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ARTIFICIAL INTELLIGENCE IN HEALTHCARE QUALITY IMPROVEMENT: ADOPTION, APPLICATIONS AND IMPLEMENTATION CHALLENGES IN SAUDI ARABIA

Abstract: *This review examines the adoption, applications and implementation challenges of artificial intelligence in healthcare, with a focus on Saudi Arabia. Google Scholar was searched for English-language research papers and reviews published from 2020 onwards. Twenty-five publications were selected through screening; international studies supplemented Saudi evidence. The literature describes applications in diagnostic imaging, predictive analytics, virtual care, workflow automation and health management during mass gatherings. Reported benefits include improved diagnostic precision, operational efficiency and support for clinical decision-making. Implementation challenges concern data privacy and security, algorithmic bias, interoperability, infrastructure, workforce skills, cost and accountability. Healthcare professionals generally recognise potential benefits while expressing concerns about reliability and employment. These findings suggest that context-sensitive governance, workforce education and infrastructure investment are important for responsible adoption in Saudi Arabia and progress towards Vision 2030 healthcare goals.*

Keywords: *Artificial intelligence, Healthcare, Saudi Arabia, Vision 2030, COVID-19, Hajj pilgrims*

1. Introduction

AI-based health informatics solutions leverage artificial intelligence to analyse healthcare data, improving various aspects of the healthcare system. These solutions can assist in diagnosis, treatment planning, and drug discovery by identifying patterns and insights that might be missed by human analysis. They also contribute to operational efficiency through automation and optimised resource allocation. However, ethical considerations regarding data privacy, algorithmic bias, and the transparency of AI decision-making processes are crucial for responsible implementation. Successful integration depends on data quality,

interoperability, and the training of healthcare professionals to effectively utilise AI tools. This includes proper oversight and validation of the AI tools.

According to Tithecott et al. (2024), Saudi Arabia is one of the leading countries in the region in adopting and regulating artificial intelligence (AI) across several sectors, including the healthcare sector. The country has issued ministerial resolutions, guidelines and policies concerning the use of AI and Big Data in medical devices, data management, and AI governance. By Council of Ministers Resolution No. (292), the Saudi Data and AI Authority (SDAIA) is the competent authority mandated to develop policies, governance mechanisms, standards, and

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controls related to data and AI and to monitor compliance upon issuance. AI is defined by SDAIA as a system that employs methods that can gather data and use it to predict, suggest, or make decisions with varying degrees of autonomy, as well as select the best course of action to accomplish particular objectives. In September 2023, SDAIA issued the Principles and Controls of AI Ethics (the 'Principles'); then in January 2024, it issued two versions of Generative AI Guidelines, one for the government and the second for the public (together the 'AI Guidelines'). SDAIA has analysed global practices and standards to develop these Principles and Guidelines, which aim to support the Kingdom's efforts towards achieving its vision and national strategies related to adopting AI technology, encouraging research and innovation, and driving economic growth for prosperity and development. Similar to principles/standards adopted by many countries and international companies, the Principles set out seven pillars:

- Fairness
- Privacy & Security
- Humanity
- Social & Environment benefits
- Reliability & Safety
- Transparency & Explainability
- Accountability & Responsibility.

The country has developed and deployed AI-based solutions for detecting and diagnosing diseases, such as breast cancer, COVID-19, and diabetic retinopathy. The country has also established specialised data and AI centres, such as the Saudi Centre for Disease Prevention and Control, the Saudi Health Council, and the King Abdulaziz City for Science and Technology. The country has also invested in building national expertise and capacities in data and AI sectors, such as through the Saudi Data and AI Academy and the National Centre for Artificial Intelligence (Tithecott et al., 2024).

These developments motivate a review of evidence on AI adoption, applications and implementation challenges in Saudi healthcare. This review draws on Saudi and international literature to identify reported benefits, limitations and priorities for further investigation.

2. Methodology

Google Scholar was searched for English-language research papers and reviews published from 2020 onwards. The first ten result pages were examined, yielding 25 included publications. Table 1 presents eligibility criteria, and Figure 1 summarises the reported selection counts.

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria	Remarks
Full texts of research papers and reviews only	Abstracts	Abstract-only records were excluded
Papers in English only	Other languages	Restricted to English-language publications
Published in 2020 or after	Published before 2020	To reflect the current research trend
	Books, book chapters	Books and book chapters were excluded
	Dissertation.	Dissertations were excluded
	Editorials or comments on other papers	
	Inadequate reference details	Citation problems

Reporting completeness was assessed using the description of aims, methods, findings and limitations on a stated 0–4 scale. The reported scores are presented in Section 4.3. The initial

target was 25 publications, comprising 10 reviews and 15 research papers. The selected publications were grouped for synthesis according to their reported designs.

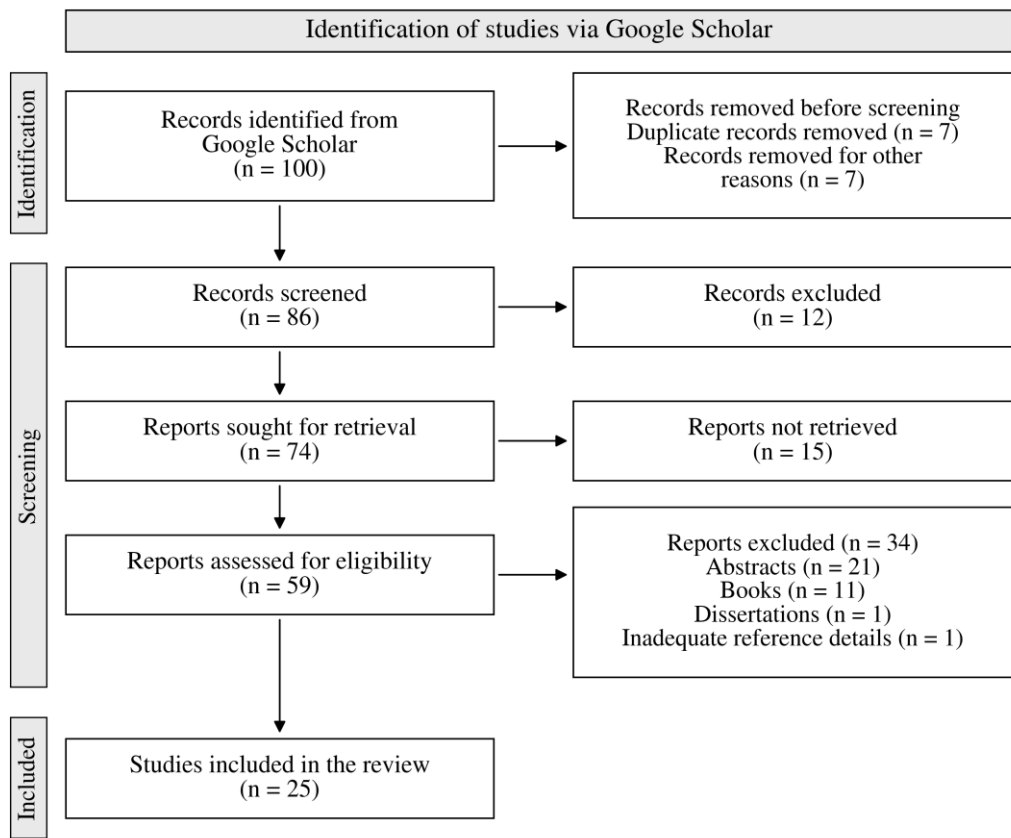


Figure 1. Study selection flow diagram

3. Results

3.1. Reviews and synthesis papers

Kumar et al. (2025) conducted a systematic review of 51 papers on AI in Saudi Arabia's public healthcare system in relation to Vision 2030. The review discussed disease management, healthcare delivery, epidemiology and policy-making, including applications to outbreak monitoring and resource planning during mass gatherings such as Hajj. It emphasised human involvement, quality control, environmental conditions and decision support as relevant to sustainable healthcare. Reported applications included diagnostic imaging, predictive analytics, virtual care, remote monitoring and wearable technologies. The authors stressed

the importance of adapting implementation to Saudi socio-cultural and ethical requirements. They also identified barriers involving data privacy and security, workforce skills, cost, interoperability, regulation, algorithmic bias and infrastructure. These findings describe potential applications and implementation conditions; the review does not establish that every application improves clinical outcomes in Saudi practice.

Uraif (2024) reviewed various AI applications in healthcare, such as the interpretation of images for better diagnosis, automation of workflows and administrative tasks, optimisation of resource allocation, and improvement of operational efficiency within healthcare facilities. AI-driven chatbots and virtual assistants can support patients by informing them about personalised health and

answering their queries. The challenges are related to interoperability, data privacy, requirement of infrastructure and skills, stakeholder engagement at all levels, misinformation and mistrust, connectivity, resistance to change and financial implications. Operational challenges include ensuring the improvement of access and equity, efficiency and resource utilisation, patient engagement and empowerment, R&D investment, collaborations and partnerships, and continuous training and education of involved staff. The review identifies limited awareness as one barrier to adoption. Smart city technology, improvement of resource utilisation efficiency and patient-centred approaches are offered as solutions to these challenges.

Moafa et al. (2024) reviewed the role of AI and ML in healthcare, and its implications for international development and public health. It explored the applications, challenges, and future directions of AI and ML technologies in shaping healthcare delivery, disease prediction, diagnosis, treatment planning, and public health interventions. The authors identified many AI applications in healthcare, from medical imaging and diagnostics to personalised medicine and predictive analytics. The review describes potential improvements in clinical decision-making, healthcare delivery and early disease detection. However, challenges related to data privacy, algorithm bias, regulatory compliance, and ethical considerations remain as barriers to widespread adoption. Some specific examples of successful AI applications have been described. The paper presents a broad synthesis of applications and implementation concerns.

Al-Jehani et al. (2021) described Saudi Arabia's use of AI and digital health tools during the COVID-19 pandemic. Examples included the Doctor B2 robot at King Salman Hospital in Riyadh, which supported communication with patients in isolation and camera-based monitoring. The review also described Tawakkalna, which provided movement permits and public health

information during pandemic restrictions, and TABAOD, which notified users about contact with a person confirmed to have COVID-19. These examples illustrate technology-supported pandemic responses; the review does not establish that all application functions depended on AI or demonstrate their comparative clinical effectiveness.

A general literature review by Al Kuwaiti et al. (2023) described applications of AI in medical imaging and diagnostics, virtual patient care, medical research, drug and vaccine development, patient engagement, rehabilitation and administration. The review also discussed early COVID-19 diagnosis, electronic health records, treatment adherence, reduced administrative workload, prescription-error detection and data analysis. These examples concern healthcare broadly and should not all be interpreted as evidence of implementation in Saudi Arabia. Technical, ethical and social challenges included privacy, safety, consent, access, cost and effectiveness. The authors emphasised governance, accountability and healthcare professionals' trust as important conditions for responsible implementation.

Explainable Artificial Intelligence (XAI) improves the clarity and understandability of AI models, which is essential for establishing trust and accountability in the healthcare sector. One possible use of XAI is in the prediction of diseases utilising various data types. A systematic review of 30 papers by Alkhanbouli et al. (2025) highlighted the increasing adoption of methodologies like SHAP and LIME, which play an important role in improving the interpretability and transparency of AI models used in complex medical diagnostics. There is a trade-off between model complexity and interpretability. The review revealed a lack of diversity in datasets, complexity of models, and dependence on individual data types, which shows the need for improved interpretability and data integration. Tackling these challenges is vital for the progress of AI in the healthcare industry.

The development and implementation of AI in healthcare have economic, political and ethical implications. Observing that building trustworthy and explainable AI (XAI) in healthcare systems is still in its early stages, and the EU has stated that AI must be human-centred and trustworthy, Albahri et al. (2023) systematically reviewed 64 papers on the trustworthiness and explainability of AI applications in healthcare with an assessment of quality, bias risk, and data fusion to supplement previous studies and provide more accurate and definitive findings. The papers were categorised into explainable robotics, prediction, decision support, blockchain, transparency, digital health and review. A taxonomic diagram of trustworthy AI in healthcare containing these categories and a diagram of motivation for trustworthy AI have been presented. Some robustness, ethical and legal challenges were identified. Seven trustworthy AI requirements were identified. Some examples of XAI and their applications were tabulated. In the results and discussions, ML and DL methods dominated. Using a bibliometric analysis, El-Sherif et al. (2022) identified seven AI types. The results were discussed under the topics of AI applications, AI's role in COVID-19 predictions, Future Perspectives, Potential Challenges Facing Mobile Technologies, and Data Sharing in Health and Healthcare.

Salimi et al. (2025) reviewed AI-based nursing curricula in Iran and neighbouring Gulf countries. The article is labelled a narrative review, although its methods describe a structured literature search and document analysis. It reported differences in the use of simulation, adaptive learning and other AI tools across the countries examined. Saudi Arabia, Qatar and the UAE were described as having more advanced integration, while several other countries faced more limited implementation. The review identified infrastructure, cost and faculty training as recurring challenges. Its comparisons were constrained by incomplete country-level information, differences in educational approaches and policies, and

limited evidence about effects on student or clinical outcomes. These reported differences support further comparative evaluation rather than a definitive ranking of national performance.

Al-Momani (2023) conducted a systematic review of seven papers to examine the theories and models used to study the adoption of AI and Robotics (AIR) in healthcare. The results showed a recent increase in papers published on these topics. Among the theories (UTAUT, UTAUT2, Human-Computer theory, TAM2, TAM, Trust theory), the UTAUT model was the most frequently used one. AIR adoption was affected by 23 factors in all. AIR adoption was affected by 13 factors in developed countries (Netherlands) and by 17 factors in developing countries (China, Saudi Arabia, India and Vietnam), with wide variations in the number of factors among these countries. Behavioural intention was affected by 10 factors, performance expectancy was affected by one factor and effort expectancy was affected by two factors. Within the seven papers included in that review, Saudi Arabia was the only Arab country represented. The limitation of only getting seven papers for this review due to using only Scopus and Web of Science was mentioned.

A systematic review of 106 papers by Khan and Alotaibi (2020) revealed that the global m-health market is rapidly increasing. Ten types of sensors for use in m-health were identified. M-healthcare quality is assessed by its usefulness, effectiveness, veracity and interactivity, customisation and user satisfaction. The authors proposed a model based on AI and big data analytics for the m-healthcare system. Privacy and security issues, limited access and complete dependency of patients on these technologies can affect the widespread use of AI and big data analytics integrated m-healthcare.

Chang et al. (2023) conducted an overview of 24 systematic reviews or meta-analyses: 18 concerned AI, two concerned the internet of things (IoT), and four concerned personal

health records (PHR). The AI evidence primarily addressed clinical outcomes such as disease prediction and diagnostic performance. The wider overview also considered psycho-behavioural, managerial and socioeconomic outcomes. The authors found that benefits varied by technology, application and condition, and that the available evidence remained limited in volume and scope. Benefits attributed to IoT or PHR therefore should not automatically be attributed to AI. The overview provides useful evidence about potential benefits while highlighting the need for further evaluation in specific healthcare settings.

Zhang and Zhang (2023) examined the concerns of trustworthiness that impact the ethical issues of medical AI. The authors used a multidisciplinary conceptual approach. The authors noted that medical data are mainly unstructured, with a lack of consistent and standardised labelling, thus affecting the quality of the data. This can influence the effectiveness of medical AI algorithm models. Algorithmic bias can influence AI predictions in clinical settings and worsen health inequities. The lack of transparency in algorithms undermines the trust that both patients and doctors have in medical AI, and errors within algorithms or vulnerabilities in security can present significant risks and harm to patients. The use of medical AI in clinical environments may jeopardise the autonomy and dignity of both physicians and patients. In instances where medical AI fails, determining accountability is often ambiguous. All these elements impact the level of trust people have in medical AI.

Al Ghufaynah et al. (2024) presented a critical literature-based analysis of telemedicine, AI and machine learning, electronic health records, health information exchange and integrated care. The paper used published case examples to discuss access, efficiency and implementation challenges. For AI, the authors described potential contributions to predictive analytics, diagnosis and personalised care, alongside concerns about bias, privacy, skills and cost.

Its comparisons are presented as a qualitative synthesis. They should not be interpreted as estimates from a comparative effectiveness study or as evidence that the authors collected new patient-level data.

3.2. Empirical studies and system proposal

Using the data collected from workshops and interviews with healthcare sector professionals and stakeholders, Naim and Khan (2024) showed that the professionals agreed with the use of AI in green supply chain management in the healthcare sector despite some initial costs of handling GSCM and the application of sensors for automation, but the stakeholders were apprehensive about the costs and skills. The number of participants in the interviews is not given in this paper.

Alshahrani (2025) used a qualitative multiple-case design to examine technology adoption across six Saudi government sectors. Interviews with project managers and stakeholders were combined with thematic analysis of project reports, government publications and policy documents. The healthcare case concerned Seha Virtual Hospital and described the use of AI, IoT and augmented reality. The case reported 400,000 referrals annually, 177 hospitals offering virtual services, and more than 50 core and secondary services. These service figures provide context; they do not independently establish an effect of AI. Reported adoption drivers included crisis response, efficiency and data-informed decisions. Regulatory support, infrastructure readiness and leadership were identified as enablers, while integration, workflow disruption and cost presented challenges. The study's focus on selected cases and managerial perspectives limits the transferability of its findings and its ability to establish long-term outcomes.

Jadi (2020) proposed a mobile healthcare system for Saudi Arabia that combines neural networks, AI, big data and predictive analytics. The paper describes a system

architecture and reports approximately 95% accuracy for risk prediction. However, it provides insufficient detail about the validation data and evaluation procedure to assess that performance claim independently. The paper is therefore treated here as a system proposal, with limited evidence of validation, rather than as a mixed-methods evaluation of an implemented service.

To explore the factors associated with nursing students' intention to use AI, Al Omari et al. (2024) surveyed 1,713 university nursing students from Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Saudi Arabia and the United Arab Emirates. Results showed that most nursing students in Arab countries have moderate levels of knowledge, attitude, perception and intention towards the use of AI. There was a significant positive association between knowledge, attitude, perception and intention towards the use of AI. A multivariate regression analysis revealed that understanding AI technologies, self-perception as tech-savvy, age, clinical performance in previous semesters, and knowledge of AI were significant and positively correlated with intention. The highest level of good knowledge was recorded by the participants from the UAE (45.8%), followed by Lebanon (38.5%). The lowest level of good knowledge was recorded by the participants from Oman (24%). Weak to moderate intention to use AI was noted in the case of participants from all the countries. Saudi Arabia recorded the highest moderate intention (50.9%), and the lowest was by Bahrain students (26.9%). Good attitude was the highest in Oman (36.9%) and the lowest in Bahrain (21.8%). The highest good perception was for Kuwait (37.7%), and the lowest was for Bahrain (21.8%). Cross-sectional nature and possible self-report bias were mentioned as the limitations.

A survey of 458 ENT specialists by Alshehri et al. (2024) showed that most respondents were familiar with AI tools (60.7%) and perceived them as generally usable and clinically impactful. However, they identified some challenges like integration with existing

systems, user-friendliness, accuracy, and cost. Trust and satisfaction levels varied among participants, with concerns regarding data privacy and support. Perceptions and experiences varied by geographic region and practice setting. The limitations mentioned include reliance on self-reported data, cross-sectional nature, and non-representative nature of the sample due to most participants belonging to specific geographic regions, not including other potential applications and implications of AI.

Aljamaan et al. (2024) evaluated the Saudi healthcare workers' (HCWs') usability of ChatGPT three months post-launch using the System Usability Scale (SUS). The authors surveyed 194 HCWs, which included physicians, nurses, interns and students, technicians, therapists and pharmacists. Among the respondents, 47% reported being satisfied with its utilisation, while 57% showed moderate to high levels of trust in its ability to make medical decisions. Additionally, 58% anticipated that ChatGPT would enhance patient outcomes, even though 84% held a positive outlook regarding its potential to advance healthcare practices in the future. They raised potential concerns, such as the possibility of suggesting harmful medical advice and the medicolegal consequences. The overall SUS score of 64.52 suggested marginal acceptability of the system. The most significant positive predictors of high SUS scores included participants' belief in the advantages of AI chatbots in medical research, their self-assessment of familiarity with ChatGPT, and their self-evaluation of computer skills. Conversely, medical students and interns demonstrated considerably higher learnability scores compared to other groups, while ease of use scores were strongly correlated with participants' views on the positive impact of ChatGPT on the future of healthcare practices. Cross-sectional nature and convenience sampling might lead to selection, response and recall biases. Recall bias may exist if the participants did not remember their ChatGPT experience. As the

test was done three months after the ChatGPT launch, the time available to the participants for adequate familiarisation might have been too short.

In a comparable study conducted on ChatGPT within three months of its release, Temsah et al. (2023) surveyed 1,057 Saudi healthcare workers (HCWs) to assess their familiarity with ChatGPT-3.5, levels of satisfaction, potential future use, and perceived usefulness in the healthcare field. Among the respondents, 18.4% had used ChatGPT for healthcare-related tasks, whereas 84.1% of non-users showed interest in employing AI Chatbots in the future. About 75% felt comfortable integrating ChatGPT into their healthcare practices. HCWs viewed the Chatbot as beneficial in several areas of healthcare, including medical decision-making (39.5%), support for patients and families (44.7%), appraisal of medical literature (48.5%), and assistance with medical research (65.9%). Most respondents (76.7%) believed that ChatGPT could have a positive effect on the future of healthcare systems. However, concerns regarding the credibility and origin of information given by AI Chatbots (46.9%) were the primary obstacles. While HCWs acknowledge ChatGPT as a promising addition to digital health during its initial adoption phase, it is vital to address issues surrounding accuracy, reliability, and medicolegal ramifications. Given these concerns, the authors recommended human expert oversight when considering the chatbots available at the time of their study for diagnostic or treatment purposes. Establishing the trustworthiness and reliability of AI Chatbots is crucial for their successful integration into healthcare environments. The limitations include the biases of sampling, response and recall due to the cross-sectional nature of the study from one country, selection bias due to the sampling method, the impossibility of measuring Saudi regional influence and the absence of in-depth qualitative information.

Syed and Al-Rawi (2024) reported a cross-sectional survey of 273 community

pharmacists in Riyadh examining awareness and perceptions of AI. Respondents generally recognised potential benefits while expressing concerns about professional roles and employment. These findings concern reported perceptions, rather than measured improvements in clinical care. The article is listed in a publisher's expression of concern as being under investigation ("Expression of Concern," 2026). Its findings should therefore be interpreted with caution. In addition, the published abstract contains inconsistent percentage-count pairs, which limit interpretation of its numerical results. The study remains identified in this review, with that qualification.

A survey conducted by Alruwaili et al. (2024) on 220 Saudi nurses indicated that their awareness of AI was moderate, with 70.9% possessing fundamental knowledge about AI, while only 58.2% (128 nurses) were classified as "aware" of AI through their engagement with one of its applications in healthcare. Nurses showed a willingness to integrate AI, but they also voiced certain concerns regarding it. The nurses displayed conservative views towards AI, with a larger proportion of negative sentiments found among female nurses compared to their male colleagues. Younger nurses tended to have more favourable attitudes towards AI than older nurses. Educational background was associated with differences in attitudes, as those holding undergraduate degrees showed the highest levels of positive attitudes. Nonetheless, there were no significant differences in attitudes based on years of nursing experience. The study's limitations include its focus solely on nurses from one country and its cross-sectional design.

Ahmad et al. (2025) surveyed 237 healthcare professionals in three hospitals in Wuhan, China, using data collected in 2021. The study examined system, information and service quality in relation to satisfaction and adoption of AI-based clinical decision support. The reported associations support attention to information-system quality when examining adoption. Its cross-sectional

design and setting limit causal interpretation and direct generalisation to Saudi healthcare. In an online survey of 562 Saudi radiographers by Aldhafeeri (2022), most respondents (90.6%) believed that AI was the direction of diagnostic imaging. Among the respondents, 88.5% stated that AI would improve the accuracy of diagnosis. Some challenges in implementing AI in Saudi Arabia included the high cost of equipment, inadequate knowledge, radiologists' fear of losing employment, and concerns related to potential medical errors and cyber threats. Among the demographic variables, only educational level was associated with these responses. The non-inclusion of any open-ended questions in the survey and the fact that it was a multisite study in only one country were the limitations mentioned.

4. Discussion

4.1. Publication profile

The 25 selected publications comprised 14 reviews or synthesis papers, eight cross-sectional surveys, two qualitative studies and one system proposal. These categories describe the reported study designs and do not indicate methodological quality.

Year-wise frequency of the reviewed papers is shown in Figure 2.

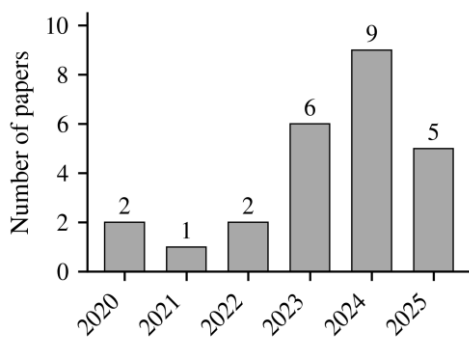


Figure 2. Publication years of the reviewed papers

The largest number of selected papers was published in 2024 (9), followed by 2023 (6) and 2025 (5). The remaining papers were published in 2020 (2), 2021 (1) and 2022 (2). This distribution describes the selected sample and cannot establish the overall growth of research in the field. A broader search or a different search period could produce a different distribution.

4.2. Study designs

Figure 3 summarises the selected publications using mutually exclusive broad design categories.

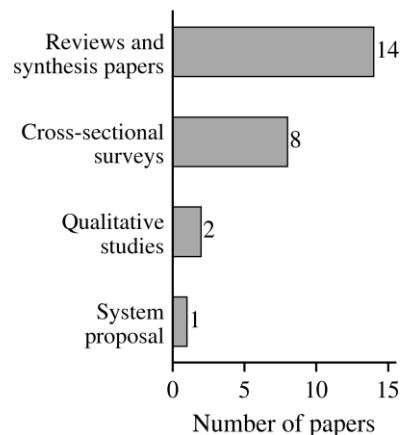


Figure 3. Reported designs of the 25 selected publications

Reviews and synthesis papers formed the largest group (14). This group includes systematic and other literature reviews, a bibliometric analysis, an overview of reviews, and conceptual or critical analyses. Eight studies used cross-sectional surveys, two reported qualitative approaches, and one proposed a technical system. Combining interviews with document analysis does not, by itself, constitute mixed-methods research. Broad categories were used because the publications differed in their terminology and reporting of review methods.

4.3. Reporting completeness

The review used a simple overall score from 0 to 4 based on the reporting of aims, methods, findings and limitations. The stated scoring rule assigned one point when a component was present and zero when it was absent. The reported results awarded a score of 4 to one paper and 3.9 to the other highest-scoring papers. Table 2 presents the reported score distribution for the 25 publications.

Table 2. Reported scores for reporting completeness

Reported score	No.
2.5 to 2.9	4
3.0 to 3.5	8
3.6 to 4.0	13

The reported distribution places 13 of the 25 papers in the 3.6–4.0 range. These scores concern reporting completeness and should not be interpreted as a validated assessment of methodological quality or risk of bias.

4.4. Synthesis and interpretation

The 14 reviews and synthesis papers described AI applications in disease management, healthcare delivery, epidemiology and policy-making. Commonly discussed uses included prediction, diagnostic support, virtual care and resource planning. The strength and directness of evidence varied across applications and study types.

For Saudi healthcare, the reviewed literature emphasised alignment with Vision 2030 and sensitivity to local socio-cultural and ethical requirements. Examples included diagnostic imaging, predictive analytics, remote monitoring and health planning during Hajj. The literature also described robots, pandemic-response applications and virtual hospital services. These examples illustrate a wider digital health environment; they do not establish that every digital service uses AI or that its outcomes can be attributed to AI

alone. Proposed systems should also be distinguished from evaluated deployments.

Across the literature, reported or anticipated benefits included support for clinical decisions, more efficient workflows, improved resource allocation, drug discovery, treatment planning and patient engagement. Explainable AI was discussed as a means of improving model interpretability and supporting accountability. However, evidence about diagnostic performance, users' perceptions and organisational implementation answers different questions. Positive perceptions or technical accuracy alone cannot establish improvements in patient outcomes, cost or equity.

Recurring implementation challenges concerned privacy and security, algorithmic bias, data quality, interoperability, infrastructure, cost, workforce skills and accountability. The literature also highlighted trust, usability, connectivity, access and resistance to change. These concerns suggest the need for context-specific evaluation, appropriate governance, workforce development and ongoing monitoring of both intended benefits and unintended consequences.

The surveys reported varied levels of knowledge, awareness, trust and willingness to use AI among nursing students and healthcare professionals. Some studies identified associations with age, education or familiarity with technology, but these findings do not establish that younger staff necessarily learn AI tools more quickly. Concerns about accuracy, reliability, employment and professional responsibility were common. Education and implementation strategies should therefore respond to demonstrated needs, and the use of clinical AI tools should include appropriate professional oversight.

5. Conclusions

The reviewed literature identifies promising AI applications in diagnosis, decision

support, workflow management and healthcare planning, including uses relevant to Saudi Arabia. Evidence of effectiveness varies across applications and settings. Privacy, security, bias, interoperability, infrastructure, skills, cost and accountability remain important implementation considerations. Progress towards Vision2030 healthcare goals will require evaluating benefits and risks in the settings where the technologies are used.

Healthcare professionals and nursing students often recognise potential benefits while expressing concerns about reliability, professional roles and employment. Findings from the included surveys describe perceptions and associations. They support targeted education and implementation support, together with evaluation of effects on practice and patient outcomes.

For Saudi Arabia, future implementation should be informed by local needs, socio-cultural considerations and evidence of clinical and organisational value. The applications identified in this selected literature should be treated as examples rather than an exhaustive inventory of national AI deployment. Stronger evaluations are needed to determine which approaches improve care, under what conditions, and for whom.

6. Limitations of this review

This review was limited to Google Scholar, the first ten pages of results, English-language publications from 2020 onwards, and a target of 25 publications. These restrictions may have excluded relevant evidence and limit the breadth and reproducibility of the review. Search coverage cannot be inferred from the number of results screened; additional databases, search terms and citation searching could identify further eligible publications. The inclusion of both reviews and primary studies

also creates a possibility of overlapping evidence, so the 25 publications should not be interpreted as 25 independent empirical tests of AI effectiveness. The reporting-completeness score does not substitute for a design-appropriate assessment of risk of bias.

7. Scope for future research

Further Saudi research could evaluate how AI is implemented and used within specific clinical and organisational settings, including the implications of local cultural and service requirements. The restricted search in this review does not establish the total volume of Saudi research or demonstrate an absence of relevant studies.

Future evidence synthesis should distinguish technologies, settings and outcomes, and assess whether studies are sufficiently comparable for quantitative pooling. Where meta-analysis is appropriate, consistent outcome definitions and measurement units would improve interpretability. Qualitative evidence can complement these evaluations by examining implementation experiences and context.

The eight cross-sectional surveys in this sample provide useful information about perceptions and associations. Longitudinal, implementation and comparative studies could provide stronger evidence about adoption processes and outcomes over time. Mixed-methods designs may be useful where there is a clear rationale for combining and integrating quantitative and qualitative evidence.

The included publications offered limited comparable evidence across countries. Further cross-country studies using clearly defined populations, technologies and outcomes could clarify how implementation conditions differ and which findings transfer to Saudi healthcare.

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