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Leveraging Artificial Intelligence: Leadership Challenges and Opportunities for Nurse Managers in the Digital Age in Saudi Arabia

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Abstract

Many challenges are faced by Saudi nurse managers in integrating AI with the current healthcare systems. The benefits and challenges are obvious, as many published papers indicate. The need for a review of the status of the leadership challenges and opportunities in leveraging AI for Saudi nurse managers was attempted by this review. A targeted 25 papers were selected from Google Scholar and the results were described and discussed. It can be concluded from this review that in leveraging AI in healthcare, nursing leadership face many challenges globally. The problem is especially more concerning in the case of Saudi Arabia due to its religious and social peculiarities. Very few Saudi women enter nursing jobs due to these factors. Therefore, nurse managers also will be very few. These factors reduce the scope for nurse managers facing challenges in leveraging AI for better healthcare outcomes. Although this situation is fast changing, the goal of replacing foreign nurses with Saudi nurses is still to be achieved. The future holds scope for leveraging AI largely by nurses under the guidance of nurse managers for significant healthcare outcomes in Saudi Arabia. Some limitations and scope for future research have been mentioned.

Keywords: AI, Nurse managers, Digital technologies, Healthcare systems.

Introduction

Saudi nurse managers face many leadership challenges and opportunities in leveraging AI within the healthcare sector. The primary challenges include overcoming resistance to change among staff, addressing ethical concerns regarding AI decision-making, and ensuring adequate training and education for nurses for the effective use of AI tools. There may be barriers to infrastructure and technology adoption.

Opportunities exist in AI capabilities to enhance patient care quality, streamline administrative tasks, and improve decision-making processes. Nurse managers can drive AI transformation by fostering an innovation culture, asking for the necessary resources, and leading training initiatives to empower their teams. The integration of AI in the hospital healthcare management system can improve healthcare outcomes and operational efficiency

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as a significant area for leadership development in nursing. Nurse managers need to be updated on AI and actively engage with their teams to leverage the opportunities presented by new developments in AI.

Thus, the opportunities and challenges to nurse leadership offered by leveraging AI are well-known. This review aims to integrate all this knowledge and apply it in the context of Saudi nurse managers.

Methodology & Results

A targeted 25 recent full-text English papers were selected from Google Scholar. These are described and discussed in the Results section below.

A survey of 329 nurses from five Riyadh hospitals by Alenezi, Alshammari, and Ibrahim (2024) showed that there were initial disruptions when AI was implemented. Later, an increase in nursing productivity was obtained. Nursing workforce competencies mediated the relationship between AI and nursing productivity increases. However, technological leadership did not affect these relationships.

A survey of 300 Riyadh medical employees by Muafa and Al-Obadi (2024) contained 150 nurses. The survey showed that AI has already been adopted by all participants and can significantly transform Riyadh's healthcare sector facilitating the achievement of Vision 2030 healthcare goals. However, many Saudi hospitals adopted AI for limited use only. The challenges were privacy/security concerns, the high cost of implementation, leadership hesitance to implement AI, concerns about legal liabilities, and all-round distrust of AI. Opportunities exist for wider AI adoption with favourable national policies, public awareness campaigns, financial incentives, internal advocacy within institutions, strict cybersecurity measures, a higher focus on the ethical use of AI and pilot programs to demonstrate benefits.

Ramadan, Alruwaili, Alruwaili, Elsehrawy, and Alanazi (2024) conducted focus group discussions with 48 registered nurses from four major healthcare facilities in Al-Kharj, Saudi Arabia. Thematic analysis, guided by the Technology Acceptance Model framework, was employed to analyse the data. AI adoption was facilitated by perceived benefits to patient care, strong organisational support and comprehensive training programs. The main barriers were technical challenges, ethical concerns regarding patient privacy and fears of job displacement. The limitations are the focus on a single culturally and religiously specific country, response bias due to the Saudi government's high investments and technological developments and the cross-sectional nature of the study.

The leadership domains of AI introduction in healthcare were identified by Sriharan, et al. (2024) using a review of 22 papers. These domains are shown in Fig 1. The authors could not establish relationships among specific leadership domains, capacities, and contextual factors;

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the effectiveness of leadership approaches; or the moderating effects of contextual factors. The authors used conceptual, non-standardised definitions. The authors used Medline journals to identify the papers which can miss many papers in other journals.

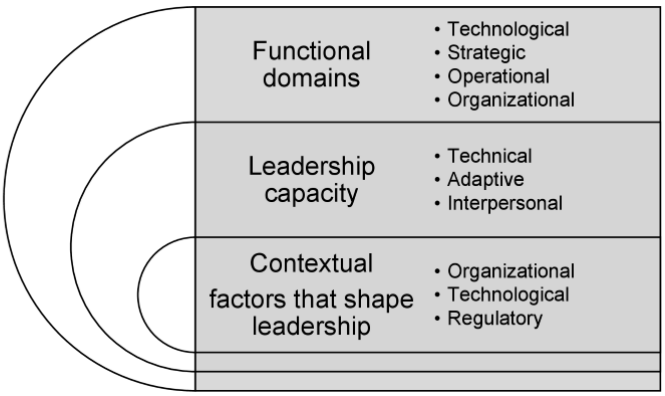

Figure 1 Leadership domains for AI in healthcare (Sriharan, et al., 2024).

Hassan and El-Ashry (2024) employed interpretive phenomenological analysis (IPA) to understand the lived experiences of critical care nurses who are leading with artificial intelligence (AI). They interviewed ten nurses holding leadership positions in the General Adult ICU, Coronary Care Unit, Surgical ICU, Medical ICU, and Trauma ICU, using purposive sampling. Semi-structured interviews delved into the nurses' experiences, the challenges they face, and the opportunities presented by AI. The thematic analysis of the interview responses revealed two major themes: understanding challenges and opportunities and the significance of the human element in AI leadership. AI provided advantages such as task automation, yet overdependence on AI and the necessity for continuous training were significant concerns. The challenges included adjusting to new workflows and addressing potential biases. Effective integration of AI in ICU nursing practices relied on clear communication and cooperation. Trust in AI is contingent upon transparency and collaboration. AI-enabled nurses to prioritise human-centred care while facilitating data analysis. Major ethical concerns included patient autonomy and accountability for decisions made with AI support. Consequently, the human aspects of AI usage emerged as a consistent theme in the feedback. The limited sample size of ten might influence the validity and generalizability of the results. Although the research was conducted by one Egyptian researcher and one Saudi researcher, the study's country of origin was not specified.

AI can very well be used to process and interpret patient records to make decisions and anticipate. AI integration can provide promising benefits but poses the challenge of building up new competencies among nurses. Nurses need to familiarise themselves with the insights provided by AI and address the patient while ensuring that patients do not feel they are being treated mechanically. These challenges to nurses need to be solved by nursing leadership.

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Nurse managers should persuade the management for policies favourable for nurses who are faced with such challenges when using AI with safety, reasonable remuneration, and continued training. They should also support an organisational culture of effective teamwork minimising fatigue and burnout. Nurse managers need to campaign for the adoption of more new technologies for patient-centred care. Effective change management is necessary for transitioning to new technologies like AI. Nurse leaders should be professional representatives of nurses to influence the management through direct contact with them, the healthcare facilities and academic institutions to equip the nurses under them to be future-perfect (Al-Harbi, et al., 2024).

Semi-structured interviews with 20 participants (ten frontline nurses from the new generation and ten senior nurse managers from the old generation consisting of nurses and senior nurse managers) by Abujaber, et al. (2024) identified four themes related to the generation gap between nurses and nurse managers. To optimise the work environment, older generations preferred transformational and situational leadership, while younger nurses valued respect, teamwork, accountability, and professionalism. To strengthen the work atmosphere through communication and values, older nurses preferred face-to-face communication and younger nurses preferred digital tools. To cultivate respect and empathy, younger nurses stressed fairness in assignments and promotions and older nurses preferred empathy and understanding. For the dynamic enhancement of healthcare systems, younger nurses were more adaptable to technology and professional development but older nurses prioritised clinical care and patient outcomes. The limitations of sampling bias due to purposive sampling, interviewer bias, the subjective nature of data saturation, the context-specific nature of the study and the use of virtual interviews might limit the depth and transferability of the findings. Time constraints may have restricted the comprehensiveness of the data collected. This generation gap needs to be considered when AI integration into nursing care is attempted by nurse managers.

A cross-sectional survey of 382 healthcare workers (including nurse managers) from five Saudi hospitals by Al-Anezi (2024) showed user experience and accessibility to modern technologies as the most important factors for a sustainable competitive edge in the Saudi healthcare system. AI adoption was a major factor. Data security and privacy were major issues for nurses and nurse managers. Cross-sectional nature, self-report bias, focus on public hospitals of a single country and a narrow set of factors restrict the applicability of the findings on a wider scale.

A survey of 242 nurses working in Egyptian ICUs by Elkholy, Ageiz, and Elshrief (2024) showed a moderate effect of job control on the relationship between the independent variable (artificial intelligence) and the dependent variable (nurses' innovative behaviour). The results showed that nurse managers should support nurses' career development needs by training

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them to obtain competencies in healthcare informatics and thus promote rapid AI adoption. This will enhance their job control.

Another survey of 242 nurses working in Tanta University Hospital, Egypt, by Elbus, Mostafa, Mahmoud, and Mahmoud (2024) revealed moderately high innovation by nurse managers across all dimensions including new patient care models, use of advanced technology, continuous learning and development and advanced technology. New models and advanced technologies imply AI, although not directly mentioned. Nurses exhibited improved planning and adaptability levels. Most nurses exhibited high levels of internal focus control. Managerial innovation was correlated with nurses' proactivity and internal control. Age, gender, experience, education and ICU type were predictors of proactivity and locus of control.

A survey of 246 nurses from Egyptian outpatient health centres by Ibrahim, et al. (2024) revealed a strong awareness of integrating digital healthcare with telemedicine. The Patient Safety Culture Survey (PSCS) indicated positive Communication Openness, Leadership Support, Teamwork and Organizational Learning scores. The high scores of Telemedicine Risk Assessment and Mitigation Matrix (TRAMM) scores indicated effective risk management. The high total mean score of the Digital Health Adoption Readiness Assessment (DHARA) showed considerable preparedness. The Digital Health Impact Assessment Tool (DHIA) also proved this readiness indicating a robust anticipated impact, especially in Patient Engagement and Usability. Although AI is not explicitly mentioned, AI might have been used for the integration of digital healthcare with telehealth. The limitations are the same as those mentioned by Al-Anezi (2024).

From the results of a survey of 415 nurses at Alexandria Main University Hospital, Atalla, El-Ashry, and Mohamed (2024) observed a significant correlation between attitude, ethical awareness, and creativity, highlighting that ethical awareness moderates the relationship between attitudes and innovative work behaviours. These findings emphasise the importance of ethical awareness in fostering positive attitudes towards AI and enhancing innovative practices in nursing, ultimately contributing to nurses' well-being. Nurse managers need to develop ethical awareness and positive attitudes among nurses to leverage AI for innovative uses in patient care.

A review of 76 recent papers by AL Enezi, et al. (2024) on nursing and pharmaceutical care management highlighted the importance of patient-centred approaches, interdisciplinary collaboration, and the integration of technology like AI to improve care quality and efficiency. The challenges to this like workforce shortages, training gaps and resource limitations need to be overcome. The suggested solutions are professional development, advanced nursing leadership, automation, inter-disciplinary collaboration, shared decision-

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making, patient-centred approaches, policy support and international collaborations. Based on the findings, the authors gave eight recommendations.

In a general literature review, Al Kuwaiti, et al. (2023) observed the impact of AI in detecting clinical conditions, in medical imaging and diagnostic services, using early diagnosis to control the COVID-19 outbreak, using AI tools for virtual patient care, electronic health records management, enhancing patient engagement and compliance with the treatment plan, reducing administrative workloads of nurses, new drugs and vaccines discovery, identifying medical errors, expanded data storage and analysis and AI-assisted rehabilitation. However, there are many technical, ethical, and social challenges to privacy, safety, the right to decide and try, costs, information and consent, access, and efficacy when AI is integrated into healthcare. The limitations of the general review were mentioned by the authors.

An extended model of Shaft and Vessey (2006) cognitive fit model applied to healthcare organisations in Saudi Arabia was validated by Nasseef, Baabdullah, Alalwan, Lal, and Dwivedi (2022) using a survey of 362 participants comprising CEOs (10%), senior managers/managers (20%), doctors (27%), nurses (28%), and other relevant healthcare professionals from 20 Primary COVID-19 Hospitals and 5 COVID-19 Backup Hospitals. The sample also included those who worked in Clinics 'Tetamman'. These tetammen were used by the Saudi Ministry of Health to serve everyone who felt coronavirus symptoms. They were also included in the decision-making process related to COVID-19. The validated cognitive fit model provided by the authors is shown in Fig 2.

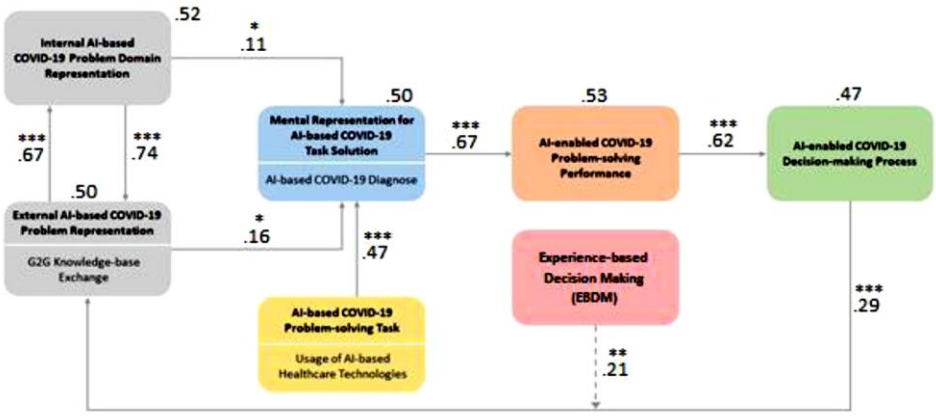

Figure 2 The validated cognitive fit model (Nasseef, Baabdullah, Alalwan, Lal, & Dwivedi, 2022)

Semi-structured interviews were conducted by Lytras, et al. (2022) with 11 (10 male) healthcare leaders from different backgrounds and governmental institutions to understand the current healthcare workforce quality and future expectations from the attitudes and perceptions of health leaders. The study yielded 5 main themes: workforce competency,

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health transformation, leadership, workforce planning and healthcare quality. These results showed that healthcare leaders were satisfied with the current direction of workforce competency and planning. However, the fragmentation of the system and poor accessibility required improvement. Also, the misutilisation of services, the uncertainty of the future and the limited talent pool were potential barriers to building capabilities. Privatisation and corporatisation may be able to solve the workforce shortage problems to some extent. Saudization may also contribute to promoting competition. Here, health transformation implies AI. Leadership includes nurse managers.

Almalki, Jamal, Househ, and Alhefz (2021) used a review of 20 papers, followed by a survey of 24 experts and then a focus group of 14 experts to identify six domains and 22 subdomains of healthcare informatics competencies to guide the Saudi Commission for Health Specialties (SCFHS). Based on the results, a Saudi Health Informatics Competency Framework (SHICF) was developed. The six domains included core principles, ICT, health sciences, health data analytics, education and research, and leadership and management. ICT and health data analytics might imply the use of AI. Leadership includes nurse managers. One drawback of this study is that the thematic analysis primarily focused on the data related to the competencies in the HI profession. The data gathered from the selected publications were inadequate to create a standardized definition of the key domains or to compare the definitions presented in this paper with those found in the included publications. The sample sizes used for the survey and focus group were inadequate to obtain the full range of possibilities.

Based on a review, Alnasser, et al. (2024) concluded that technology increases nursing workflow towards enhanced productivity, reduction of errors and patient-centred care. However, the need to ensure that technology does not determine everything jeopardises the nurse-patient relationship. Technologies should support, rather than, replace nurses. Here, technology included AI. Enhancement of nursing productivity and other benefits accrue due to nurse managers motivating nurses to use technologies.

A scoping review was conducted on 39 papers by Teixeira, Lucas, and Gaspar (2024) following the Joanna Briggs Institute guidelines to explore how nurse managers' personality traits, competencies, behaviours, and leadership styles affect the outcomes for nurses in multicultural environments across different clinical settings. The review identified 29 personality traits, 9 competencies, 115 behaviours, and 5 leadership styles that influence nurses' outcomes. The key findings underscore the significance of nurse managers being supportive, culturally aware, and effective communicators, with a transformational leadership style proving to be especially advantageous. All these characteristics of nursing managers play a crucial role in facilitating AI integration in healthcare systems among nurses, resulting in improved quality of care outcomes.

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Health equity is a multifaceted concept that aims to eliminate biased, unjust, and correctable differences between groups of people. It is a fundamental element in the design of algorithms. To address this, Cary Jr, et al. (2024) introduced the Bias Elimination for Fair AI in Healthcare (BE FAIR) framework. This framework adopts a comprehensive strategic approach that incorporates principles of health equity by design. Nurses can utilise this framework to reduce bias and prevent discriminatory practices associated with clinical algorithms in healthcare. The methodology consisted of three steps. First, the authors conducted a critical examination of the concept of health equity by design, guided by the recent principles from the Office of the National Coordinator for Health Information Technology. Next, they reviewed the latest literature on the risks posed by AI technologies in healthcare and their potential to promote health equity. The BE FAIR framework was developed based on the findings from these two steps. Lastly, the authors analysed leading frameworks that promote health equity to identify effective methods for operationalising BE FAIR within local AI governance frameworks. The results indicated that the BE FAIR framework can be successfully implemented within existing governance systems for clinical AI technologies. By leveraging their expertise, nurses can support the development and deployment of clinical algorithms, helping to mitigate risks such as bias and promoting ethical, high-quality care powered by big data and AI technologies. Such empowerment of nurses to use AI technology happens with the support of nurse managers. The application of BE FAIR may be affected by many limitations and challenges. The limited availability of diverse representative data limits training the AI models to some extent. In the absence of population subgroups, it may not be possible to use the framework to reduce biases and support equity across different groups. All types of biases may not be solved by the framework. The qualitative nature of the framework reduces objectivity in bias assessments.

Hamdan, Jaaffar, Khraisat, Issa, and Jarrar (2024) surveyed 200 nurses from clinical nurses at three hospitals and two specialised centres in Riyadh. Results showed significant positive relationships between transformational leadership, patient safety culture, and nursing safety practices. Patient safety culture mediated the relationship between transformational leadership and safety practices among nurses. The use of AI may produce better outcomes with many safety practices. The finding on leadership style is related to nurse managers. Limitations of cross-sectional studies preventing causal conclusions, sample size, a single hospital in a single country, non-inclusion of many other variables, possible response bias and common method variance were mentioned by the authors.

The results of in-depth interviews with six nurse leaders in charge of Saudi primary healthcare centres by Alakeely, Almutari, Masud, and Altulaihi (2021) revealed the use of technology (virtual clinics, telehealth, dedicated mobile apps and remote delivery of services)

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helped them to prepare for the COVID-19 pandemic despite many challenges. Considering the nature of the problem, the results may apply only to Saudi Arabia.

According to Khalifa, Albaz, and Nageab (2024) AI technologies can be leveraged to track and register any crisis before or as soon as it occurs. It enables rapid intervention and success in overcoming the crisis immediately on detection through rapid alerts for intervention using AI applications. The study focused on tracking these applications during the stages of managing the COVID-19 crisis on the mechanism of operation of these technologies, their areas, and the challenges of their use based on their applications. The authors recommended enhancing the role of artificial intelligence technology due to its achieving high levels of environmental quality with the support of (nurse) managers.

Ajegbile, Olaboye, Maha, and Tamunobarafiri (2024) conducted a review of technologies useful for business analytics in healthcare. The technological foundations that enable business analytics in healthcare are rapidly evolving, driven by advancements in AI, big data and machine learning. AI algorithms can process large volumes of data quickly and accurately, making it possible to generate insights that would be difficult or impossible to achieve with traditional analytical methods. Machine learning models can be used in healthcare for various applications, from predicting disease outbreaks to developing personalized treatment plans. For example, AI-powered diagnostic tools can analyse medical images with high precision, assisting radiologists in detecting abnormalities and improving diagnostic accuracy. Technologies like AI improve patient outcomes, improve operational efficiencies and help in cost management. Privacy, quality, security and integration of data, technical and organisational challenges and ethical considerations are problematic issues. Nurses need to implement these technologies at the point of care. Nurse managers should motivate and guide them in this respect.

Ahmad and Wasim (2023) reviewed the methods of preventing medical errors using AI. Diagnostic, medication, surgical, communication and systemic errors are caused by human, communication breakdown and systemic issues. AI can prevent these medical errors through diagnostic support, medication safety, surgical support, predictive analytics, monitoring and early warning systems and natural language processing. Most of these errors occur at the point of care. Hence, nurse managers need to support nurses in using AI appropriately.

Discussion

Out of 25 papers reviewed above, only eight papers (Sriharan et al. (2024), Hassan & El-Ashry (2024), Al-Harbi et al. (2024), Al-Anezi (2024), Elkholy et al. (2024), Teixeira et al. (2024), Hamdan et al. (2024), Alakeely et al. (2021)) directly dealt with the topic of this paper. Out of 25 papers reviewed, only 10 were related to Saudi Arabia. The period of reviewed papers ranged from 2021 to 2024 by default and not by deliberate selection.

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Therefore, it can be deduced that very few papers have been published on this topic in the Saudi context. This indicates a fertile research area for the future.

The topics discussed on AI technology in healthcare were similar in most papers. The common trend was to first describe the technological trends, definition and applications of AI and problems and challenges in integrating AI into the current healthcare systems. Only the papers dealing with COVID-19 (both from Saudi Arabia- (Alakeely et al. 2021; Khalifa et al. 2024) and the four papers (Cary Jr et al. 2024; Almalki et al. 2021; Naseef et al. 2022; Ramadan et al. 2024) which validated frameworks provided different contents.

Conclusion

In leveraging AI in healthcare, nursing leadership face many challenges globally. The problem is especially more concerning in the case of Saudi Arabia due to its religious and social peculiarities. Very few Saudi women enter nursing jobs due to these factors. Therefore, nurse managers also will be very few. These factors reduce the scope for nurse managers facing challenges in leveraging AI for better healthcare outcomes. Although this situation is fast changing, the goal of replacing foreign nurses with Saudi nurses is still to be achieved. The future holds scope for leveraging AI to a great extent by nurses under the guidance of nurse managers for significant healthcare outcomes in Saudi Arabia.

Limitations

As was indicated above, despite not setting any year limit, the reviewed papers belonged to the 2021 to 2024 period. Only 10 papers dealt with the topic directly. Instead of using Google Scholar to select papers, if databases were searched, some more papers directly dealing with the topic might have been obtained. The trends over many papers were repetitive. These trends could have been tabulated for ready reference. However, many other papers provide such tables. Hence, doing it in this paper would have been repetitive.

Scope for future research

The limitations indicate the scope for the future. Thus, more research needs to be done directly dealing with leadership challenges and opportunities in leveraging AI for Saudi nurse managers in this digital age. Empirical studies using mixed approaches are preferable.

Countries of different cultures and socio-economic factors may be compared in this respect. This might help to assess whether cultural, social and religious factors have any influence on AI adoption and leverage for better healthcare outcomes.

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