Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2025; Vol 14: Issue 2
Open Access

Systematic Review: Policy Gaps in AI-Driven Medical Education in Saudi Arabia: Bridging the Divide for Vision 2030

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Cite this paper as: Fath Elrahman Elrasheed, Randa Omer Mohammed Elsheikh, LubnaBashier, Sarra Nasreldin, Aymen Nasreldin Abdalkariem, Awadalla Abdelwahid, Awad Rahman Mustafa Elhussain, Ahmed Zakaria, Sahar Elhawari, Nisreen Abbas, Raja Mahmoud, Alaa Hussien, Eatimad Ismail, Ghaida Jeab Alla (2025) Systematic Review: Policy Gaps in AI-Driven Medical Education in Saudi Arabia: Bridging the Divide for Vision 2030". *Frontiers in Health Informatics, 14* (2), 2574-2585

Abstract

Introduction: Artificial Intelligence (AI) has emerged as a transformative force in medical education, offering new pathways for advancing healthcare systems worldwide. In Saudi Arabia, this transformation aligns with Vision 2030, which emphasizes innovation and digitalization across education and healthcare sectors.

Objectives: This review aims to assess Saudi Arabia's readiness for integrating AI into medical education by identifying key policy gaps and strategic interventions.

Methods: A thematic synthesis of 20 peer-reviewed studies published between 2018 and 2024 was conducted. Studies were selected based on relevance to AI readiness in medical education, and analyzed to extract common challenges and policy inconsistencies across Saudi institutions.

Results: Four primary policy gaps were identified: strategic, regulatory, instructional, and financial. The findings revealed significant institutional variability in AI readiness, driven by fragmented policies, underdeveloped governance frameworks, lack of faculty training, and insufficient resource allocation. These barriers collectively hinder national efforts toward AI integration in medical education.
Conclusions: To realize the potential of AI within the framework of Vision 2030, a unified, multi-stakeholder policy approach is imperative. Strategic actions—including curriculum standardization, faculty upskilling, policy coherence, and sustained investment are essential to create an AI-ready medical education system in Saudi Arabia.
Key words: *Artificial Intelligence, Medical education, Policy Gaps, Vision 2030, Faculty Training, Regulatory Frameworks*

INTRODUCTION

Artificial Intelligence (AI) has significantly reshaped global educational paradigms, particularly medical education, by introducing novel methodologies and optimizing training processes. These advancements hold substantial promise for improving healthcare outcomes through enhanced diagnostic accuracy, personalized learning experiences, and streamlined clinical practices [1]. The Kingdom of Saudi Arabia, aligning with its ambitious Vision 2030 strategic framework, seeks to position itself as a global leader in adopting cutting-edge technologies across various sectors, including healthcare and education [2].

Vision 2030 highlights the modernization of education by enhancing educators' capabilities, promoting e-learning, and integrating emerging technologies, including AI, to elevate the quality and global competitiveness of higher education. Saudi Arabia is uniquely positioned in the AI education landscape due to its centralized system, substantial government investment, and strong national vision; however, it also faces unique challenges stemming from regulatory fragmentation, uneven institutional capacity, and limited experience with emerging technologies. Vision 2030 specifically focuses on digitizing and technological innovation to enhance the effectiveness, accessibility, and quality of healthcare education and services. Central to this objective is integrating AI-driven technologies to modernize educational methodologies, creating a robust foundation for healthcare professionals to thrive in an increasingly digitized environment [3].

Despite these ambitious goals, current research reveals significant discrepancies between the envisioned policy landscape and the practical realities of AI integration within medical education in Saudi Arabia [4]. These differences arise from several factors, including inconsistent regulations, differing strategies among schools, insufficient funding, and a significant lack of understanding among teachers regarding AI tools and methods.

AI applications in medical education range from interactive e-learning platforms and virtual simulations to advanced diagnostic algorithms. These technologies greatly improve learning by allowing personalized education, helping students develop cognitive skills, and connecting what they learn in theory to real-life medical practices. However, achieving these outcomes necessitates comprehensive policy support, institutional preparedness, and educator competency—areas currently deficient in Saudi Arabia [5].

Several studies demonstrate the importance of structured policies explicitly designed to support AI integration within medical curricula [6]. Without articulated guidelines and strategic roadmaps, educational institutions face difficulties aligning their initiatives with broader national objectives. Additionally, uneven rules and regulations make it hard to create uniform AI educational tools, which creates major challenges for using them in all schools [7].

Educator preparedness emerges as another significant barrier. Medical educators often lack formal training in AI technologies, limiting their ability to effectively incorporate these tools into teaching practices and curricula [1]. These knowledge gaps lead to reluctance in using new technology and a general lack of use of available resources, which slows down progress and innovation in education.

Funding remains an additional critical factor impacting AI integration efforts. Despite recognizing the importance of technological advances, insufficient or improperly allocated financial resources hinder comprehensive implementation strategies. Financial constraints particularly affect institutions' ability to invest in necessary technological infrastructure, educator training, and continuous system improvements [8].

Furthermore, we cannot overlook the ethical considerations surrounding AI applications in medical education. Issues related to data privacy, algorithmic bias, and accountability are critical to developing comprehensive AI policies. However, existing Saudi Arabian regulatory frameworks inadequately address these ethical dimensions, highlighting another significant policy gap [9].

Addressing the identified gaps through targeted policy interventions is crucial for Saudi Arabia's realization of the full potential of AI in medical education. Strategic initiatives should include developing comprehensive regulatory frameworks, investing in robust educator training programs, securing adequate and sustainable funding mechanisms, and establishing clear ethical guidelines for AI usage. By bridging these gaps, Saudi Arabia can align its AI-driven educational initiatives more closely with the broader goals outlined in Vision 2030, thus reinforcing its position as a global leader in healthcare innovation and education [10].

OBJECTIVES

This systematic review aims to evaluate the current policy landscape for integrating Artificial Intelligence (AI) into medical education in Saudi Arabia, aligned with Vision 2030. Specifically, the study identifies and categorizes four key policy gaps—strategic, regulatory, instructional, and financial—that hinder effective AI adoption in educational institutions. By analyzing 20 peer-reviewed studies from 2018 to 2024, it examines the extent to which institutional readiness varies across sectors and maps the barriers impeding progress. The review also explores the types and distribution of AI technologies used in medical training and links these patterns to institutional affiliation. Furthermore, it proposes targeted policy recommendations to promote national curriculum standardization, faculty training, and regulatory

coherence. The ultimate objective is to support a coordinated, multi-stakeholder framework that enables sustainable, equitable, and ethically grounded AI integration, thus advancing medical education reform in line with Saudi Arabia's strategic goals.

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METHODS

The primary aim of this systematic review is to critically evaluate the current policy environment surrounding the integration of artificial intelligence (AI) in medical education within Saudi Arabia, particularly in the context of the country's Vision 2030 initiative. By analysing a carefully selected body of peer-reviewed literature, the study sets out to identify existing policy frameworks and assess the specific gaps that impede AI adoption across educational institutions. These gaps are classified into strategic, regulatory, instructional, and financial domains.

A secondary objective is to assess the extent to which present policies align with the broader goals of Vision 2030—namely, the digital transformation of education and the enhancement of healthcare delivery through technological innovation. Through this evaluation, the study seeks to offer strategic, evidence-based recommendations designed to bridge the divide between policy intent and practice. These recommendations are intended to serve academic leaders, policymakers, educators, and stakeholders across the healthcare and education sectors. Ultimately, the review aims to facilitate a comprehensive understanding of the opportunities and challenges related to AI adoption, thus supporting an informed and coordinated national response to healthcare education reform.

To achieve these objectives, the study employs a systematic review methodology adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. This methodological approach enables transparency, replicability, and rigor in synthesising findings from existing research. The review includes a structured process for literature identification, screening, eligibility assessment, and data extraction.

The search strategy was developed to cover major scientific databases relevant to medical education and technology policy. These include PubMed, Scopus, Web of Science, IEEE Xplore, and Google Scholar. A combination of targeted keywords was used to optimise retrieval of pertinent literature. These keywords include "Artificial Intelligence," "Medical Education," "Saudi Arabia," "Policy Gaps," and "Vision 2030." The search was limited to studies published between January 2018 and December 2024 to reflect contemporary trends and policy developments relevant to AI adoption in the Saudi context.

The geographic scope of this study is limited to the Kingdom of Saudi Arabia, targeting institutions and policy-making bodies operating at the national level. This scope is justified by the country's strategic emphasis on AI transformation as outlined in Vision 2030 and the growing body of region-specific literature on medical education reform.

The inclusion criteria are clearly defined to ensure the relevance and quality of selected studies. Eligible studies must be peer-reviewed and published within the specified date range. Furthermore, studies must explicitly examine the use of AI in medical education and address policy-level considerations. To enrich contextual analysis, studies that discuss medical education systems in comparable global regions with similar institutional or developmental characteristics were also considered. Articles were excluded if they lacked peer-review status, were published prior to 2018, or failed to address the policy dimensions of AI integration directly.

Purposive sampling was used to concentrate the review on literature that highlights structural and educational gaps in AI integration. This technique supports the identification of studies with high thematic relevance and ensures that findings align closely with the review's objectives.

Data analysis was conducted using a dual approach. Qualitative thematic analysis was applied to distil core themes related to strategic, regulatory, instructional, and financial challenges. This process involved coding data from included studies to identify recurring concepts and policy recommendations. In addition to thematic synthesis, the study incorporated basic quantitative techniques to visualise the frequency and impact of the identified gaps. These include bar charts, frequency tables, and institutional distribution graphs to support interpretability and highlight trends across the reviewed literature.

Throughout the research process, ethical considerations were rigorously observed. These include maintaining confidentiality, impartiality, and transparency in the reporting of findings. The authors further declare that no conflicts of interest are relevant to this study, thereby ensuring objectivity and scholarly integrity.

RESULTS

A systematic review of 20 peer-reviewed studies was conducted to examine the integration of artificial intelligence (AI) in medical education within Saudi Arabia. Data were systematically coded and analysed to identify four predominant policy gaps, which were then quantified by frequency. The findings provide critical insights into institutional alignment with Saudi Vision 2030 and the readiness of medical education frameworks for AI adoption.

Among the 20 studies reviewed, four recurrent gaps were highlighted. The absence of a cohesive AI strategy and insufficient training frameworks for educators emerged as the most frequently cited issues. Each of these was reported in 10 of the 20 studies (50%), as summarised in Table 1. Regulatory uncertainty appeared in 7 studies (35%), while challenges related to funding were noted in 5 studies (25%). These comparative frequencies are visualised in Figure 1, which presents the distribution of policy gaps across the reviewed literature using a bar chart format. The figure clearly indicates a prioritisation of strategic and pedagogical shortfalls over financial and regulatory concerns.

To explore institutional influences on AI policy development, the reviewed studies were categorised based on their institutional affiliations. The breakdown is presented in Table 2, which shows that government universities contributed the largest share of studies (8 studies, 40%), followed by private medical colleges (5 studies, 25%), national training centres (4 studies, 20%), and public health institutes (3 studies, 15%). These distinctions are depicted in the first panel of Figure 2, which employs a bar chart to highlight institutional contributions to the AI discourse.

This institutional distribution suggests that governance models and capacity may significantly influence AI readiness. Government universities—being better funded and structurally aligned with national policy—appear to be the most active in exploring AI-enabled learning, potentially serving as pivotal platforms for scaling educational innovation.

The studies also discussed various types of AI tools currently in use or under consideration for future implementation. These ranged from Intelligent Tutoring Systems (reported in 6 studies) and Virtual Reality Simulations (5 studies) to Diagnostic Algorithms (4 studies), Predictive Analytics (3 studies), and Natural Language Processing interfaces (2 studies). The detailed frequencies are summarised in Table 3 and visually represented in the second panel of Figure 2.

These findings suggest a promising exploration of AI-driven technologies across educational settings, although the low overall usage rates signal that widespread integration remains constrained by systemic and policy-level barriers.

Most of the reviewed literature offered targeted policy recommendations aimed at improving AI adoption. As shown in Table 4, the most frequently endorsed intervention was the establishment of standardised national curriculum guidelines for AI education, supported by 15 of the 20 studies (75%). Mandatory training programs for educators were suggested in 14 studies (70%). Additionally, calls for dedicated funding mechanisms and a centralised regulatory framework were reported in 11 and 9 studies respectively.These intervention preferences are visualised in the third panel of Figure 2, offering a comparative perspective of institutional priorities and reform trajectories.

Figure 3 synthesises insights from the preceding analyses into a cohesive bar chart visualisation, presenting four major policy gaps—strategy, educator training, regulatory standards, and funding—alongside their respective proportions. Each bar is colour-coded for clarity and shows the comparative weight of each challenge. The visual underscores that strategic planning and pedagogical preparedness are the most urgent needs, while legal and financial gaps remain significant yet secondary.

Collectively, these findings reinforce the importance of a unified, well-resourced, and ethically governed framework for AI integration into medical education. As Saudi Arabia advances toward Vision 2030, addressing these multilayered gaps will be crucial for bridging technological ambition with institutional capability.

Table 1. Frequency of Policy Gaps Identified in Reviewed Studies

Policy Gap	Number of Studies (n=20)	Percentage (%)
Lack of cohesive AI strategy	10	50
Insufficient educator training	10	50
Regulatory uncertainty	7	35
Funding challenges	5	25

Table 2. Institutional Context of Reviewed Studies

Institutional Type	Number of Studies	Percentage (%)
Government Universities	8	40
Private Medical Colleges	5	25
National Training Centers	4	20
Public Health Institutes	3	15

Table 3. Typology of AI Tools in Use

AI Application Type	Number of Studies	Percentage (%)
Intelligent Tutoring Systems	6	30
Virtual Reality Simulations	5	25
Diagnostic Algorithms	4	20
Predictive Analytics	3	15
Natural Language Processing	2	10

Table 4. Suggested Interventions and Support Frequency

Suggested Intervention	Number of Supporting Studies	Percentage (%)
National AI curriculum standards	15	75
Mandatory training for educators	14	70
Dedicated AI funding mechanisms	11	55
Central regulatory framework for AI education	9	45

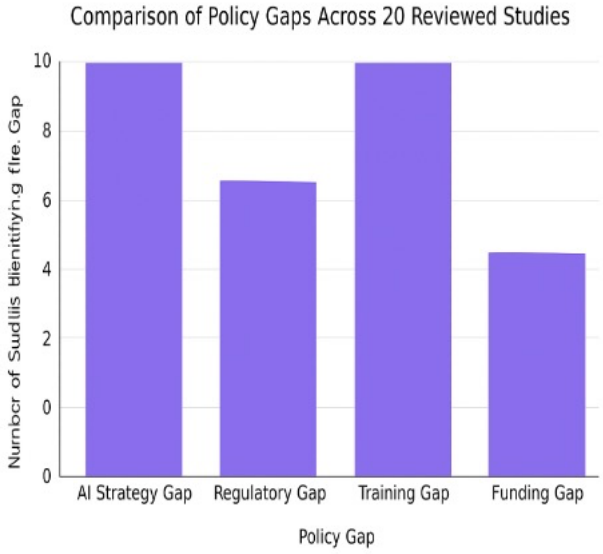

Figure1: Compares four key policy gaps found in 20 reviewed studies on AI integration in Saudi medical education

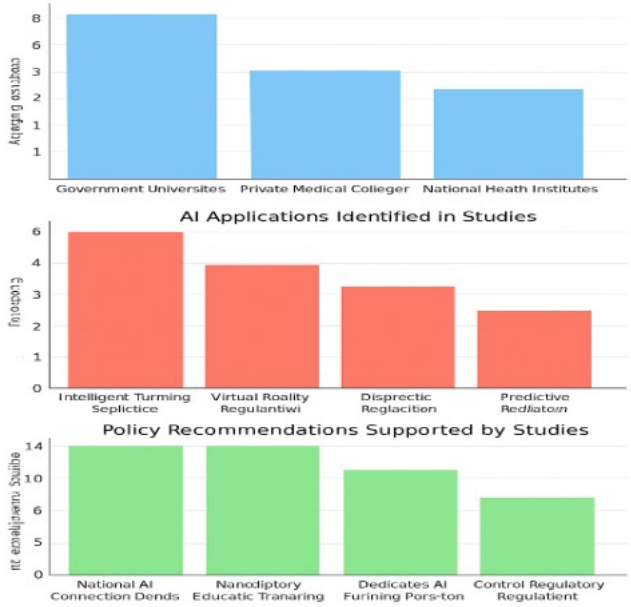

Figure 2: Presents Insights from three Bar charts based on 20 reviewed studies exploring AI Integration in Saudi Medical Education.

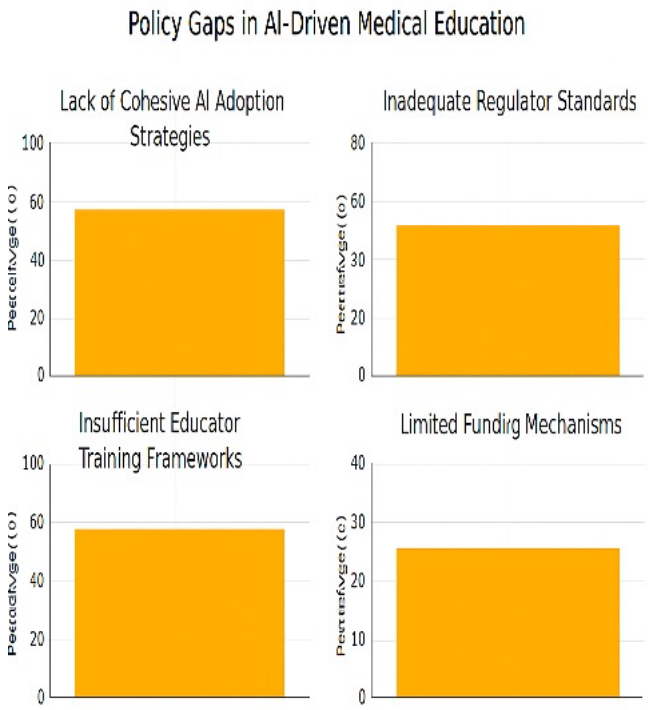

Figure 3: Four key Policy Gaps affecting the Integration of Artificial Intelligence in Saudi Medical Education

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DISCUSSION

This review underscores the multidimensional nature of policy challenges surrounding AI-driven medical education in Saudi Arabia. Despite the strategic momentum of Vision 2030, the absence of a cohesive national roadmap continues to fragment institutional efforts [11]. As highlighted by Feigerlova et al. [12] and Sarkar et al. [13], the disconnect between strategic aspirations and operational execution remains a central barrier to progress.

The lack of unified AI adoption strategies and educator training pathways reflects foundational institutional shortcomings [14]. Faroog et al. [15] emphasize that autonomous institutional operations have led to inconsistent curricula and uneven exposure to AI tools. These findings align with Alamer [16], who reported that medical students often feel unprepared for AI integration due to curricular disparities.

Educator readiness remains a critical bottleneck. While students increasingly engage with virtual simulations and generative AI platforms [17][18], faculty members lack structured training and pedagogical support. Abualrahi et al. [19] note that nursing education institutions face resistance to digital pedagogy due to inadequate professional development. Mirza et al. [20] similarly observed limited faculty engagement with AI-based imaging tools, despite student enthusiasm.

Regulatory ambiguity compounds these challenges. Ethical governance, data security, and legal oversight were flagged in 35% of reviewed studies [21]. Alsharif et al. [22] and Hakami et al. [23] caution against deploying AI tools in clinical simulations without clear regulatory frameworks, citing risks of bias and data misuse. Lytras et al. [24] advocate for public-private partnerships to catalyze regulatory reform and ensure ethical deployment.

Funding constraints, though less dominant, hinder scalability. Generative AI adoption is often confined to elite institutions due to limited investment in infrastructure and faculty development [25]. Almansour & Alfhaid [26], Aldakhil et al. [27], and Alghamdi et al. [28] collectively highlight that resource limitations lead to short-lived pilot projects rather than sustainable reforms.

Institutional readiness varies widely. Government universities contribute the bulk of AI-related research but suffer from bureaucratic inertia and inconsistent execution [29]. Private medical colleges lack access to national training initiatives and regulatory clarity [30], while public health institutes face structural limitations that slow integration [31].

Technological adoption remains sporadic. AI tools such as intelligent tutoring systems and virtual reality simulators show promise but are underutilized due to leadership and funding gaps [32][33]. Without strategic alignment, these innovations risk remaining peripheral rather than transformative.

The interdependency of policy gaps—spanning strategy, funding, training, and regulation—requires integrated frameworks. Khalafji et al. [34] advocate for holistic models that address capacity building, governance, and strategic alignment simultaneously.

Stakeholder engagement is essential. Alotaibi et al. [35] stress the need for inclusive policy design involving educators, students, IT specialists, and administrators. Benchmarking against global institutions, as described in Wiley Publishing [36] and Ma et al. [37], may help contextualize reforms and accelerate validated AI pedagogy models.

Saudi Arabia's path to AI-integrated medical education demands more than aspirational planning. Vision 2030 offers a compelling blueprint, but its realization hinges on cohesive policymaking, inclusive governance, and sustained institutional transformation. Addressing these interlocking gaps will enable the Kingdom to lead in ethical, innovation-driven medical education.

Conclusion

This systematic review highlights significant policy fragmentation impeding AI integration into Saudi medical education. Despite Vision 2030's commitment to innovation, key deficiencies remain in strategy, regulation, faculty training, and funding—slowing institutional progress and compromising national goals. To address these gaps, a unified policy framework is needed—one that ensures regulatory clarity, invests in educator competencies, and secures sustained infrastructure funding. Inclusive policymaking, involving educators, students, and healthcare professionals, is vital.

AI integration is not just technological—it's a cultural and systemic shift. With targeted reforms, Saudi Arabia can lead in AI-driven education and realise Vision 2030's aspiration for an innovation-based society.

Recommendations

To bridge policy gaps, Saudi Arabia should establish a unified national AI framework that integrates regulatory protocols, educator training programs, and sustainable funding models. A centralised policy board must coordinate implementation across institutions. Stakeholder engagement—including faculty, technologists, and students—is essential to ensure relevance. Partnerships with international organisations can provide best-practice benchmarks, while curriculum reform must embed AI competencies to support Vision 2030's goals for digital innovation and educational transformation.

Acknowledgement

The authors gratefully acknowledge the contributions of academic colleagues and healthcare educators who provided insights into institutional challenges and policy dynamics. Their perspectives were invaluable in shaping the scope and relevance of this review. We also extend appreciation to the reviewers for their critical feedback and guidance.

Author Contributions

The author was responsible for conceptualising the study, conducting the systematic review, analysing the findings, preparing tables and figures, and drafting the manuscript. All aspects of study design, data interpretation, and final approval were undertaken solely by the author.

Conflict of Interest

The author declares no conflicts of interest associated with this research.

Funding

This research was conducted without any external funding support.

Ethical Clearance

Ethical approval was not applicable to this study, as no human or animal subjects were directly involved.

Data Availability

All data underlying this study are available from the corresponding author upon reasonable request.

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