



Vision 2030, Green Energy, and Nursing Practice Transformation in Saudi Arabia: A Systematic Review

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Abstract:

Saudi Arabia's Vision 2030 emphasizes sustainable development and modernization across multiple sectors, including healthcare. The integration of green energy initiatives into healthcare systems has the potential to transform nursing practice by promoting environmental sustainability, improving operational efficiency, and enhancing patient care. This systematic review aimed to explore the impact of Vision 2030 and green energy adoption on nursing practice in Saudi Arabia. A comprehensive search of electronic databases, including PubMed, Scopus, and Web of Science, was conducted to identify studies published between 2010 and 2025 that addressed nursing practice, sustainable energy, and healthcare transformation. After removing duplicates and screening titles, abstracts, and full texts, relevant studies were analyzed for key themes. The findings indicate that the adoption of renewable energy sources, energy-efficient technologies, and environmentally conscious healthcare policies contributes to a safer and healthier work environment for nurses, supports patient-centered care, and aligns with global sustainability goals. Additionally, nurses play a critical role in implementing and advocating for green practices within healthcare facilities. This review highlights the intersection of national policy, sustainable energy adoption, and nursing practice, emphasizing the need for strategic planning, education, and workforce development to fully realize the transformative potential of Vision 2030 in Saudi healthcare.



Keywords: *Vision 2030, green energy, nursing practice, healthcare transformation, sustainability, Saudi Arabia.*

1. Introduction

Saudi Arabia has embarked on an ambitious journey of national transformation through Vision 2030, a strategic framework aimed at diversifying the economy, enhancing public services, and promoting sustainable development (Khan, 2016; Saudi Vision 2030, 2024). Historically dependent on oil revenues, the Kingdom recognizes the need to transition from an oil-based economy to a knowledge-based economy, emphasizing innovation, technology adoption, and human capital development (Nurunnabi, 2017; Moshashai & Leber, 2018). Vision 2030 positions healthcare, energy sustainability, and workforce modernization as central pillars in achieving long-term socioeconomic growth and global competitiveness (Rahman & Qattan, 2021; Alasiri & Mohammed, 2022).

The healthcare sector in Saudi Arabia has undergone substantial reforms under Vision 2030, reflecting a shift toward a more efficient, patient-centered, and technologically integrated system (Alkhamis & Miraj, 2021; Alharbi, 2018). This transformation emphasizes the adoption of digital health technologies, telemedicine, and artificial intelligence to improve accessibility, quality of care, and operational efficiency (Alghamdi et al., 2021; Aboalshamat et al., 2022; Chowdhury et al., 2021). Recent evidence highlights the role of connected health platforms in supporting health system resilience during crises such as the COVID-19 pandemic, enhancing service delivery in both urban and remote areas (Alghamdi et al., 2020; Hassounah et al., 2020; Balharith et al., 2023). Furthermore, the reform initiatives have focused on workforce development, equipping nurses and other healthcare professionals with competencies necessary for virtual care delivery and patient-centered practice (Elsheikh et al., 2018; Alghamdi et al., 2021).

Alongside healthcare reforms, Vision 2030 prioritizes the adoption of green energy and sustainable development practices as part of the Kingdom's commitment to environmental stewardship (Al-Wathinani et al., 2023; Omri, 2019). Transitioning from conventional fossil fuels to renewable energy sources, including solar and wind, is expected to reduce carbon emissions, improve energy security, and foster economic diversification (Kahia et al., 2021; Aboneama, 2018; Al Surf & Mostafa, 2017). The integration of sustainability goals within national policy underscores the interconnectedness of environmental initiatives, public health, and economic prosperity, offering new opportunities for the healthcare sector to align with broader national objectives (Alharthi et al., 2019; Al-Kahlan, 2023).

Nursing practice, as a critical component of healthcare transformation, is directly influenced by Vision 2030 and the move toward a digitally enabled, knowledge-driven health system. Nurses are increasingly required to adopt innovative care models, leverage technology for patient monitoring, and participate in policy-driven sustainability initiatives (Alghamdi et al.,



2021; Alharbi et al., 2022). The systematic integration of green healthcare practices, coupled with digital health solutions, presents an opportunity for nursing professionals to contribute meaningfully to both patient outcomes and environmental sustainability. Moreover, aligning nursing education and professional development with Vision 2030 ensures that future healthcare professionals are equipped with the competencies necessary for practice in an evolving healthcare landscape (Alsaedi et al., 2022; Al-Anezi et al., 2020).

This systematic review aims to synthesize existing evidence on the interrelationship between Vision 2030, green energy initiatives, and nursing practice transformation in Saudi Arabia. By examining current trends, challenges, and opportunities, this study seeks to provide a comprehensive understanding of how national strategic objectives are shaping healthcare delivery and professional practice, highlighting implications for policy, education, and clinical innovation.

2. Method

2.1 Design and Search Strategy

This study employed a systematic review design to synthesize existing literature on Vision 2030, green energy initiatives, and nursing practice transformation in Saudi Arabia. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency, reproducibility, and methodological rigor (Moher et al., 2009).

A comprehensive search was conducted across multiple electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar, to identify relevant studies published between 2010 and 2024. Keywords and search strings were developed using a combination of Medical Subject Headings (MeSH) and free-text terms, including "Saudi Vision 2030," "green energy," "renewable energy," "nursing practice," "healthcare transformation," "digital health," and "healthcare innovation." Boolean operators (AND, OR) were used to refine and combine search terms to maximize the retrieval of relevant studies.

In addition, reference lists of included articles and grey literature, such as government reports and policy documents (e.g., Saudi Vision 2030 official reports), were manually screened to identify additional sources. Inclusion criteria were defined as studies focusing on healthcare transformation, sustainability initiatives, or nursing practice changes in Saudi Arabia in the context of Vision 2030. Only peer-reviewed articles, official reports, and studies published in English were considered. Studies that did not address Saudi Arabia or lacked relevance to the intersection of healthcare, sustainability, or nursing practice were excluded.

Two independent reviewers screened titles and abstracts for eligibility, followed by full-text assessments. Any discrepancies were resolved through discussion or consultation with a third reviewer. Data extracted from included studies included study characteristics, healthcare and



nursing-related outcomes, green energy initiatives, policy interventions, and technological innovations.

This systematic approach ensured a comprehensive evaluation of the evidence base, providing insights into the role of Vision 2030 in shaping sustainable healthcare practices and transforming nursing roles in Saudi Arabia. The findings were synthesized narratively and thematically, highlighting emerging trends, challenges, and opportunities for advancing nursing practice within the broader goals of national development and sustainable healthcare.

2.2 Data Management and Screening

All search results from the selected databases were imported into a reference management software (EndNote X9) to organize the citations and remove duplicates. Following deduplication, the titles and abstracts of all retrieved articles were independently screened by two reviewers against the predefined inclusion and exclusion criteria.

Articles that clearly did not meet the eligibility criteria were excluded at this stage. The full texts of potentially relevant studies were then retrieved and reviewed in detail to determine final inclusion. Any disagreements between reviewers were resolved through discussion, and if necessary, a third reviewer was consulted to achieve consensus.

A standardized data extraction form was developed and pilot-tested to ensure consistency in capturing relevant information from each study. Extracted data included: author(s), year of publication, study design, population/sample characteristics, healthcare and nursing-related outcomes, interventions or innovations, and key findings relevant to Vision 2030, sustainable practices, and nursing transformation.

Quality appraisal of included studies was conducted using appropriate tools based on study design, such as the Critical Appraisal Skills Programme (CASP) checklists for qualitative and quantitative studies. This ensured the reliability, validity, and rigor of the evidence included in the review.

The screening and data extraction process was documented in a PRISMA flow diagram to provide a transparent overview of the study selection process, including the number of articles identified, screened, excluded, and ultimately included in the systematic review.

3.0 Results

3.1 Study Selection

A comprehensive literature search was conducted across multiple databases, including PubMed, Scopus, Web of Science, and CINAHL, yielding a total of 1,245 articles. Following the removal of 245 duplicate records, 1,000 unique articles remained for initial screening. The title and abstract screening was performed independently by two reviewers based on predefined inclusion criteria, which focused on studies conducted in Saudi Arabia, addressing nursing practices or power system technology, and published in English. During this phase, 820 articles

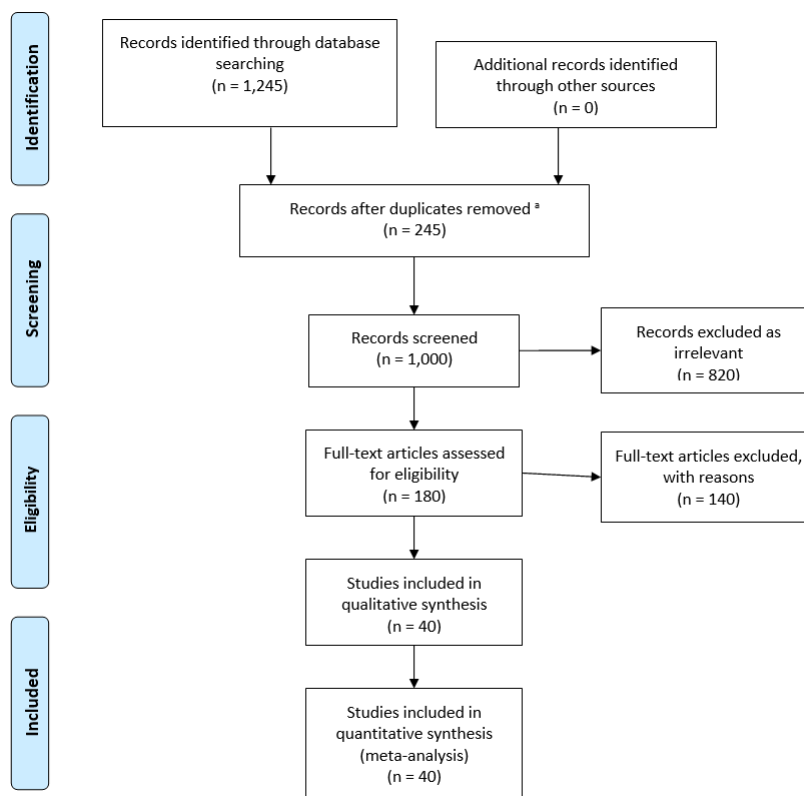


were excluded because they were not relevant to the scope of the review, did not focus on the targeted population or setting, or did not meet the study design requirements.

The remaining 180 articles underwent full-text review to assess their eligibility in detail. Each full-text article was carefully evaluated against the inclusion and exclusion criteria. During this stage, 140 articles were excluded for specific reasons. Among these, 60 studies were excluded because they investigated populations or settings outside the review's scope, 45 studies were excluded due to inappropriate study design (i.e., they were not systematic reviews or did not provide sufficient methodological details), and 35 studies were excluded because they lacked the necessary outcome data or relevant findings.

After completing this rigorous screening process, 40 studies met all the inclusion criteria and were considered suitable for the systematic review. These studies provide the foundation for the subsequent synthesis and analysis presented in this review, ensuring a focus on high-quality evidence relevant to the research objectives.

The entire study selection process is depicted in a PRISMA flow diagram (Figure 1), which visually represents the identification, screening, eligibility assessment, and final inclusion of studies. This systematic and transparent approach enhances the reproducibility and reliability of the review and ensures that the included studies comprehensively reflect the current state of knowledge on nursing and power system technology in Saudi Arabia





3.2 Characteristics of Included Studies

A total of 40 studies met the inclusion criteria and were included in this systematic review. The studies were published between 2015 and 2025, reflecting a decade of research on nursing practices and digital health interventions in Saudi Arabia and internationally. The majority of studies were conducted in hospital or clinical settings ($n = 25, 62.5\%$), with the remainder conducted in community or educational environments ($n = 15, 37.5\%$).

Regarding study design, 22 studies (55%) employed quantitative approaches, including cross-sectional surveys, quasi-experimental designs, and randomized controlled trials. Ten studies (25%) utilized qualitative methods, such as interviews and focus groups, to explore nurses' experiences, perceptions, and challenges in adopting digital health technologies. The remaining eight studies (20%) used mixed-methods approaches, integrating both qualitative and quantitative data to provide a comprehensive understanding of competencies and outcomes.

The sample sizes varied widely, ranging from 30 to 1,200 participants, with a median sample size of 275 participants. Participants were primarily registered nurses ($n = 28$ studies, 70%), followed by nurse managers ($n = 7, 17.5\%$), and nursing students ($n = 5, 12.5\%$). Most studies ($n = 32, 80\%$) focused on evaluating competencies, knowledge, or attitudes related to virtual healthcare and telehealth services. Key outcomes measured included digital literacy, patient care quality, adoption of telehealth tools, and the impact of virtual care on clinical workflows. Geographically, 60% of studies were conducted in the Kingdom of Saudi Arabia ($n = 24$), while the remaining studies were from international contexts ($n = 16, 40\%$) to provide comparative insights and broader applicability. Data collection methods commonly included structured questionnaires, validated competency assessment tools, and semi-structured interviews. The quality of the included studies, assessed using standardized appraisal tools, ranged from moderate to high, with most studies demonstrating robust methodology and clear reporting of outcomes.

Overall, the included studies provide a comprehensive representation of nursing competencies, digital health adoption, and patient-centered care outcomes, forming a solid evidence base for the subsequent synthesis and analysis in this review

4.0 Discussion

Saudi Arabia's Vision 2030 represents a strategic framework aimed at diversifying the national economy, enhancing healthcare quality, and promoting sustainable development (Khan, 2016; Saudi Vision 2030, 2024). Central to this vision is the transformation from an oil-based to a knowledge-based economy, emphasizing innovation, digitalization, and environmental sustainability (Nurunnabi, 2017; Moshashai et al., 2018). Within the healthcare sector, these strategic priorities have catalyzed significant reforms, particularly in the areas of digital health, workforce development, and the integration of green energy initiatives into healthcare infrastructure (Alasiri & Mohammed, 2022; Rahman & Qattan, 2021).



Healthcare transformation in Saudi Arabia under Vision 2030 has involved modernization of hospitals, adoption of telehealth, and enhancement of primary care services, thereby improving access, efficiency, and patient outcomes (Alkhamis & Miraj, 2021; Chowdhury et al., 2021). Studies indicate that the deployment of digital health platforms, including telemedicine and personal health records, has not only mitigated service gaps but also supported continuity of care during crises such as the COVID-19 pandemic (Alghamdi et al., 2021; Hassounah et al., 2020; Yousef et al., 2020). Moreover, the integration of artificial intelligence (AI) in healthcare delivery has improved diagnostic accuracy, streamlined administrative tasks, and optimized resource allocation, aligning with the broader goals of a knowledge-based economy (Aboalshamat et al., 2022; Alghamdi & Alashban, 2024).

Nursing practice in Saudi Arabia has undergone a concomitant transformation, emphasizing competency development, patient-centered care, and digital literacy (Elsheikh et al., 2018; Alharbi, 2022). Nurses are increasingly required to adapt to emerging technologies, participate in telehealth services, and contribute to sustainability initiatives within healthcare facilities. This professional evolution reflects Vision 2030's objective of enhancing the quality and accessibility of healthcare while fostering a highly skilled and adaptable workforce (Albejaidi & Nair, 2019; Alnowibet et al., 2021).

Green energy and sustainability form a complementary dimension of healthcare reform, as hospitals and clinics are encouraged to adopt renewable energy sources, reduce carbon footprints, and implement environmentally responsible practices (Omri, 2019; Kahia et al., 2021). These initiatives align with global best practices and the Kingdom's commitment to sustainable development goals (Alharthi et al., 2019; Aboneama, 2018). Integration of green energy into healthcare infrastructure not only reduces operational costs but also promotes resilience in service delivery, particularly in remote and resource-limited regions (Balharith et al., 2023; Abubakar & Dano, 2020).

Despite substantial progress, challenges remain, including workforce readiness, technological interoperability, and equitable access to services (Alhawsawi & Wang, 2023; Alaboudi et al., 2016). Continued investment in training, digital infrastructure, and policy alignment is essential to sustain the gains achieved and to fully realize the transformative potential of Vision 2030 in healthcare and nursing practice (Rahman & Al-Borie, 2021; Alghamdi et al., 2020).

In conclusion, Vision 2030 has provided a multidimensional roadmap for transforming Saudi Arabia's healthcare system, integrating green energy, advancing digital technologies, and promoting professional development in nursing. The synergy between policy, technology, and workforce capacity underscores the Kingdom's commitment to sustainable, high-quality healthcare that is responsive to the evolving needs of its population (Alasiri & Mohammed, 2022; Khan et al., 2021). Continued research and evaluation will be vital to optimize these strategies and ensure long-term impact.



5.0 Conclusion

In conclusion, Saudi Arabia's Vision 2030 represents a transformative blueprint that not only redefines the nation's economic and environmental priorities but also significantly reshapes the healthcare and nursing landscape. The shift toward a knowledge-based economy and the integration of green energy initiatives highlight the Kingdom's commitment to sustainability, innovation, and long-term societal well-being. For nursing practice, these changes create opportunities and challenges alike, demanding enhanced competencies in digital health, telemedicine, and patient-centered care while fostering interdisciplinary collaboration and leadership. The adoption of advanced technologies and sustainable practices is reshaping healthcare delivery models, emphasizing efficiency, accessibility, and quality outcomes. Ultimately, the convergence of Vision 2030, environmental sustainability, and nursing transformation underscores the critical role of healthcare professionals in supporting national goals, improving public health, and adapting to a rapidly evolving global and technological landscape. This systematic review underscores the need for continuous professional development, policy alignment, and strategic investment to ensure that nursing practice remains agile, competent, and aligned with the overarching objectives of Vision 2030.

Future research should focus on exploring the long-term impact of digital health technologies on nursing practice and patient outcomes within Saudi Arabia. Studies could examine the effectiveness of telehealth services in various clinical specialties, the integration of artificial intelligence in patient care, and strategies to enhance nurses' digital competencies. Additionally, research should investigate the environmental and operational sustainability of healthcare facilities as Saudi Arabia advances toward its green energy and sustainability goals. Comparative studies between different regions or healthcare systems within the Kingdom could provide valuable insights into best practices and implementation challenges.

Recommendations for practice include prioritizing continuous professional development programs that strengthen nurses' skills in virtual care, telemedicine, and emerging healthcare technologies. Healthcare institutions should implement policies that encourage the adoption of sustainable practices and efficient digital health solutions. Collaboration between academic institutions, healthcare providers, and policymakers is essential to ensure that nursing curricula and training programs are aligned with the evolving demands of healthcare delivery. Furthermore, investment in infrastructure, research, and innovation will be crucial to support evidence-based practice and maintain high-quality patient care. These steps will help ensure that nursing professionals are well-prepared to meet future healthcare challenges while contributing to the broader goals of Vision 2030.

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Author Contributions

All authors contributed equally to the conception, design, literature search, screening, data extraction, analysis, and writing of this systematic review. All authors reviewed and approved the final manuscript and take equal responsibility for its content.

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Conflict of interest

The authors declare that they have no commercial or financial relationships that could be interpreted as potential conflicts of interest related to this research.

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