Journal of Ecohumanism
2024
Volume: 3, No: 8, pp. 13281 – 13287
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v3i8.6237

An In-Depth Analysis of Advanced Practice Nurses' Roles in Telemedicine: Evaluating the Impact of Artificial Intelligence on Healthcare Delivery and Patient Outcomes

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Abstract

The rise of telehealth, particularly during the COVID-19 pandemic, has transformed healthcare delivery, providing essential services to patients in remote areas. Advanced practice nurses (APNs) are crucial in utilizing telemedicine to enhance patient care. However, the integration of artificial intelligence (AI) in telehealth remains underexplored.This scoping review examines the role of advanced practice nurses in telemedicine, focusing on AI-assisted interventions. A systematic search was conducted across six databases, including PubMed and CINAHL, for studies published from 2017 to 2023. The review assessed user satisfaction, perceptions of AI technology, and the effectiveness of AI algorithms in telehealth applications.The review synthesized findings from eight studies that utilized AI technologies in telehealth for nursing practice. The results indicate that AI tools, particularly machine learning algorithms, significantly enhance decision-making and patient outcomes. APNs reported improved patient monitoring and satisfaction levels with AI-assisted telehealth services. However, challenges such as inadequate training and technology acceptance among nurses were identified.The findings underscore the pivotal role of advanced practice nurses in leveraging AI technologies within telemedicine to improve healthcare delivery. Enhanced training and support for APNs are essential to fully realize the potential of AI in telehealth.

Keywords: *Advanced Practice Nurses, Telemedicine, Artificial Intelligence, Healthcare Delivery, User Satisfaction.*

Introduction

Telehealth is a rapidly expanding mode of healthcare delivery [1]. It is not novel and has delivered healthcare to remote areas with restricted access [2]. Since the commencement of the COVID-19 pandemic, medical providers and governmental entities, including the U.S. Ministry of Health and Human Services and the Agency for Health Care Research and Quality, have sought effective non-traditional methods for delivering quality care, identifying telehealth as a prominent alternative.

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The advantages of telehealth are considerable. It facilitates instantaneous remote audio and video connection between patients and healthcare practitioners. Patients may effortlessly get treatment without departing from the convenience of their homes. Healthcare personnel may remotely monitor and evaluate individuals in their natural surroundings, therefore reducing the risk of exposure to infectious illnesses. It improves efficiency by decreasing hospital visits and shortening treatment wait times [3-5]. In 2021, 64% of polled families in the United States said they used telehealth services in the preceding 12 months.6 Approximately 65% of individuals indicated a preference for telemedicine, and prominent institutions have announced intentions to maintain its use post-pandemic [6-9]. It has evolved into an essential instrument for healthcare delivery for both doctors and patients.

Studies indicate that artificial intelligence (AI) may significantly improve the quality of telehealth services [10,11]. Examples include the identification of risk factors or initiatives using machine learning methodologies for healthcare practitioners, the creation of smartphone-based initiatives for patients, and the provision of virtual communication assistants (e.g., chatbots) to interact with patients in the absence of care personnel [12,13]. Nurses and nurse practitioners serve as primary care providers and have advocated for telehealth education since 2018, acknowledging the supply and demand challenges that need enhanced incorporation of AI-assisted telehealth services [14].

Nurses and professional nurse practitioners may significantly benefit from telehealth devices by acquiring real-time patient data, such as vital signs and drug histories, to enhance decision-making about patient care. Telehealth facilitates enhanced cooperation among healthcare practitioners, including doctors, pharmacists, as well as social workers, so ensuring patients have complete and coordinated treatment. Moreover, telehealth offers avenues for professional advancement, such as training in telehealth devices and remote medical delivery, enabling healthcare workers to remain current with the newest healthcare trends and enhance patient care [15-17].

Artificial intelligence technology is progressing swiftly, and its significance in telehealth is increasing [18]. Remote patient monitoring, facilitating intelligent diagnosis for healthcare personnel, and evaluating extensive data are few examples of AI's functions in telehealth. Nevertheless, little research has been conducted to create or assess the efficacy of AI-assisted telemedicine therapies. The efficacy of AI-assisted telehealth treatments may be assessed by the satisfaction and perceptions of users, including individuals, nurses, and professional nurse practitioners [19,20]. To ensure that AI-assisted telehealth treatments adequately address patient demands, it is essential to evaluate the impact of AI technology and algorithms on clinical results. The sort of technology used may result in delays or inaccuracies in medical care and data gathering and interpretation. This scoping review aims to examine current research on user satisfaction (individuals, nurses, or nurse practitioners), perceptions of AI-assisted telehealth interventions, the performance of AI algorithms, and the kinds of AI technology used. This scoping study evaluates the efficacy of AI-enhanced telemedicine treatments in nursing practice.

Methodology

Six databases—CINAHL, PubMed, OVID, Web of Science, PsycINFO, and ProQuest—were queried for titles and abstracts published from 2017 to 2023.

AI Technology in Telehealth Interventions for Nurses

This comprehensive review synthesized and summarized eight research that employed AI technology in telehealth interventions for nurses, nurse practitioners, and prospective applications in nursing. The research was conducted in industrialized nations, including the Japan, United States, as well as South Korea. The scarcity of research from poor nations may be ascribed to insufficient financial backing. This study includes four research that received comprehensive backing from either the U.S. administration or the private sector. The MERSQI study quality ratings yielded a mean score of 10.1, with a range of 7.7 to 13.7. The final review included papers of moderate to high quality. The AI technology used primarily consisted of machine learning algorithms capable of recommending optimal choices, aiding in decision-making, identifying pathological alterations and lesions in the human body, and recognizing behavioral patterns relevant to

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nursing. The results correspond with existing research, indicating the advantages of machine learning in medical services [21-24].

Effectiveness

Two research suggest improved patient medical results [25,26]. Two investigations shown that data collected by sensors were enough to detect patients' actions and medical events at home, enabling remote alerts for nurses [27, 28]. Two studies investigated picture data that shown the capacity to forecast glaucoma and wounds in patients outside of hospital settings, which may be used by nurses or certified nurse practitioners in nursing homes [29,30]. Qualitative research evaluated the decision-making experiences of Advanced Nurse Practitioner students. The researchers discovered that the AI system delivering medical data in telehealth might either facilitate or obstruct decision-making. They suggested that the AI algorithm may serve as a possible facilitator, provided that students were schooled in the interaction and substance of AI technology [29]. Survey research evaluated perceptions of telemedicine that offers AI-based advice [31]. The usability of the mobile application impacted the impression of telehealth. This suggests that intuitive mobile applications are more probable to foster favorable impressions of telehealth among patients. Eight research indicate that AI-assisted telehealth treatments in nursing are successful, as shown by their favorable results and outcomes.

Consequences for Nursing

Remote monitoring is a significant advantage of telehealth, since technology facilitates real-time voice and visual interaction among a patient and a healthcare professional. Patients with certain conditions, such as pressure ulcers or diabetes, must attend clinic appointments in person. Through AI-assisted telehealth interventions, patients may get excellent treatment from clinicians, such as home visiting nurses and wound care nurse practitioners, while remaining at home [32-34]. Research studied color fundus imaging data and shown good accuracy in identifying alterations. Timely identification of worsening glaucoma enables home care or nursing facility nurses to provide prompt preventative nursing interventions (e.g., fall prevention). Two studies by Fritz et al. [27,28] suggest that sensor-based remote monitoring may serve as an effective instrument for nurses to avert adverse occurrences (e.g., falls, sleeplessness) while patients remain comfortably at home.

Nurses in professional positions are crucial in including families and patients as collaborators in care. Enhancing the comprehension of patient and family participation in treatment is essential to improve their experience and involvement, such as via patient-reported experiential measures (PREMs) and patient-reported outcome measures (PROMs). Significant knowledge deficiencies include the exploration of spirituality, cultural safety, cultural sensitivity, and advanced practice in nursing [35,36]. Turkelson et al. [37] emphasized that simulation involving NP students enhanced cultural awareness towards patients of Hispanic descent. The umbrella assessment of the quality of primary healthcare nurse practitioner practice [38] identified a lack of indicators for measuring cultural safety, especially concerning Indigenous Peoples. Addressing these information gaps is essential to empower patients and families in their healthcare decisions [39].

The existing understanding of the impact of both low and high-fidelity simulator on provider behaviors and outcomes for patients, providers, and systems is mostly anecdotal [40]. We discovered two evaluations that analyzed simulations involving nurse practitioners in acute as well as primary care, emphasizing the enhancement of knowledge and satisfaction among learners [41,42]. A comprehensive study of brief team treatments [43] found effective modalities for both low- and high-quality simulators and feedback for providers. Nonetheless, further information is required to delineate topic areas for certain patient groups (for instance, complicated care, home care) and provider groups (such as advanced technical capabilities), involving various advanced practice nursing jobs.

Table 1 represents the summary of roles and effectiveness of advanced practice nurses in ai-assisted telemedicine.

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Table 1. Summary of Roles and Effectiveness of Advanced Practice Nurses in AI-Assisted Telemedicine

Country	AI Technology Used	Nurse Roles	Key Findings
USA	Machine Learning Algorithms	Educator, Remote Monitor	Improved patient outcomes through real-time monitoring of vital signs, leading to a 30% reduction in hospital readmissions.
Japan	AI Chatbots	Counselor, Decision Support	Increased patient satisfaction scores by 25% due to effective communication and support provided through AI interactions.
South Korea	Image Recognition for Diagnostics	Evaluator, Care Coordinator	Enhanced early detection of eye conditions like glaucoma, allowing for timely interventions in 90% of cases studied.
USA	Remote Patient Monitoring Devices	Caregiver, Data Analyst	Reduced hospital visits by 40%, with effective home monitoring of chronic conditions like diabetes and hypertension.
South Korea	Predictive Analytics	Patient Educator, Support	Facilitated timely interventions and improved care plans, resulting in a 20% increase in medication adherence among patients.
USA	AI-Powered Telehealth Platforms	Primary Care Provider	Positive impact on chronic disease management, with a 15% improvement in health outcomes reported over six months of follow-up.
UK	Natural Language Processing (NLP)	Educator, Patient Advocate	Enhanced patient education and understanding of treatment plans, leading to higher engagement levels and satisfaction.
Canada	Virtual Reality Training for Nurses	Trainer, Technology Integrator	Improved confidence and skill levels among nurses using VR simulations for telehealth interactions, resulting in better patient rapport.

Constraints

This review has certain limitations that must be acknowledged when evaluating the findings. Initially, the total papers included in the final evaluation were limited, and none used an experimental design. Furthermore, the research lacked power analyses, and just English-language research were included, thus introducing bias into the review outcomes. We used the MERSQI to evaluate the quality of the research, since it is a thorough assessment instrument; nevertheless, using other techniques could have produced different outcomes.

While we used "Artificial Intelligence" as a search term to include a wide array of artificial intelligence applications in telehealth, this strategy may have overlooked certain subdisciplines of AI. Furthermore, our search period was limited to 2017 to 2023, thus excluding significant papers published before to 2017. These constraints hinder a thorough understanding of AI-assisted telehealth solutions in practice and diminish the applicability of the review findings.

Summary

The exploration of advanced practice nurses in telemedicine highlights their essential contributions to modern healthcare delivery systems. This review reveals that AI-assisted telehealth interventions can significantly enhance the quality of care provided by nurses, leading to improved patient outcomes and satisfaction. The integration of AI technologies facilitates real-time data access, enhances decision-making, and fosters collaborative care among healthcare professionals.

Despite these advancements, the review identifies critical barriers that must be addressed. Many nurses lack adequate training and confidence in utilizing AI tools, which can hinder the effective implementation of

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telehealth services. It is crucial to develop comprehensive educational programs that equip nurses with the necessary skills and knowledge to navigate AI technologies effectively.

Furthermore, as telehealth continues to evolve, ongoing research is needed to evaluate the long-term effects of AI on clinical outcomes. Future studies should focus on the development and validation of AI algorithms specific to nursing practice, ensuring that they align with the unique needs of patients and healthcare providers.

In conclusion, the successful integration of AI in telemedicine requires a concerted effort to enhance the capabilities of advanced practice nurses. By investing in training and resources, healthcare systems can empower nurses to leverage AI technologies effectively, ultimately leading to improved patient care, enhanced efficiency, and better health outcomes. The potential of AI-assisted telehealth interventions is vast, and with the right support, advanced practice nurses can play a transformative role in the future of healthcare delivery.

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تحليل متعمق لأدوار ممرضي الممارسة المتقدمة في الطب عن بُعد: تقييم تأثير الذكاء الاصطناعي على تقديم الرعاية الصحية ونتائج المرضى

الملخص

الخلفية:

أدى انتشار التطبيب عن بُعد، خاصة خلال جائحة COVID-19، إلى إحداث تحول في تقديم الرعاية الصحية، مما أتاح الخدمات الأساسية للمرضى في المناطق النائية. يلعب ممرضو الممارسة المتقدمة (APNs) دورًا حيويًا في استخدام الطب عن بُعد لتعزيز رعاية المرضى. ومع ذلك، لا يزال دمج الذكاء الاصطناعي (AI) في هذا المجال غير مستكشف بشكل كافٍ.

المنهجية:

تبحث هذه المراجعة الاستكشافية في دور ممرضي الممارسة المتقدمة في الطب عن بُعد، مع التركيز على التدخلات المدعومة بالذكاء الاصطناعي. تم إجراء بحث منهجي في ست قواعد بيانات، بما في ذلك PubMed وCINAHL، للدراسات المنشورة بين عامي 2017 و2023. وقد شمل التقييم رضا المستخدمين، وجهات نظرهم حول تقنية الذكاء الاصطناعي، وفعالية الخوارزميات الذكية في تطبيقات الطب عن بُعد.

النتائج:

قامت المراجعة بتحليل نتائج **ثماني دراسات** استخدمت تقنيات الذكاء الاصطناعي في التطبيب عن بُعد ضمن الممارسة التمريضية. أظهرت النتائج أن أدوات الذكاء الاصطناعي، خاصة الخوارزميات المعتمدة على التعلم الآلي، تساهم بشكل كبير في تعزيز عملية اتخاذ القرار وتحسين نتائج المرضى. كما أفاد ممرضو الممارسة المتقدمة بتحسن مراقبة المرضى وزيادة مستويات الرضا عن الخدمات الصحية المدعومة بالذكاء الاصطناعي. ومع ذلك، تم تحديد تحديات مثل نقص التدريب المناسب ومقاومة تبني التكنولوجيا بين الممرضين.

الاستنتاج:

تؤكد النتائج على الدور المحوري لممرضي الممارسة المتقدمة في توظيف تقنيات الذكاء الاصطناعي ضمن الطب عن بُعد لتحسين تقديم الرعاية الصحية. لذا، فإن تعزيز التدريب والدعم المقدم لـ APNs ضروريان لتحقيق الاستفادة الكاملة من إمكانيات الذكاء الاصطناعي في التطبيب عن بُعد.

الكلمات المفتاحية :ممرضو الممارسة المتقدمة، الطب عن بُعد، الذكاء الاصطناعي، تقديم الرعاية الصحية، رضا المستخدم.