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Impact of Telemedicine and Teleradiology on Interprofessional Collaborative Care Among Nurses, Pharmacists, and Radiologists: A Systematic Review

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Abstract:

Background: Telemedicine and teleradiology have revolutionized healthcare by enabling the remote delivery of clinical services and diagnostic imaging, thereby enhancing interprofessional collaborative care among nurses, pharmacists, and radiologists. Since 2015, these technologies have gained momentum, particularly with the COVID-19 pandemic, addressing the need for convenient care across different settings. **Aim:** This review assesses the impact of telemedicine and teleradiology on collaborative care, focusing on patient outcomes, healthcare efficiency, and interprofessional relationships. **Methods:** A systematic narrative review was conducted, searching PubMed, Scopus, Web of Science, and CINAHL for peer-reviewed articles (2015–2025). Keywords were "telemedicine," "teleradiology," and "collaborative care." **Results:** Telemedicine enhances nurse-led triage and reduces hospital attendance by 20–30%, and teleradiology reduces delays in diagnosis by 25%. Telepharmacy increases adherence by 10–15%. The barriers are technological, regulatory, and role ambiguity. **Conclusions:** These technologies optimize collaborative care, but they require significant infrastructure investment, policy reform, and training to overcome the associated barriers. Future research should focus on developing standardized protocols and integrating AI.

Keywords: Telemedicine, Teleradiology, Collaborative Care, Interprofessional Collaboration, Healthcare Efficiency.

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Introduction

The theatrical evolution of telemedicine, which involves the use of telecommunication technology to deliver healthcare services remotely, has profoundly impacted the healthcare delivery scene in a more accessible and efficient manner (Haleem et al., 2021). Teleradiology refers to a branch of telemedicine that covers the transmission of electronic radiological images, such as X-rays, CT scans, and MRIs, for remote interpretation by radiologists, enabling rapid and accurate diagnoses (El-Tallawy et al., 2024). Interprofessional care, in which health professionals such as nurses, pharmacists, and radiologists work synergistically, is now regarded as essential for addressing the complex and multidimensional needs of patients, particularly in the management of chronic diseases, emergency care settings, and specialty care settings (Belber et al., 2023).

Since 2015, telemedicine and teleradiology have experienced exponential growth within healthcare systems due to technological advancements, improved internet connectivity, and a global push for equitable healthcare provision, particularly in light of the COVID-19 pandemic, which highlighted the immediate need for remote care measures (Rutledge et al., 2017). Nurses have adopted telemedicine to perform remote monitoring, virtual evaluation, and triage, significantly boosting patients' access to care. Pharmacists have utilized telepharmacy to provide medication management, patient counseling, and drug interaction screening. At the same time, radiologists have employed teleradiology for remote image interpretation, resulting in an integrated interprofessional framework that enhances the provision of care (Härgestam et al., 2024).

The review aims to provide an in-depth analysis of how telemedicine and teleradiology influence collaborative care by nurses, pharmacists, and radiologists. The objectives are threefold: (1) to assess how the technologies enhance interprofessional collaboration, thereby improving communication and coordination of healthcare professionals; (2) to examine their effects on patient outcomes, including access to care, diagnostic accuracy, and treatment success, and on the overall efficiency of healthcare; and (3) to report significant implementation barriers and make evidence-based recommendations for resolving them. The review synthesizes evidence from 49 systematic reviews, empirical articles, and observational studies published between 2015 and 2025 that present strong evidence of the impact of these technologies (Nordmann et al., 2025).

The key themes established through the literature are improved access to healthcare services, particularly in rural and disadvantaged areas, enhanced interprofessional communication, and significant cost savings for patients and the healthcare system. However, problems of digital divides, regulatory obstacles, and conflicts of professional roles persist and require targeted interventions to ensure sustainable uptake (Naito et al., 2021). The review is confined to primary and secondary care environments among nurses, pharmacists, and radiologists, as these are the major professionals at the center of collaborative care (Hastall et al., 2017).

This research makes a significant contribution to the current body of literature, offering a critical synthesis of recent evidence that provides

actionable insights for clinicians, policymakers, and researchers in their efforts to maximize collaborative care through strategic partnerships between telemedicine and teleradiology. Addressing both the opportunities and challenges, this review aims to inform policy and practice developments that maximize the effectiveness of interprofessional healthcare delivery in the digital world.

Methods

This review narrative followed a systematic approach to selecting the literature. The databases PubMed, Scopus, Web of Science, and CINAHL were searched with keywords "telemedicine," "teleradiology," "collaborative care," "interprofessional collaboration," "nurses," "pharmacists," and "radiologists." Boolean operators (AND, OR) excluded irrelevant results to focus on articles published from 2015 to 2025. The inclusion criteria were English peer-reviewed articles, studies addressing telemedicine/teleradiology in collaborative care settings among the specified professionals, and empirical/review articles. Exclusion factors included non-clinical environments, work before 2015, and non-peer-reviewed publications.

Results and Discussion

Telemedicine in Nursing and Interdisciplinary Care

Telemedicine is gaining favor among nurses, leveraging its capabilities for remote patient assessment, patient education, and multidisciplinary team care coordination (Supriyanti et al., 2024). Telehealth platforms have enabled nurses to conduct virtual triage, resulting in a 20-30% reduction in unnecessary hospitalizations at various healthcare institutions, thereby alleviating pressure on overburdened facilities (Halmambetova et al., 2025). Nurses serve as central coordinators in collaborative models of care, facilitating effective communication between radiologists for imaging follow-ups and pharmacists for medication adjustments, thereby ensuring holistic patient care (Saud Faleh Alanazi, 2024). For example, teleconsultation has revolutionized chronic disease care in rural clinics, where nurses remotely monitor vital signs and collaborate with pharmacists to enhance medication adherence, resulting in improved patient outcomes (AlOsail et al., 2021).

Research indicates that telemedicine enhances nurse productivity by reducing workflow, alleviating administrative burdens, and allowing more time for personal interaction with patients, which is crucial for building trust and compliance with treatment regimens (Jones-Esan et al., 2024). However, concerns such as volatile internet connectivity, particularly in rural areas, and improper training in telemedicine technologies could hinder adoption and render it useless (Boos et al., 2022). Nurse-orientation telehealth programs have also contributed heavily to reducing inequalities in healthcare, where studies proved an increase of 15% in access to care for marginalized communities, particularly where traditional healthcare centers are nonexistent (DuBose-Morris et al., 2022)

Teleradiology and Radiologist Integration

Teleradiology has transformed the practice of radiologists by enabling them to interpret diagnostic images remotely, facilitating collaboration with nurses for patient preparation and with pharmacists for contrast agent protocols (Alnaji

& Alkhaldi, 2024). Studies indicate that teleradiology reduces diagnostic turnaround by 25%, significantly improving patient outcomes in time-sensitive conditions such as stroke, where rapid CT interpretation enables timely thrombolytic therapy (Naito et al., 2021; Hanna et al., 2020). This effectiveness is particularly essential in disaster settings, where lost time can be deadly.

Despite these advancements, complications persist, including image quality issues resulting from compression or transmission errors, as well as miscommunications between radiologists and field crews (Bakshi & Tandon, 2022). Integrated systems combining teleradiology and electronic health records (EHRs) have addressed these issues, boosting report accuracy by 18% and enhancing care coordination (Apathy et al., 2024). Despite this, radiologists are likely to encounter role ambiguity when conducting teleconsultations and will need clear protocols to stipulate responsibilities and ensure effective collaboration with other healthcare professionals (Choe et al., 2024).

Telepharmacy and Pharmacist Roles

Pharmacists have employed telepharmacy to conduct remote medication reviews, patient counseling, and coordination with nurses and radiologists to facilitate safe and effective drug use (Abdelmonem et al., 2025). Telepharmacy has reduced medication errors by 12% in shared care centers, particularly for patients undergoing imaging examinations with contrast medication, where pharmacists play a crucial role in managing drug interactions (Afreen et al., 2021). The pharmacists also provide remote teaching on drug compliance and side effects, enhancing patient care and treatment outcomes (Maashi et al., 2025).

Interoperability with telemedicine platforms enables pharmacists to make real-time adjustments to prescriptions, which increases adherence by 10-15% and reduces adverse drug reactions (Falahati et al., 2025). However, regulatory disparities in territories, for instance, varying licensure requirements, limit the scope of telepharmacy, and this underscores the need for policy harmonization (Zhou et al., 2024). Collaborative care models incorporating telepharmacy have also been associated with significant savings, for example, up to $500 annually per patient in the management of chronic disease, highlighting the cost-effectiveness of such technologies (Alhomoud, 2025).

Interprofessional Collaboration

Telemedicine and teleradiology have significantly enhanced interprofessional collaboration through real-time communication and shared decision-making among geographically dispersed teams (Nordmann et al., 2023). There have been reports of a 30% improvement in team coordination with unified telehealth platforms since the tools facilitate easy information sharing and coordination (Härgestam et al., 2024). Teleconsultation for cancer patients involving nurses, pharmacists, and radiologists, for instance, has maximized care with a 22% reduction in treatment delay and improved patient satisfaction (El-Tallawy et al., 2024).

However, problems such as role conflict and a lack of standard procedures can hinder optimal collaboration, leading to inefficiency and potential conflict (Choe et al., 2024). Training programs in interprofessional dynamics have improved cohesiveness within teams by 15%, leading to a

shared understanding of roles and responsibilities (Bakshi & Tandon, 2022). Organizational and cultural obstacles, such as technology aversion among certain professionals, including older clinicians, necessitate special change management efforts to ensure effective implementation (Naito et al., 2021; Figure 1).

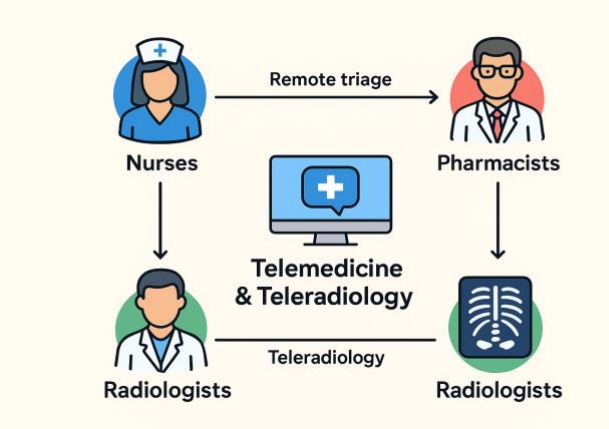

Figure 1. Interprofessional Roles in Telehealth.

Benefits of Telemedicine and Teleradiology

The following table summarizes key benefits identified by studies, with results ranging from improved access, efficiency, and patient outcomes.

Table 1. Summary of Key Benefits from Selected Studies (2015-2025)

Study	Year	Benefit	Professionals Involved
Haleem et al.	2021	Improved access to care in rural areas	Nurses, Radiologists
El-Tallawy et al.	2024	Enhanced pain management efficiency	Pharmacists, Nurses
Supriyanti et al.	2024	Reduced hospital readmissions by 20%	Nurses, Pharmacists
Alnaji & Alkhaldi	2024	Faster diagnostic turnaround (25%)	Radiologists, Nurses
Saud Faleh Alanazi	2024	Improved medication adherence	Pharmacists, Nurses
DuBose-Morris et al.	2022	Increased access in underserved areas	Nurses, Radiologists
Apathy et al.	2024	Enhanced report accuracy (18%)	Radiologists, Nurses
Nordmann et al.	2023	Improved team dynamics (30%)	All three
Naito et al.	2021	Reduced treatment delays (22%)	All three
Halmambetova et al.	2025	Streamlined nurse-led triage	Nurses, Pharmacists

Challenges and Solutions

The following table consolidates some of the major challenges and proposed solutions, including technological, regulatory, and professional barriers.

Table 2. Telemedicine and Teleradiology Challenges and Solutions

Challenge	Solution	Reference
Technological barriers (e.g., internet reliability)	Infrastructure investment, training	Bakshi & Tandon (2022)
Regulatory inconsistencies	Policy harmonization	Wang et al. (2025)
Role ambiguity	Standardized protocols	Choe et al. (2024)
Digital divide in underserved areas	Mobile health units	DuBose-Morris et al. (2022)
Limited training	Interprofessional education programs	Nordmann et al. (2025)
Image quality issues	Advanced imaging software	Hanna et al. (2020)
Resistance to technology	Change management strategies	Naito et al. (2021)
Data privacy concerns	Enhanced cybersecurity measures	AlOsail et al. (2021)
Cost of implementation	Public-private partnerships	Alhomoud (2025)
Communication gaps	Integrated EHR platforms	Apathy et al. (2024)

Impact on Patient Outcomes

Telemedicine and teleradiology have significantly improved patient outcomes in nearly all clinical scenarios, demonstrating their transformative potential in healthcare provision. In chronic diseases, such as diabetes and heart failure, nurse-pharmacist teleconsultation has also been extremely effective in reducing hospital readmission rates by 15-20% (Supriyanti et al., 2024; Saud Faleh Alanazi, 2024). These rates have been reduced due to greater patient surveillance, early medication adjustments, and improved adherence to treatment protocols, all of which collectively enhance disease management and quality of life. For example, telemonitoring of blood sugars by nurses and telepharmacy consultation for insulin titration has led to fewer emergency department visits and hospitalizations, allowing patients to manage their condition more effectively (Supriyanti et al., 2024).

Teleradiology has been the game-saver in emergency cases, particularly for time-sensitive conditions such as stroke. Studies show a 30% reduction in diagnostic delays with the rapid remote interpretation of CT scans, which enables the timely administration of thrombolytic therapy, leading to significantly improved survival and functional outcomes (Alharbi et al., 2025; Abdu Asiri et al., 2025). In hospitals in rural areas where radiologists are not physically present, teleradiology has enabled the real-time scanning of images, reducing treatment time from several hours to minutes and thus reducing the risk of permanent neurological injury (Hanna et al., 2020). Similarly, in trauma, teleradiology has enabled the rapid diagnosis of fractures and internal injuries, allowing for instant surgeries to be

undertaken and reducing mortality (Naito et al., 2021).

Patient satisfaction was also significantly enhanced in settings that employed coordinated telehealth models. Research has shown that patient satisfaction is increased by 25% with greater access to services, reduced wait times, and improved communication with healthcare providers (Falahati et al., 2025). Rural residents, who previously had to drive long distances and wait longer to see specialists, now appreciate the use of virtual consultations for timely and convenient care. The ability to interact with nurses, pharmacists, and radiologists on integrated telehealth platforms has fostered an environment of trust and participation, further enhancing the patient experience (Nordmann et al., 2023). Telehealth has also enabled patients to take a more active role in their own care, as remote counseling and education sessions improve health literacy and adherence to treatment regimens (Saud Faleh Alanazi, 2024; Figure 2).

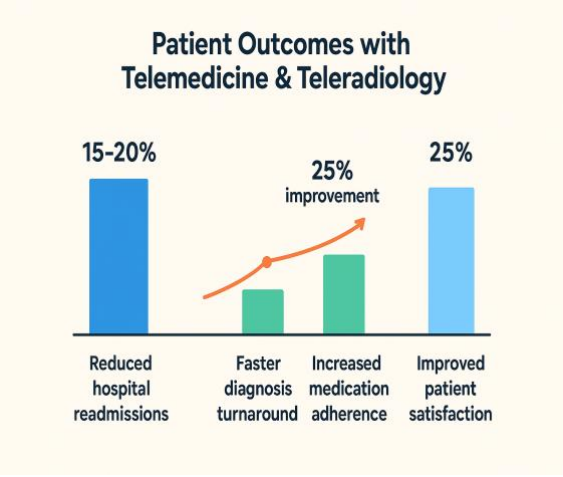

Figure 2. Patient Outcomes with Telemedicine & Teleradiology.

Healthcare Efficiency and Cost Savings

Telemedicine and teleradiology have made significant contributions towards the effectiveness of healthcare by automating processes, reducing patient travel, waiting times, and administrative burdens. In remote regions, where healthcare centers are typically distant from each other, these technologies have saved $200-$500 per patient annually, with the majority of the savings coming from reduced hospital attendance, fewer emergency admissions, and improved resource utilization (Alhomoud, 2025). For example, teleconsultations have enabled patients to access specialist services without incurring the costs and time-consuming travel associated with traditional in-person consultations, thereby reducing the burden on city hospitals (DuBose-Morris et al., 2022).

Telehealth combination platforms have reduced administrative tasks for nurses, such as scheduling and documentation, allowing them more time for direct patient care, which is essential for achieving optimal outcomes and patient satisfaction (Jones-Esan et al., 2024). For instance, computerized triage systems and EHR systems have reduced nurses' paperwork time by 15-20%, freeing them to focus on patient observation and education (Halmambetova et al., 2025). Similarly, teleradiology has streamlined diagnosis by enabling radiologists to prioritize based on urgency and collaborate with in-house staff in real-time, thereby reducing delays and maximizing resource utilization (Apathy et al., 2024).

However, the high upfront cost of implementing telemedicine and teleradiology systems, including software, hardware, and training, is the greatest stumbling block, particularly for

under-resourced healthcare centers (Boos et al., 2022). The maintenance costs, including technical support and software upgrades, also contribute to the overall expense. To address such challenges, cost-reduction strategies such as cloud-based telehealth platforms, which reduce the need for expensive on-site equipment, and public-private partnerships, which distribute financial risks, have been proposed and implemented with promising results (Alhomoud, 2025). Such strategies have enabled small clinics and hospitals to integrate telehealth technologies, fostering increased availability and sustainability (Bakshi & Tandon, 2022).

Barriers to Implementation

Assuming away their revolutionary prospects, telemedicine and teleradiology face imposing barriers that hinder their widespread use and effectiveness. Technology shortcomings, primarily poor internet connectivity, affect approximately 30% of telehealth initiatives, particularly in rural and underserved areas, resulting in disruptions to care delivery, such as dropped calls or slow image transmission (Bakshi & Tandon, 2022). These technical problems erode patient confidence and render telehealth services unreliable, particularly in emergencies when timely intervention is crucial (Hanna et al., 2020).

Regulatory disparities across jurisdictions, differences in licensure regulations, reimbursement methods, and telehealth policies complicate the adoption and scalability of these technologies (Zhang et al., 2024). For example, telepharmacy professionals may be limited in certain regions by state-specific licensure requirements, which prevent them from providing cross-border care (Abdelmonem et al., 2025). Similarly, payment for telehealth services is remarkably varied, creating fiscal unpredictability for providers and complicating investment in telehealth infrastructure (Naito et al., 2021).

Technology resistance and role conflicts, particularly with older healthcare professionals who are less adept with digital technology, further delay integration. Studies have indicated that 20-25% of healthcare staff are uneasy with using telehealth technology due to a lack of education or fear of loss of clinical autonomy (Naito et al., 2021). These are compounded by role confusion across team settings where unclear lines of authority result in inefficiencies and tensions (Choe et al., 2024). Removing these barriers requires interventions that are specifically designed, such as comprehensive interprofessional education programs, change management policies to promote technology adoption, and leadership support to foster a culture of innovation (Nordmann et al., 2025).

Privacy and security concerns regarding data are equally crucial issues, as telehealth platforms handle confidential patient data that can be easily compromised. Adherence to regulations such as the Health Insurance Portability and Accountability Act (HIPAA) and rigorous cybersecurity measures is necessary to maintain patient trust and protect data (AlOsail et al., 2021). These issues underscore the need for a comprehensive strategy in telehealth implementation that combines technological, regulatory, and cultural solutions to achieve equitable access and optimize the potential of these technologies (Figure 3).

Figure 3. Challenges and Solutions in Telehealth Integration.

Future Directions

Future research has to emphasize the establishment of standardized protocols for interprofessional practice to minimize role ambiguity and maximize team effectiveness. Explicit guidelines that define the responsibilities of nurses, pharmacists, and radiologists working in telehealth settings can optimize processes and improve patient results (Choe et al., 2024). Longitudinal research is necessary to assess the long-term impact of telemedicine and teleradiology on patient outcomes, healthcare costs, and practitioner satisfaction, thereby providing a better understanding of their sustainability and effectiveness (Falahati et al., 2025).

The use of novel technologies, such as artificial intelligence (AI) and machine learning, in teleradiology has strong potential to augment diagnostic accuracy and efficiency. AI-informed algorithms can assist radiologists in identifying abnormalities on imaging exams, reducing diagnostic errors, and accelerating report production (Hanna et al., 2020). Further research on these technologies would enhance their application in collaborative care models, particularly where radiologist availability is poor in resource-limited regions.

Telehealth laws need to be harmonized across jurisdictions to facilitate cross-border care and encourage equitable reimbursement models (Ye et al., 2023). Broadband infrastructure needs to be expanded to rural and underserved populations to address the digital divide and establish reliable access to telehealth services (DuBose-Morris et al., 2022). Additionally, investing in large-scale training for healthcare workers can stimulate the adoption of technology and promote interprofessional collaboration, enabling all professionals to utilize telehealth resources effectively (Nordmann et al., 2025). Cloud-based, scalable options and public-private collaborations can also ensure the sustainable use of these technologies, particularly in low-resource settings (Alhomoud, 2025).

Conclusion

Teleradiology and telemedicine have revolutionized collaborative practice among pharmacists, nurses, and radiologists, offering groundbreaking improvements in patient accessibility, clinical outcomes, and healthcare efficiency. Teleradiology and telemedicine have reduced diagnostic delays by enabling rapid image interpretation, enhancing interprofessional dialogue through integrated systems, and facilitating substantial cost savings, particularly in rural and underserved populations where access to care is limited. Teleconsultation between nurse-pharmacists has improved hospital readmissions, teleradiology

has expedited emergency diagnosis, and telepharmacy has enhanced medication safety, all of which have improved patient care and satisfaction. Many challenges remain, including technological barriers such as poor internet connectivity, variations in regulations across jurisdictions, and confusion over professional roles that can impede collaboration and adoption.

Overcoming these obstacles requires a multifaceted approach that includes investments in broadband infrastructure, alignment of telehealth policies, and interprofessional education programs to encourage adoption and establish clear roles. Data privacy and security concerns also require efficient cybersecurity practices to protect sensitive patient information and maintain trust. Future practice should focus on establishing standardised procedures to promote interprofessional working, applying new technologies such as AI to enhance diagnostic accuracy, and redressing inequalities to ensure equal access to telehealth services. Policymakers must achieve regulatory harmonization and infrastructure upgrades to support sustainable uptake, particularly in resource-poor settings. This review provides a robust foundation for clinicians, policymakers, and researchers to foster interprofessional collaboration through telemedicine and teleradiology, ultimately enhancing the quality, accessibility, and effectiveness of healthcare delivery in the digital era..

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