, hindering experiential learning and innovation transfer.	0.08	2	0.16
Total	1.00		2.82

Table 2: EFE Matrix for the Saudi Pharmaceutical and Pharmacy Education Sectors: Opportunities and Threats.

External Factors	Weight	Rating	Weighted Score
Vision 2030, NIDL, HSTP, and NBS collectively promote pharmaceutical sector growth through national policy alignment and investment priorities.	0.15	4	0.60
High potential for import substitution as 70% of pharmaceuticals are currently imported, indicating opportunities for local manufacturing expansion.	0.12	4	0.48
Public-private financing mechanisms (e.g., the Saudi Industrial Development Fund, PIF, and national tenders) support industrial growth and investment in infrastructure.	0.10	3	0.30
Strategic MENA positioning and increasing GMP readiness enable Saudi Arabia to become a regional export hub for pharmaceuticals.	0.10	3	0.30
Emergence of biotechnology subsectors such as biosimilars, oncology, and precision medicine offers new growth avenues.	0.10	3	0.30
Limiting capacity and emphasizing the need for expanded investment in biopharma localization, as only 10% of established pharmaceutical manufacturers currently produce biologics.	0.12	2	0.24
Talent shortages in key areas such as regulatory science, bioprocess engineering, and quality assurance hinder rapid development.	0.10	2	0.20
Strong regional competition could impact market share and investment flow.	0.08	2	0.16
Geopolitical risks and continued dependency on imported pharmaceutical inputs pose threats to supply chain stability.	0.08	2	0.16
Fragmentation and complexity in the national RandD ecosystem limit effective translation of research into marketable products.	0.05	2	0.10
Total	1.00		2.84

disease prevalence, investment in biosimilars, and digital transformation (Future Market Insights, 2024). This projected growth supports the country's ambition to become a regional pharmaceutical hub.

Notably, localization is being driven by targeted public-private partnerships and financing mechanisms. The role of entities such as SIDF and PIF in underwriting pharmaceutical infrastructure projects highlights the robustness of the Vision 2030 economic model (Tawfik *et al.*, 2022). Multinational collaborations such as Boehringer Ingelheim's strategic entry into local biopharmaceutical production demonstrate growing international confidence.

However, the limited capacity for biologics manufacturing remains a critical constraint. Fewer than 10% of facilities are currently capable of producing advanced biologics, underscoring the need for infrastructure modernization and specialized talent development (IQVIA Me Consulting, 2022). Yet, this gap is viewed constructively within the national strategy as an investment opportunity rather than a barrier.

Education, Talent Development, and the Role of Pharmacy Colleges

The strategic development of the pharmaceutical industry is closely linked to the educational readiness of future professionals. The results revealed major inconsistencies across Saudi pharmacy curricula in areas such as industrial pharmacy, GMP, and regulatory sciences. Many programs remain heavily clinically oriented, with insufficient alignment to national industrial competency frameworks (Alfaifi *et al.*, 2022). In a national comparison of study plans, the majority of colleges lacked mandatory experiential training in pharmaceutical manufacturing or regulatory pathways.

This mismatch contributes to low student interest in industry roles with only 10.9% expressed intent to join pharmaceutical companies (Bin Saleh *et al.*, 2015). Faculty shortages in industrial disciplines may further restrict the ability of institutions to bridge this gap. These findings present a clear opportunity for pharmacy colleges to reform study plans to incorporate industry-relevant training, utilising the national competency framework and aligning with SFDA initiatives.

Table 3: Strategic SWOT Matrix Integrating Internal and External Factors to Guide Academic-Industrial Alignment in the Saudi Pharmaceutical Sector.

Matrix	Strategy Description
SO	Leverage Vision 2030 and NIDL zones to expand biopharma clusters and biotech parks.
	Align SFDA Academy programs with NBS targets for advanced skill development.
	Use SIDF and government tenders to incentivize local production of advanced therapies.
WO	Reform pharmacy curricula by embedding GMP, regulatory science, and biotech manufacturing into core and elective modules.
	Strengthen university-industry partnerships for experiential learning and industrial internships.
ST	Utilize HSTP and NIDL to enhance domestic biomanufacturing infrastructure and reduce import reliance.
	Develop specialized training tracks in regulatory affairs, QC/QA, and advanced therapy development.
WT	Embed mandatory industry rotations in pharmacy education to mitigate skill gaps.
	Establish faculty development fellowships with industry and regulatory bodies.

Academia-Industry-Government Collaboration and Innovation Capacity

The findings also indicate that innovation capacity and research commercialization remain underdeveloped within the academic sector. Despite the availability of government funding, many institutions lack formalized Technology Transfer Offices (TTOs), Intellectual Property (IP) policies, and dedicated translational research centers focused on pharmaceutical and biotechnological advancements (Alfaifi *et al.*, 2022).

RDIA is well-positioned to address this gap by coordinating competitive grant mechanisms, incubator programs, and public-private co-investment models to establish robust applied R&D ecosystems (RDIA, 2025). Furthermore, enhanced integration with SFDA's regulatory science platforms could streamline the path from innovation to market. In parallel, the SFDA Academy and its specialized training initiatives contribute to regulatory preparedness and workforce development. These programs may be strategically scaled to address sector-wide skill shortages in Quality Assurance (QA), Quality Control (QC), biomanufacturing, and clinical trial oversight (SFDA, 2025).

Strategic Role of Pharmacy Colleges in Advancing Vision 2030

The realization of Saudi Arabia's Vision 2030 ambitions in the pharmaceutical and biotechnology sectors is intrinsically linked to the responsiveness and strategic alignment of academic institutions, particularly colleges of pharmacy. These institutions serve as critical enablers in developing a competent, innovation-driven pharmaceutical workforce and in bridging existing gaps between education and industry.

To strengthen their contribution to national pharmaceutical localization and innovation goals, the following priority areas are proposed:

Curricular Alignment with Industrial Needs

Pharmacy education programs require comprehensive revision to incorporate industrial pharmacy modules, GMP principles, and regulatory sciences as integral components. This alignment would strengthen graduate competencies and better prepare students for evolving roles in pharmaceutical manufacturing and regulation.

Academic Workforce Development

Nationally coordinated initiatives, such as academic fellowships, faculty development programs, and structured industry-academia exchanges, are essential for equipping educators with specialized expertise in pharmaceutical manufacturing and biotechnology.

Industry-Oriented Experiential Training

To enhance pharmacy graduates' readiness for industrial roles, colleges of pharmacy should partner with pharmaceutical manufacturers, Contract Development and Manufacturing Organizations (CDMOs), and regulatory authorities to embed structured internships and hands-on industrial training within the academic curriculum.

Talent Pipeline Reinforcement

Early exposure to pharmaceutical industry career tracks, coupled with incentive mechanisms such as SFDA-supported training programs and competitive scholarships, may enhance graduate interest and retention in non-clinical domains of pharmacy practice.

Enhancing Innovation and Technology Transfer Capacity

Institutionalizing TTOs, research incubators, and commercialization units within pharmacy colleges, underpinned

by collaboration with the Research, RDIA, could accelerate the translation of academic research into market-ready products.

Institutional Partnerships and Sectoral Integration

Strategic partnerships between academia and industry, facilitated through jointly funded research centers, collaborative innovation groups, and interdisciplinary degree programs, would strengthen national capacity for biopharmaceutical innovation.

Colleges of pharmacy possess a strategic opportunity to advance Saudi Arabia's pharmaceutical and biotechnology sectors by implementing curricular reforms, investing in faculty development, and fostering deeper collaboration with industry stakeholders. Vision 2030 and its associated programs offer a timely and comprehensive framework for academic institutions to align with national priorities, contribute to pharmaceutical localization, and elevate the Kingdom's global standing in pharmaceutical education and innovation.

LIMITATIONS

This study employed a document-based strategic evaluation framework, which is well-suited for health policy analysis but inherently dependent on the availability, scope, and quality of the selected documents. While the weighting and scoring in the SWOT, IFE, and EFE matrices involved thematic judgment, they were informed by triangulated data from 27 pharmacy curricula, multiple national strategies, and official regulatory reports to enhance objectivity and analytical rigor. Nevertheless, the absence of direct stakeholder input, such as through Delphi methods or empirical validation, may limit the generalizability of specific scoring outcomes. In addition, the study did not evaluate the real-time implementation of the proposed reforms. Future research should consider integrating stakeholder perspectives and employing longitudinal designs to assess the practical impact of Vision 2030 initiatives in real-world settings.

CONCLUSION

This study has provided a comprehensive strategic evaluation of the alignment between Saudi Arabia's pharmaceutical industry and pharmacy education through a document-based SWOT analysis framework supported by IFE and EFE matrices. The findings underscore a clear national momentum towards pharmaceutical localization and biotechnological advancement, enabled by Vision 2030's policy instruments and supported by regulatory and financial infrastructure. However, the analysis also reveals critical structural gaps within academic institutions, particularly in curriculum design, experiential training, and faculty specialization, that must be addressed to realize the full potential of this industrial transformation.

Pharmacy colleges play an indispensable role as catalysts of human capital development, yet their current orientation remains largely clinical, with insufficient integration of regulatory science,

GMP, and industrial competencies. The misalignment between educational outputs and industrial needs not only hinders workforce readiness but also constrains innovation capacity. The proposed strategic directions, including curricular reform, industry-oriented internships, faculty development, and research commercialization infrastructure, offer actionable pathways for closing this gap.

To ensure long-term sustainability, the integration of pharmacy education with national pharmaceutical strategy must be institutionalized through formalized academia-industry-government partnerships. These partnerships should be grounded in shared metrics, co-funded research, and harmonized competency frameworks that reflect both global best practices and local aspirations. By advancing these reforms, Saudi Arabia can strengthen its position as a regional leader in pharmaceutical manufacturing, regulatory excellence, and innovation, contributing meaningfully to economic diversification, public health resilience, and scientific advancement under Vision 2030.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

CBAHI: Saudi Central Board for Accreditation of Healthcare Institutions; **CDMO:** Contract Development and Manufacturing Organization; **EFE:** External Factor Evaluation; **GMP:** Good Manufacturing Practice; **HCDP:** Human Capability Development Program; **HSTP:** Health Sector Transformation Program; **IFE:** Internal Factor Evaluation; **IP:** Intellectual Property; **KSA:** Kingdom of Saudi Arabia; **MOH:** Ministry of Health; **NBS:** National Biotechnology Strategy; **NCAAA:** National Center for Academic Accreditation and Assessment; **NIDL:** National Industrial Development and Logistics Program; **NUPCO:** National Unified Procurement Company; **PIF:** Public Investment Fund; **QA:** Quality Assurance; **QC:** Quality Control; **RDIA:** Research, Development and Innovation Authority; **R&D:** Research and Development; **SFDA:** Saudi Food and Drug Authority; **SIDF:** Saudi Industrial Development Fund; **SWOT:** Strengths, Weaknesses, Opportunities, and Threats; **TTO:** Technology Transfer Office.

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