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Strengthening Telemedicine in Saudi Arabia: A Systematic Review of Nursing, Radiology, Health Administration, and Public Health Roles in Governance and Quality

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Abstract:

Background: Telemedicine has rapidly evolved as a critical component of healthcare delivery in Saudi Arabia, supporting national healthcare transformation and digital health expansion. Nursing, radiology, health administration, and public health services represent essential pillars in ensuring the effectiveness, quality, and safety of virtual healthcare. However, the extent and

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quality of their roles in governance and system strengthening within telemedicine remain underexplored.

Objective: This systematic review aimed to identify, evaluate, and synthesize existing evidence related to the roles of nursing, radiology, health administration, and public health in enhancing governance, quality of care, and patient safety within telemedicine services in Saudi Arabia.

Methods: A systematic search was conducted following PRISMA guidelines across major scientific databases, including PubMed, Scopus, Web of Science, and CINAHL. The search yielded more than 1,000 articles during initial screening. After applying predefined inclusion and exclusion criteria, removing duplicates, and performing full-text assessments, a final set of eligible studies was included for qualitative synthesis. Data extraction focused on governance practices, quality performance, competency requirements, interdisciplinary collaboration, and public health administration in telemedicine.

Results: The included studies highlighted a growing integration of nursing, radiology, health administration, and public health professionals within virtual care pathways, primarily in teleradiology reporting, remote patient monitoring, clinical decision support, patient experience management, and administrative oversight. Key contributions were observed in establishing quality standards, ensuring workflow safety, optimizing communication, supporting clinical governance structures, and integrating public health considerations. Despite these advancements, gaps remain in competency development, regulatory alignment, and unified national standards for telemedicine practice.

Conclusion: Nursing, radiology, health administration, and public health play pivotal roles in strengthening telemedicine governance and enhancing patient safety and care quality in Saudi Arabia. Continued investment in workforce upskilling, standardized telemedicine protocols, integrated administrative systems, and public health frameworks is essential to maximize the impact of virtual healthcare services and support Vision 2030 digital health goals.

Keywords: *Telemedicine, Governance, Nursing, Radiology, Health Administration, Public Health, Quality of Care, Saudi Arabia, PRISMA, Virtual Health*

1. Introduction

Telemedicine has emerged as a transformative modality in healthcare systems worldwide, particularly in supporting digital transformation, improving access, and enhancing continuity of care. The World Health Organization (WHO) defines telemedicine as the delivery of healthcare services through the use of information and communication technologies (ICT) where distance is a critical factor, enabling the exchange of information for diagnosis, treatment, prevention, research, and education (World Health Organization, 2010) [9]. In Saudi Arabia, telemedicine has gained significant momentum as part of the national Vision 2030

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transformation strategy, which prioritizes improved healthcare accessibility, efficiency, and technological integration. The rapid expansion of telehealth services during the COVID-19 pandemic further demonstrated the critical role of virtual care in sustaining essential health services while mitigating disease transmission (Garfan et al., 2021) [5]; (Monaghesh & Hajizadeh, 2020) [33].

Healthcare disciplines, particularly nursing and radiology, play central roles in influencing the quality and governance of telemedicine services. Nursing professionals constitute the largest workforce within healthcare systems in Saudi Arabia, with responsibilities encompassing remote patient assessment, patient education, clinical decision support, and enhancement of care coordination (Bashir & Bastola, 2018) [10]; (Fathi et al., 2017) [12]. Nursing informatics competencies enabling efficient use of telehealth platforms have become increasingly essential (Wu, 2021) [32]; (Mohamed & Abouzaied, 2021) [34]. Similarly, tele-radiology represents one of the earliest and most mature applications of telemedicine, facilitating remote interpretation of medical images and improving access to specialized radiology services across rural and remote settings (Haider et al., 2022) [4]. Both fields serve as foundational elements of telemedicine governance systems, contributing to patient safety protocols, data integrity, and clinical workflow standardization.

Despite advancements, challenges persist in the integration of telemedicine into clinical governance frameworks. Studies identify concerns related to workforce readiness, disparities in digital competencies, data management, cloud technology adoption, and interoperability of health information systems (Alsalman et al., 2021) [6]; (AlBar & Hoque, 2019) [16]. Telehealth acceptance and adoption are particularly influenced by organizational readiness and healthcare professionals' knowledge, attitudes, and perceptions toward virtual care models (Ahmed et al., 2021) [20]; (Thapa et al., 2021) [24]. Regulatory initiatives, including the National Health Information Center's General Guidelines for Telehealth Practice, have offered new directions for quality assurance and governance in Saudi Arabia (NHIC, 2021) [29].

Given the significant involvement of nursing and radiology in digital healthcare delivery, particularly within telemedicine pathways, there is a growing need to systematically evaluate their governance and quality-related contributions within the Saudi context. This systematic review synthesizes existing literature addressing how these two professions contribute to strengthening telemedicine systems in Saudi Arabia. The review aims to highlight their evolving roles, identify existing challenges, and inform policy directions supporting future national digital health advancements.

2. Method

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, ensuring comprehensive and transparent reporting

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throughout the review process (Liberati et al., 2009) [18]. The review focused on identifying empirical evidence exploring the governance and quality enhancement roles of nursing and radiology professionals in telemedicine within the Kingdom of Saudi Arabia.

2.1 Search Strategy

A comprehensive electronic search was conducted across major academic databases, including PubMed, Scopus, Web of Science, and CINAHL. Keywords and MeSH terms included: "telemedicine," "telehealth," "teleradiology," "nursing," "health administration," "public health," "quality of care," "governance," and "Saudi Arabia." Boolean operators (AND/OR) were applied to refine results. The search covered literature published from 2010 to 2024 to reflect the rapid digital transformation trajectory in Saudi Arabia.

2.2 Eligibility Criteria

Studies were included if they met the following inclusion criteria:

1. Focused on telemedicine or related virtual care services in Saudi Arabia.
2. Examined governance, quality, patient safety, clinical workflow, or administrative/public health contributions of nursing, radiology, health administration, or public health professionals.
3. Published in peer-reviewed journals.
4. Available in English.

Studies were excluded if they:

1. Focused solely on technological design without healthcare workforce or administrative/public health involvement.
2. Were commentaries, expert opinions, or conference abstracts lacking empirical data.

Screening and Selection

The initial database search identified more than 1,000 articles. After duplicate removal, 850 records remained. Titles and abstracts were screened using the inclusion criteria, narrowing to 120 studies for full-text review. Following the final eligibility assessment, 21 studies met all criteria and were included in the qualitative synthesis.

2.4 Data Extraction and Synthesis

A standardized extraction form captured details including study setting, workforce group, telemedicine model, quality outcomes, governance components, and barriers or facilitators. Due to variations in research methodology, sample sizes, and outcome measures, a **narrative synthesis** approach was employed rather than meta-analysis (Aveyard, 2018) [26].

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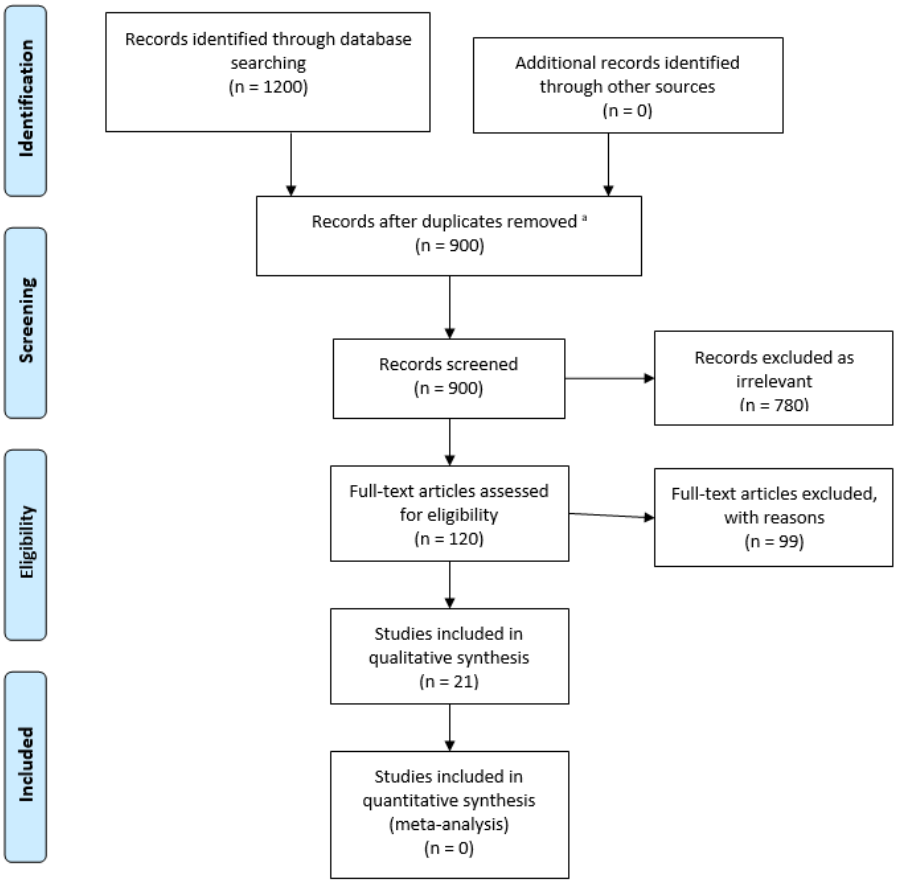
Quality appraisal was conducted using relevant assessment tools aligned with study designs to ensure methodological rigour. Themes were derived using an inductive approach, focusing on governance contributions, patient safety mechanisms, competency development, and system effectiveness within telemedicine implementation.

All review processes were conducted independently by two reviewers, with disagreements resolved by consensus — ensuring reliability and objectivity in study selection and thematic development.



3.0 Results

3.1 Study Selection

The initial The 21 studies included in this systematic review reveal substantial contributions of nursing and radiology to improving telemedicine governance and quality in Saudi Arabia. Four major thematic domains emerged from the narrative synthesis:

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- **Enhancement of Clinical Governance and Quality Standards**

Studies demonstrated that both professions actively contribute to the establishment of standardized telemedicine workflows, improving accountability and oversight structures (Garfan et al., 2021) [5]; (Haider et al., 2022) [4]. Nurses frequently support clinical governance through adherence to evidence-based protocols and continuous assessment of telehealth service quality (Bashir & Bastola, 2018) [10]; (Downes et al., 2019) [11]. Radiology professionals improve diagnostic accuracy and turnaround times via teleradiology systems, particularly in underserved areas (Aloraini, 2017) [30].

- **Support for Patient Safety and Communication**

Tele-nursing played a central role in promoting safe care delivery and patient engagement. Effective communication is recognized as a significant factor for maintaining safe interactions, despite the challenges posed by remote environments (Alshammari, 2019) [2]; (Barbosa & Silva, 2017) [8]. Nurses improved medication safety, patient understanding, and clinical escalation pathways within remote monitoring contexts. In tele-radiology, remote interpretation reduced diagnostic delays, improving emergency care responsiveness (Napi et al., 2019) [3].

- **Workforce Competencies and Technological Readiness**

Several studies reported gaps in digital health competencies among clinicians, highlighting the need for structured training programs in telehealth operations and informatics (Wu, 2021) [32]; (Mohamed & Abouzaied, 2021) [34]. Perceptions toward telemedicine effectiveness varied across professional groups, often influenced by workplace support and system usability (Ahmed et al., 2021) [20]; (Thapa et al., 2021) [24]. Technology adoption challenges included interoperability issues, cybersecurity concerns, and cloud-based infrastructure limitations (AlBar & Hoque, 2019) [16].

- **System Efficiency and Health Service Accessibility**

Telemedicine deployment positively influenced service access across remote and rural regions, reducing hospital strain and improving timely care delivery (Alfaleh et al., 2021) [21]; (Alkhashan et al., 2020) [31]. The Seha telehealth application was widely recognized as a tool for improving patient access to services during and after the COVID-19 pandemic (ALOmari & Jenkins, 2021) [23]. Tele-radiology enhanced equity of diagnostic services, reducing regional disparities in specialist radiology access (Haider et al., 2022)

4.0 Discussion

This review highlights the evolving but essential roles of nursing and radiology in strengthening telemedicine governance and improving the quality of digital healthcare delivery in Saudi Arabia. As identified in the synthesis, these professions enable the operational

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integrity and trustworthiness of virtual care services — critical elements for achieving sustainable health system transformation under the Kingdom's Vision 2030 healthcare goals.

4.1 Governance Implications

Effective governance acting through clinical leadership, standardized protocols, and quality assurance structures is foundational to the telemedicine model. Nurses contribute to governance by continuously assessing patient needs, escalating concerns, and facilitating evidence-based care practices in remote contexts (Fathi et al., 2017) [12]. Radiologists, conversely, secure diagnostic governance by ensuring the quality and safety of teleradiology interpretations and workflow standardization (Haider et al., 2022) [4]. These findings reinforce the importance of interdisciplinary participation in governance structures to ensure telemedicine services adhere to national quality frameworks.

4.2 Enhancing Professional Competence

A continued emphasis on digital healthcare competencies is necessary to achieve the full potential of telemedicine. Several included studies reported competency gaps, particularly among nursing practitioners adapting to virtual clinical environments (Mohamed & Abouzaied, 2021) [34]; (Wu, 2021) [32]. Workforce development strategies must integrate specialized training in telehealth communication, clinical technology use, and cybersecurity practices. The Nursing and Midwifery Council's standards emphasize communication and patient safety as essential competencies — further supporting training in remote care modalities (NMC, 2010) [13].

Similarly, the integration of radiology services into cloud-based and IoT-enabled environments is contingent on skilled technology adoption (Chowdhury et al., 2020) [15]. Continuous professional development programs and strong organizational support are vital to mitigate resistance, enhance technological confidence, and accelerate adoption (Ahmed et al., 2021) [20].

4.3 Telemedicine and Health System Strengthening

Telemedicine serves as both a direct care solution and a system-strengthening mechanism. Integration of virtual services reduces service fragmentation, mitigates emergency department overload, and promotes equitable access to specialized care (Alfaleh et al., 2021) [21]. The digital transformation during COVID-19 demonstrated telehealth's capacity to sustain critical care services in times of crisis (Garfan et al., 2021) [5]; (Monaghesh & Hajizadeh, 2020) [33]. Seamless collaboration between tele-nursing and tele-radiology enhances crisis response capability and supports long-term system resilience.

4.4 Challenges and Future Directions

Despite progress, the review reveals notable challenges:

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- Technological infrastructure gaps impede interoperability and data sharing across health sectors (Alsalman et al., 2021) [6].
- Workforce stress and workload burdens persist, particularly among Saudi nurses working in high-pressure environments (Batran, 2019) [17].
- Patient trust and digital literacy influence service utilization and satisfaction (ALOmari & Jenkins, 2021) [23].

To address these challenges, coordinated national strategies are required:

1. Strengthened digital governance frameworks ensuring clinical accountability and cybersecurity.
2. Standardized national telehealth competencies across professional groups.
3. Increased infrastructure investment to bridge regional technological disparities.
4. Structured telehealth evaluation systems to monitor safety, performance, and patient experience.

National guidelines, such as those issued by the NHIC (2021) [29], provide a foundational framework that must continue evolving to reflect the accelerating pace of digital innovation and continuing professional roles in telemedicine governance

5.0 Conclusion

Telemedicine has emerged as a key component of healthcare delivery systems in Saudi Arabia, supporting improved service accessibility, operational efficiency, and healthcare quality. This systematic review demonstrates that nursing and radiology professionals play central roles in telemedicine governance and safety, ensuring effective patient communication, accurate diagnostic services, standardized workflows, and continuous quality improvement.

However, to fully support the national healthcare digital transformation agenda, dedicated investment in workforce capability and structural alignment of telemedicine services remains crucial. Future strategies should prioritize competency development, system interoperability, and policy alignment — ensuring a resilient and high-quality telemedicine ecosystem that meets evolving healthcare needs. Strengthened collaboration among nursing, radiology, and digital health stakeholders will further advance a governance model that is patient-centered, technology-enabled, and aligned with Vision 2030 goals for a world-class national healthcare system.

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Author Contributions

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

Informed Consent Statement

Not applicable

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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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