EDUZONE: International Peer Reviewed/Refereed Multidisciplinary Journal (EIPRMJ), ISSN: 2319-5045
Volume 14, Issue 2, July-December, 2025, Available online at: www.eduzonejournal.com

Digital Health and Telemedicine: Implications for Nursing and Pharmacy in Chronic Disease Care.

Rafaa Ahmed Qassem[1], Sarah Abdullah Almutairi[2], Maraym Hamad Alhoreshi[3], Maryam Ahmed Almulaifi[4], Abdulrahman Saad AlShahrani[5]

[1,3,4]Pharmacist, PSMMC
[2,]Pharmacy technician, PSMMC
[5,]Nursing technician, Royal Saudi Air Force

INTRODUCTION

Digital health and telemedicine are transforming the modern concept of healthcare. They unite technology, long-term illnesses management, and interdisciplinary collaboration. As Shaw et al. pointed out (2024), the introduction of patient-generated data onto remote devices into the electronic health records can allow clinicians (nurses and chemists) to see real-time measurements and make alert thresholds and tailored care interventions based on the specifics of each patient. The models can help healthcare teams to provide effective, proactive, and data-driven management, which can improve the outcomes in patients with poorly managed chronic conditions. The EXTEND randomised trial established that technology-based, nurse-led telehealth initiatives, with pharmacist-assisted medication care, have the potential to achieve successful control of the clinical and social complexities of patients with comorbid diabetes and hypertension.

The intervention aims at reducing the level of haemoglobin A1c and improving blood pressure management in 12 months by bridging mobile monitoring devices with self-management support and professional supervision[2]. Digital health and telemedicine are not merely methods of providing care in this evolving world, but they are also constructs that transform the manner in which nurses and chemists provide care to chronic illness patients. More nurses are performing an increasing number of functions, including the organization of remote monitoring, education on digital literacy, and facilitation of evidence-based teleconsultations. Pharmacists also play a very significant role in remote review of medication, patient counselling and ensuring that patients adhere to their prescriptions. [3]. The review is quite extensive and detailed in terms of the information concerning nursing and pharmacy application in the care of chronic diseases in the format of digital health and telemedicine.

2. Evolution and Key Technologies

In a significant manner, healthcare is now being provided in the world in a different dimension through digital health and telemedicine. They combine the development of communication, biomedical studies, and data science to promote ongoing care. Telemedicine has developed out of primitive remote diagnostics, to encompass a comprehensive system of electronic health records (EHRs), wearable technology, and teleconsultation systems that enable delivery of real-time and patient-centred care in nursing, pharmacy, and other allied health professions. The fact that these technologies were crucial in improving the chronic disease management outcomes is noted by the shift between the reactive care models and the personalised and preventive models.

2.1 Historical Background

New methods of communication have made telemedicine experience numerous significant changes throughout the years. Its history can be traced back to the first half of the 20 th century when the electrocardiograph (ECG) data were transmitted via phone lines to support remote cardiovascular measurements. Satellites were initially utilised in medical delivery of information to astronauts and people in remote locations by global organisations such as NASA and the U.S. Department of Defence in the 1960s and 1970s. The Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC) project was one of the most significant ones and utilized microwave signals to transmit medical information.[4]. The internet became more prevalent in the 1990s and telemedicine emerged into a digital service incorporating the sharing of images, e-consultations, and virtual diagnostics. Modifications in digital imaging and real-time audio-visual consultation allowed accessing the experts more easily, particularly, in the spheres with a low number of them. The digitalisation drive accelerated after the 2000s as EHRs were used worldwide and patient data could be easily managed according to the policy changes and eHealth structures. As cloud computing and artificial intelligence (AI) and the Internet of Things (IoT began to gain momentum, healthcare systems began to transition to interconnected systems that could monitor, process, and predict what would occur to chronically ill individuals.[5].

2.2 Major Digital Tools: EHRs, Wearables, and Teleconsultation Platforms

2.2.1 Electronic Health Records (EHRs)

Contemporary digital health systems are made up of EHRs. EHRs provide physicians with safe, precise, and sustainable patient information, which could be applied in any healthcare environment. The reason behind this is that they substitute the paper-based systems. The current research highlights the fact that general practice and community pharmacy integrated electronic health record (EHR) systems increase medication safety, reduce duplication, and enhance cohesive interdisciplinary care, particularly in ageing populations that depend on polypharmacy to manage their health conditions (p. 6). It is also possible to predict the time when the condition of the patient will deteriorate, send automatic reminders, and suggest physicians the most suitable medications to their patients by next-generation EHRs with AI algorithms. EHRs can be improved not only to be a digital storage tool, but also an intelligent decision-support tool that is essential in ensuring that telehealth is effective.

2.2.2 Wearable Devices

One of the aspects of digital health is wearable technology that is transforming the most rapidly. Wearables such as smartwatches, biosensors, glucometers, blood pressure monitors are now capable of gathering continuous feeds of physiological data enabling them to monitor conditions such as diabetes, COPD and cardiac dysfunctions very early and then manage them self-sufficiently. Studies by Tandel et al. (2024) show that the adoption of smart wearables in Healthcare Industry 5.0 represents the intersection of biosensor-based data ecosystems with AI and the Internet of Medical Things (IoMT) to create predictive and proactive healthcare settings.[7]. Multidimensional patient profiles are made when these devices are hooked up to centralised EHRs. As an example, predictive analytics compatible with wearables allow physicians to monitor such factors as physical activity, heart rate variation, and oxygen saturation with a lot of precision over time. One review article emphasised that all-time tracker wearables can help in supporting a patient-controlled and decentralised model of care. This provides medical practitioners with additional information to operate with and the patients with additional control over their own health. These technologies help nurses develop personalised follow ups and chemists to use data insights to view adherence and drug effectiveness over time.[8].

2.2.3 Teleconsultation Platforms

Teleconsultation platforms have been quite significant in ensuring that care is accessible and sustained particularly when it comes to individuals residing in rural settings or lack sufficient resources. With this type of systems, it is possible to have synchronous (real-time video-based) and asynchronous (store-and-forward) consultations. A systemic appraisal in 2025 revealed that teleconsultation platforms with integrated mobile monitoring devices, EHR access and pharmacy interfaces are able to hold the interest of patients and make hospital care less of a tyranny. [9]. The teleconsultation systems are used by nurses to conduct virtual assessments, counselling, and educating patients on how to take care of themselves. Pharmacists adopt services of telepharmacy in order to monitor drug interactions, refills, and advice on medications.

State-of-the-art teleconsultation systems now have clinical decision support systems (CDSS) based on AI analysis and evidence-based triage and proactive follow-up. This is in compliance with the patient-focused objectives of digital health transformation. Secure cloud infrastructure is also applied to modern teleconsultation systems to maintain privacy of data and enable expansion [10]. Therefore, the integration of the modules of both virtual reality and augmented reality, as outlined in current studies, complements remote physiotherapy, mental health counselling, and chronic rehabilitation service with strict clinical supervision. These immersive models form an enhanced degree of interactivity and experience learning, as well as the relationship between practitioners and patients becomes more significant[11].

2.2.4 Digital Integration in Nursing and Pharmacy Practice

To nurses, digital health tools can facilitate the automation of their work and keep patients safe as well as care at a distance. Nurse-led telehealth models with systematic syntheses in 2024 demonstrate the fact that they are effective to reduce disease flare-ups, particularly in diabetic and hypertensive patients, through the use of structured digital follow-ups and mobile health interventions.[12]. Increasingly, nurses are playing the role of a digital health navigator, assisting their patients to utilize virtual monitoring devices and interpreting real-time data sets to enable their patients to make necessary adjustments to their lifestyle or medications. Digital integration assists chemists in leaving their old ways of dispensers and reaching clinical decisions and enhancing chronic care. Telepharmacy services provide by EHR-linked consultation systems allow chemists to monitor the adherence rates of patients to their medication regimen, identify potential drug interactions, and provide patients with the specific details of how to adhere to their treatment regimen in particular situations [13]. These operations are necessary especially because medication related problems are one of the most common preventable reasons behind rehospitalization in chronic diseases.

3. **Applications in Chronic Disease Management**

Digital health and telemedicine have changed how we treat chronic diseases like diabetes, high blood pressure, COPD, and heart problems. Their incorporation into remote patient monitoring (RPM), self-management improvement, and AI-driven predictive analytics has transformed the roles of nursing and pharmacy in the provision of continuous care. The combination of mobile technologies, electronic health records (EHRs), and artificial intelligence (AI) makes it possible to track data in real time, take proactive steps, and create personalised care plans for different groups of patients.

3.1 Remote Patient monitoring and Self-management

It is concerned with the ability to monitor and self-manage health blindly without the patient physically being present. Digital health allows self-management making patients play proactive roles in disease management. In a qualitative study published in 2025, by Alessa et al., it was found that people with chronic illnesses enjoyed flexible eHealth solutions that ensured autonomy and support through education and AI-driven warnings about critical readings [14]. This paper has highlighted that adoption of technologies by patients does not only depend on the availability of technology but also on psychological preparedness, culture and literacy. This makes the nurses critical agents in educating the population on the use of digital technology and ensuring that the RPM systems are utilized regularly.

Self-management has also shown some measurable benefits to the ageing populations. In another meta-analysis study carried out by Park et al. in 2025, it was confirmed that digital health interventions increased physical exercise and self-management skills among the independent elderly, who had chronic conditions. Such digital interventions involving step-trackers and interactive applications led to higher rates of moderate to vigorous activity and patient engagement although they only produced minor changes to clinical biomarkers[15].

This is in support of the telehealth potential in terms of promoting preventative behaviours and reducing the healthcare burden. Telepharmacy services can be added to self-management programs, and they become even better. Digital communication tools and EHR integration help pharmacists to make sure that patients adhere to their medications and monitor their health remotely. It is reported that telepharmacy can help to make drugs safer to individuals with chronic conditions, provide opportunities to monitor therapies, and reduce the incidences of bad drugs. Telemonitoring, the work of the nurses and medication optimisation, the work of the pharmacist are effective in keeping people constantly on track with their treatment and maintaining their disease at stable levels with time.

3.2 Early Intervention Predictive Analytics and AI.

Predictive analytics and AI have gained relevance in making decisions and acting at the initial stages of the treatment of chronic diseases. Predictions of disease flare-ups can be made using AI models of large datasets of remotely monitored data, clinical data, and genomics prior to clinical manifestation. A 2025 review of the literature revealed that AI applications that incorporate real-world data can identify groups of individuals with various health issues, anticipate readmission to hospitals, and improve the treatment of groups of patients. Some of these techniques include the random forests, XGBoost classifiers and neural networks, which enhance prognostic accuracy by identifying minor alterations in biometric patterns with time. As a matter of fact, predictive algorithms are transforming the manner in which diseases are treated.[16]. One of the studies described telehealth-enabled discharges, which involve analytics to identify high-risk patients to prevent readmission and, thus, allow the teams to create tailored follow-up strategies.

There has also been the development of adaptive insulin titration systems and low blood sugar level early-warning alerts due to the use of AI in diabetes management. A 2025 synthesis paper noted that AI-enhanced diagnostics uses continuous glucose monitoring (CGM) to dynamically optimize insulin dosages, which improves glycaemic control and reduces emergency events[17]. The clinical accuracy of AI is shown in disease-specific applications, including in chronic myeloid leukemia (CML). According to Ram et al. (2024), AI algorithms, such as neural networks and hybrid convolutional structures, demonstrated almost perfect accuracy in the prediction of disease progression and response to treatment in CML patients[18]. Although these oncology models are not similar to chronic metabolic disease frameworks, they highlight the predictive capabilities that AI can add to chronic disease pathophysiology and individual treatment development.

The AI-based analytics can also aid nurses in determining who to see first and the prioritisation of their work. Predictive models developed on EHR systems allow nurses to identify patients who are at risk of experiencing a hypertensive crisis, kidney failure, or that may not be taking their medications as prescribed. Such alerts allow physicians to act promptly with the help of telemedicine or medicine changes. AI-based drug utilisation reviews in pharmacy practice analyse risks of interaction, comorbidities of the disease, and propose changes in doses, thus, combining safety with personalised therapeutics. Nivethitha et al. (2025) conducted a scoping review on the vast implications of AI in early detection, highlighting the use of AI to optimise models of cardiovascular and diabetic disease prediction in primary care environments.[19].

Such systems process multi-parameter wearable biosensor and clinical diagnostics data and provide early alerts to patients and medical staff. The research established that early diagnoses using AI does not only increase the survival chances but also reduces the number of unnecessary tests because diagnoses are more precise. Predictive analytics is also being utilized to help in enhancing the health policy planning and resource utilization. Predictive modelling assists hospital systems to calculate how many individuals with chronic illnesses they are going to cure and optimize their resources, which will prevent overload in the public health systems. This proactive form of continuity of care that results in whole population data being used in order to make a personalised decision in clinical care is what the World Health Organisation envisions.

4. Impact on Nursing Practice

The use of digital health has changed nursing practice in a big way, expanding their professional roles into areas that use technology, such as teleconsultation, virtual assessment, and data-driven care coordination. This evolution improves patient management by making it easier to access, continue, and be precise, especially for chronic diseases. However, it also brings up new problems with technology literacy, interoperability, and professional adaptation.

4.1 Virtual Assessment and Triage

Telemedicine systems play a vital role in the assessment and triage of the patient through virtual assessment and triage. A 2025 cohort study, by Khairat et al., indicated that the virtual nursing intervention in emergency departments reduced patient wait time, simplified the process of getting admission, and reduced the number of errors in documentation, in comparison with the traditional models. In teleassessments, the nurse can view the symptoms, history, and the risks of a patient through video-based platforms that are compatible with electronic health records (EHRs).[20] With the help of digital platforms, nurses can have live consultations, monitor chronic illnesses remotely, and initiate prophylactic actions according to generally accepted clinical algorithms.

Similarly, Charalambous et al. (2024) provided a scoping review, which indicated that nurse practitioner-led telehealth services would benefit in terms of access to care, patient satisfaction, and reduced healthcare expenditures due to the facilitation of initial assessment through digital diagnostic devices, such as digital stethoscopes and remote pulse oximeters. The information gathered enables multidisciplinary decision-making, which also enables a smooth shift to physicians or pharmacists when escalations need to be made. Avatar-based telecare systems have enhanced both adherence and engagement in long-term care through facilitating personalized animation-based health interactions.

4.2 Competency and Role Transformation.

The use of digitalisation is transforming nursing skills in a manner that has never been experienced before. Today, nurses are also digital navigators as they apply their clinical expertise and technical capabilities to manage cloud-based and AI-enabled resources. According to Conte et al., a paper written by them said that digital technologies in cardiovascular nursing simplify work, enable accurate care through continuous data integration, and reduce the time required to record information in a written form (22). Such developments have transformed nursing to be a task delegation to systems coordination, where analytics are used to establish clinical priorities. Telehealth communication, AI literacy and cybersecurity modules are being added to nursing programs worldwide to prepare future nurses to work remotely in a care setting [23].

There is an increasing number of nurses who are assuming the role of assisting patients learn how to use technology, such as how to interpret information provided by wearables or use telehealth portals appropriately. Due to this, good communication in virtual environments as well as awareness of privacy legislation are two of the critical aspects of becoming a good nurse in the modern days. Virtual models are also useful in assisting workers to overcome stress and prevent burnout. There is evidence that tele-triage models can be adopted to achieve flexible staffing and improve the distribution of work and continuity of care[24]. There has been an increased strength in interdisciplinary collaboration, where nurses were at the core of interpreting remote monitoring data to care teams comprising physicians, pharmacists, and data experts.

4.3 Obstacles in Technology Adoption.

Although digital health tools offer numerous advantages, there are several issues that complicate the process of using it among nurses. In a 2023 systematic review, do Nascimento et al. identified important barriers, such as poor infrastructure, limited interoperability, overwork, lack of training and psychological resistance[25]. In rural places where telemedicine may be the most applicable, the issue of network reliability and equipment shortages remains critical. Other nurses also declare that they experience technostress and fear that clinical judgement will be replaced by automation. The other reason as to why a number of healthcare organisations have not yet integrated structured telehealth training into their continuing professional development programs is the lack of education.

Based on research, more significant resistance can be alleviated by continuous investment in digital literacy and simulation-based education to support the more trouble-free adoption. Ethical and privacy concerns particularly related to patient confidentiality and data leakages cause even more hesitation among people. Cybersecurity policies, user authentication standards, and privacy education are some of the strong institutional frameworks required to address these needs [26]. There is also cultural and gender discrimination that reduces the rate of adoption. Limited engagement of females in the digital realm can reduce the role of nurses in telehealth frameworks in developing settings, which highlights the need to develop telehealth education and infrastructure development policies that are gender inclusive and sensitive.

5. Impact on Pharmacy Practice

Pharmacy practice, traditionally centered on medication dispensing and patient counseling, has undergone a revolutionary digital transformation under telemedicine frameworks. The integration of telepharmacy services, e-prescription systems, and digital drug information repositories enables pharmacists to provide accurate, timely, and remote medication management with unprecedented efficiency.

5.1 Telepharmacy and Remote Medication Management

Telepharmacy is the expansion of the traditional pharmacy services to remote or resource-limited areas, which ensures that the pharmaceutical care is not discontinued. A review by Sharma et al. indicated in 2025 that telepharmacy allows individuals to monitor adverse drug events (ADEs) remotely through safe electronic communication networks by checking prescriptions, seeking advice, and monitoring adverse drug events (ADEs). Pharmacists consult drugs, enhance treatment schedules, and make remote follow-ups via video and electronic communications. This transformation ensures that individuals administer their medicines, it makes them safer, and their accessibility in a setting lacking adequate physical pharmacy facilities. In 2024, Alanzi et al. conducted a study that examined patient feelings towards telepharmacy.

They discovered that the patients were extremely satisfied with the digital platforms that provide the opportunity to maintain communication between the patients and chemists. The respondents emphasized the importance of privacy, timely reaction, and personalized education [27]. Telepharmacy development has also facilitated collaborative efforts of nursing teams, and this has resulted in the ability of chronic disease patients to collaborate in medication reconciliation and adherence monitoring. The remote medication management is an indispensable requirement in post-pandemic healthcare systems. Chemists can identify drug-related issues by using a telemonitoring dashboard by combining EHR data and patient-reported symptoms. This information-based approach assists the chemists in making prescriptions in advance and collaborate with physicians to achieve the optimal outcomes.

5.2 E-prescriptions and ADR monitoring

E-prescriptions are one of the foundations of the contemporary digital pharmacy operations, which helps to reduce the errors in transcription and address minimal medication duplications. EHR-integrated e-prescription systems enable safer and faster dispensing of medication and longitudinal pharmacovigilance by standardizing medication data. An analytical review published in 2014 already demonstrated the clinical advantage of remote pharmacist interventions in preventing transcription and prescribing errors; the AI-based review systems have now been included in more recent models to increase the accuracy of error detection further [28]. Telemetry-based monitoring of adverse drug reactions (ADRs) has become an ongoing process. Remote reporting systems are utilized by pharmacists to monitor patient safety in real time. This facilitates their reporting safety concerns to the regulatory agencies. In the 2025 scoping model by Sweta et al., telepharmacy surveillance of ADRs reduced unnecessary events by establishing digital feedback between patients and the chemist and prescribers. These systems demonstrate the significance on digital pharmacovigilance concerning the pharmaceutical industry to adjust to timely detection and data analysis.

5.3 Digital drug information systems

The digital drug information systems (DDIS) enhance the capacity of pharmacists to provide evidence-based clinical advice. AI-based platforms like real-time drug interaction checkers, forecasting toxicity alert devices, etc. - help you quickly assess contraindications and pharmacokinetic changes. These systems unify the world pharmacologic databases and EHRs of patients, making it possible to make decisions tailored to telephony networks using a network of consultations. In clinical care, DDIS improve collaboration through multidisciplinary access to shared medication records in real-time between nurses, physicians, and pharmacists.[29]. This interoperability helps to guarantee that drug regimes will be consistent across care transitions and minimizes differences amid hospital discharge or chronic care programs. European society of clinical pharmacy recommends that DIS be built into the telepharmacy systems to enable continuous learning and enhance patient safety awareness. Patient-centered education is also enabled by digital databases. Pharmacists are able to share visual medication guides, explain interactions as well as give adherence support using app-based modules and chatbots[30]. Current AI-driven pharmacovigilance systems identify the appearance of a reaction based on population-wide data and give automatic warning signals and reduce response time to a reaction by regulatory authorities.

6. Interprofessional Collaboration

6.1 Integration of Nursing and Pharmacy Workflows

Effective interprofessional collaboration between nursing and pharmacy is crucial for seamless chronic disease management through digital health technologies. (Figure 1) Nursing and pharmacy workflows integrate through shared electronic health records (EHRs), synchronized remote monitoring platforms, and coordinated teleconsultations. According to a 2024 study by Cresswell et al., pharmacy and medical students engaged in simulated EHR activities collaboratively formed medication management plans, highlighting the need for digital communication skills to enhance coordinated care.[31] Nurses and pharmacists jointly interpret patient data, optimize pharmacotherapy, and develop personalized care strategies in a digitally connected environment, ensuring continuity and safety.

Co-designed interprofessional educational resources foster mutual understanding of roles, enhancing teamwork in clinical settings. A 2024 study from Wilson et al. demonstrated that involving students from nursing, pharmacy, medicine, and allied health in co-creating educational tools improved collaboration skills and appreciation of interprofessional perspectives.[32] Such initiatives are foundational to preparing digitally competent healthcare professionals able to work synergistically in telehealth ecosystems. (Figure 1)

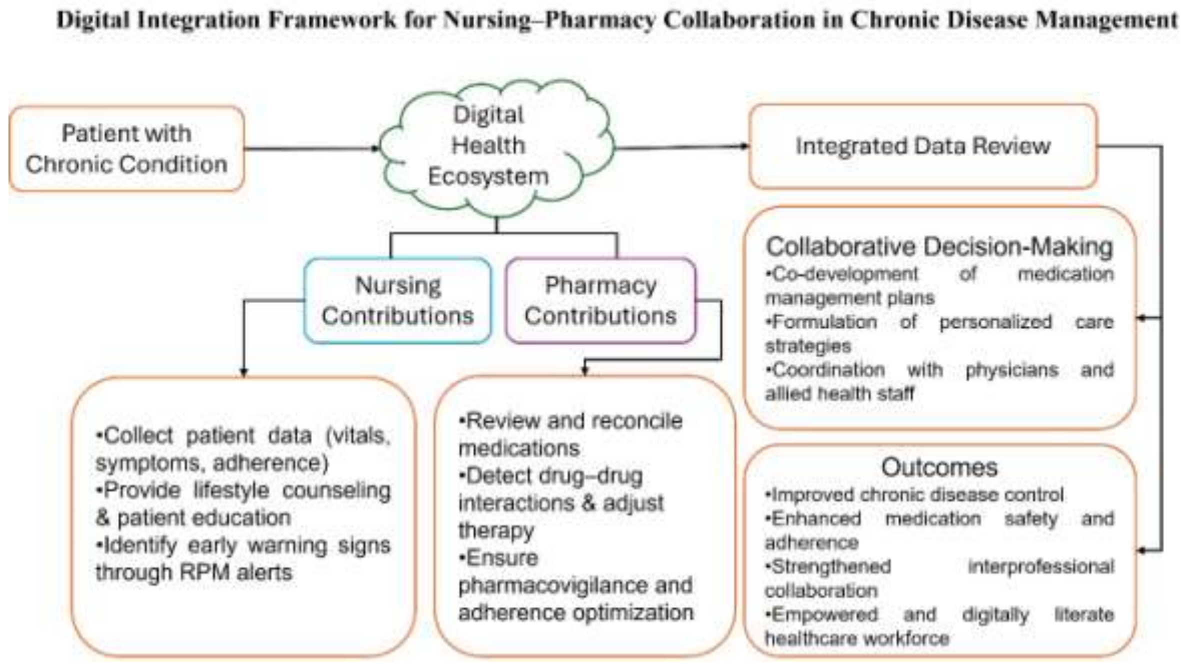

Figure 1: Digital Integration framework

6.2 Virtual Communication Channels

The technological infrastructure that makes it possible for professionals to work together is based on virtual communication channels. These are secure messaging systems, video conferencing, shared documentation platforms, and clinical decision support built into telehealth apps. Nurses, chemists, doctors, and other staff can talk about complicated cases, change care pathways on the fly, and get patients more involved in their care through real-time virtual meetings. Research emphasises the significance of asynchronous and synchronous communication tools in alleviating delays, minimising errors, and enhancing accessibility.[33] Platforms allowing review of shared patient charts combined with teleconsultation enable professionals across settings primary care, community pharmacies, and hospitals—to communicate efficiently despite geographic and temporal barriers. Building effective virtual communication pathways is a priority to optimize patient outcomes and streamline care coordination.

7. **Outcomes and Evidence**

Recent evidence from clinical studies and systematic reviews emphasizes the significant positive impact of digital health and telemedicine on chronic disease management, focusing on clinical effectiveness, patient satisfaction, economic savings, and quality-of-life improvements.

7.1 Clinical Effectiveness and Patient Satisfaction

Telehealth, telepharmacy and remote monitoring are digital health interventions that have shown high clinical efficacy in the management of chronic diseases like diabetes, high blood pressure, and chronic wounds. As an example, telemedicine platforms allowed controlling the diseases better since it was possible to monitor the disease and respond to the patient in time, which resulted in the decrease of hospitalizations and the rate of complications [34]. Evidence suggests that the clinical indicators such as blood glucose levels, blood pressure, and wound healing scores have been improved significantly, attested by telehealth programs. The patients are also typically quite pleased with the treatment since access to them is faster, convenient and communication among providers is improved. Telehealth will allow self-management to occur with the assistance of a guide, reducing the traveling risks and waiting periods, improving patient experience and treatment compliance levels. (Table 1) Nonetheless, satisfaction may vary depending on demographic characteristics and the use of technology, which highlights the need to support patient-specific needs and digital illiteracy.

Author(s) & Year	Study Focus	Key Outcomes	Clinical Effectiveness	Patient Satisfaction	Economic/QoL Benefits	Ref
Hendy et al., 2025	Telehealth in chronic diseases	62.9% patient satisfaction, improved accessibility	Improved continuity and monitoring	High overall satisfaction	Better access, tailored training needed	[35]
Zhang et al., 2025	Telemedicine for chronic wounds	Improved healing score, reduced amputation rate	Significantly better wound healing	Neutral satisfaction reported	Improved pain and quality of life	[36]
Park et al., 2025	Digital health in older adults	Increased physical activity and self-management	Moderate improvements in clinical markers	Not explicitly reported	Improved independence and QoL	[37]
Cresswell et al., 2024	Interprofessional collaboration training	Improved teamwork and medication management planning	Not clinical outcome-focused	Positive educational impact	Long-term system efficiency	[38]
Wilson et al., 2024	Co-design interprofessional education	Development of collaborative skills and resource creation	Not clinical outcome-focused	Positive participant feedback	Supports future collaborative workforce	[39]
Hendy et al., 2023	Cost-effectiveness of telehealth nutrition	60% of interventions cost-effective, especially mHealth	Clinical benefit in diet-related outcomes	Not reported	Health system savings and patient benefit	[40]
Xiaoyan et al., 2025	Telemedicine wound care meta-analysis	Reduced healing time and pain	Statistically significant improvements	No significant differences	Quality of life improvements	[41]

Table 1: Summary of Evidence from Recent Studies on Clinical Effectiveness, Patient Satisfaction, and Economic Benefits of Digital Health Interventions in Chronic Disease Management.

7.2 Economic and Quality-of-Life Benefits

The economic analyses indicate that digital health interventions reduce the cost of healthcare by preventing unnecessary hospitalizations, emergency room admissions, and reduce medication errors through remote monitoring and telepharmacy. The quality of life is reported to improve due to increased physical activity, pain relief, and improved mental health in patients who use digital interventions, and this is cost-effective. [42]The quality of life is reported to improve as the amount of physical activity increases, pain decreases, and mental health is improved as a result of digital interventions. Remote support also enables patients to become independent and cope with the symptoms, enhancing the overall health-related quality of life[43]. These advantages, along with the advantages in the efficiency of the system, support the idea of digital health as a sustainable approach to the care of chronic diseases.

8. Challenges and Future Directions

The evolution of digital health and telemedicine has encountered several challenges, but it also offers vast opportunities for future development. As these technologies become more integrated into healthcare systems, addressing infrastructural, technical, and policy gaps remains crucial.

8.1 Infrastructure Challenges

Another main issue regarding the increased popularity of telehealth is that the infrastructure is not as good as it can be. Individuals usually experience difficulties regarding their internet access and, in particular, in rural or underserved regions, they are unable to reach newer devices such as smartphones, tablets, and digital health devices. Many healthcare providers lack the appropriate hardware, software, and network capacity to ensure that video consultations and remote monitoring run in a proper manner and in real-time. These issues render telehealth difficult to implement in many locations, particularly in communities with low income or remote locations where it is frequently most in demand. [44]In addition, the healthcare systems have interoperability and digital architecture issues. Current health records and telehealth systems frequently run on systems that are incompatible with each other, leading to data silos and disjointed care trails. Related issues include secure data management, cybersecurity, and patient privacy since there are cyberattacks and breaches that jeopardize the integrity of telehealth services.

8.2 Training and Workforce Readiness

Telehealth adoption is slowed by gaps in technical knowledge and skills among both healthcare workers and patients. A lot of doctors and nurses don't know how to use telemedicine platforms, telemonitoring devices, or data security protocols correctly. Likewise, patients, especially older adults, may lack the digital literacy necessary to navigate telehealth systems with confidence, resulting in disparities in access and engagement.[45] To overcome these barriers, healthcare institutions need to invest in comprehensive training programs, user-friendly interfaces, and ongoing technical support. Developing digital literacy among healthcare workers and patients alike is essential for optimising telehealth's potential.

8.3 Policy and Regulatory Challenges

The telehealth and digital health rules and regulations continue to evolve. The dissimilarity of the licensing conditions, reimbursement policies, and legal liabilities across nations and jurisdictions makes it difficult to have telemedicine services functioning efficiently. Indicatively, certain nations have ambiguity with regard to teleconsultations with international nations or alternative methods of financing them, thereby reducing the probability of healthcare providers providing telehealth services. Standardisation of the protocols, privacy policies, and the coverage of liability is significant to the creation of trust between providers and patients [46]. The governments and policymakers should have well-defined supportive regulations to support innovation and provide safety and privacy of data, as well as equality in access.

8.4 Innovative Technologies and Future Directions

All the above are on the way of improvement that can contribute to resolving some of the large issues and transforming telehealth to a better level. One can use AI to assist in clinical decision-making, risk prediction, and the development of individual treatment plans, which implies that fewer infrastructure applications are required. The IoT provides opportunities to transmit real-time patient data even when remote sensors and wearables are in place, and it becomes possible to monitor patients even beyond the clinical environment [47]. VR and AR may be applied in pain management, mental health therapy, and medical training and provide immersive experiences to change the interactions between patients and healthcare providers or medical education. Nonetheless, incorporating such tools involves huge investments and validation research in order to confirm safety and efficacy.

8.5 Research and Policy Recommendations

Studies have shown that the effective expansion of the role of telehealth depends on the development of the proper evidence base. Possibly some of the most essential recommendations are to develop standardised measures of evaluation to assess the extent of safety, effectiveness, and affordability of telehealth interventions. Investing in infrastructure, particularly in underserved and rural regions, to bridge the digital divides. [48]. Developing long-term funding models that promote the adoption of telehealth and its incorporation into regular healthcare services.[49]. Encouraging cross-sector cooperation between governments, the private sector and academia to enhance innovation and to provide regulatory control.[50]. Reducing the social determinants of health so that disparities in telehealth access and outcomes can be prevented.

CONCLUSION

The impact of digital health and telemedicine on chronic illness, Nursing and pharmacy show that healthcare is moving towards being easier to access, more focused on the patient, and based on data. Teleconsultation platforms, remote patient monitoring, wearables, and AI-driven analytics have all changed how chronic illnesses are treated. They keep an eye on things all the time, act quickly, and improve communication between patients and providers. In remote care ecosystems, nurses and chemists have become digital health navigators, educators, and clinical decision supports. Using virtual communication channels to coordinate the workflow between nurses and pharmacies can improve patient safety, medication adherence, and the quality of care. These combined digital treatments improve clinical outcomes, patient satisfaction, cost savings, and quality of life for people with chronic diseases. Infrastructure, technology literacy, interoperability, and changes in the law make it harder to adopt telehealth. Healthcare workers and patients need to learn how to use technology. AI, the Internet of Things, and immersive virtual and augmented reality tools could make predictive analytics, personalised treatments, and immersive therapy and education better in the future. Standardising telehealth evaluation, fixing access problems, data security, and making sure that reimbursement and policy frameworks are long-lasting are all important strategic research goals. By 2025 and beyond, telemedicine will work well with traditional care to make hybrid models that are fair and work well all over the world. Digital health is changing healthcare from being episodic and focused on facilities to being continuous, proactive, and patient-centered. By using new technologies, improving the skills of their staff, and making smart policy decisions, nursing and pharmacy professionals can provide better, more personalised, and more sustainable care for people with chronic illnesses. This change improves health outcomes, patient experiences, and the health system's ability to handle more chronic illnesses. It also encourages health fairness and care excellence based on new ideas.

REFERENCES

[1]. Shaw RJ, Montgomery K, Fiander C, Bullock K, Craig R, Pennington G, et al. Mobile Monitoring-Enabled Telehealth for Patients with Complex Chronic Illnesses, 2024. https://doi.org/10.3233/SHTI230954.

[2]. German J, Yang Q, Hatch D, Lewinski A, Bosworth HB, Kaufman BG, et al. EXpanding Technology-Enabled, Nurse-Delivered Chronic Disease Care (EXTEND): Protocol and Baseline Data for a Randomized Trial. Contemp Clin Trials 2024;146:107673. https://doi.org/10.1016/j.cct.2024.107673.

[3]. Berardinelli D, Conti A, Hasnaoui A, Casabona E, Martin B, Campagna S, et al. Nurse-Led Interventions for Improving Medication Adherence in Chronic Diseases: A Systematic Review. Healthcare 2024;12:2337. https://doi.org/10.3390/healthcare12232337.

[4]. Freiburger G, Holcomb M, Piper D. The STARPAHC collection: part of an archive of the history of telemedicine. J Telemed Telecare 2007;13:221–3. https://doi.org/10.1258/135763307781458949.

[5]. Dutta S, Mallick NR, Gayatri P. Telemedicine- digital revolution in healthcare through virtual interconnection: A review. Archives of Dental Research 2024;14:76–84. https://doi.org/10.18231/j.adr.2024.014.

[6]. Shaw RJ, Montgomery K, Fiander C, Bullock K, Craig R, Pennington G, et al. Mobile Monitoring-Enabled Telehealth for Patients with Complex Chronic Illnesses, 2024. https://doi.org/10.3233/SHTI230954.

[7]. Tandel V, Kumari A, Tanwar S, Singh A, Sharma R, Yamsani N. Intelligent wearable-assisted digital healthcare industry 5.0. Artif Intell Med 2024;157:103000. https://doi.org/10.1016/j.artmed.2024.103000.

[8]. Trinh S, Skoll D, Saxon LA. Health Care 2025: How Consumer-Facing Devices Change Health Management and Delivery. J Med Internet Res 2025;27:e60766. https://doi.org/10.2196/60766.

[9]. Dohrn A, Hoskins R, Collier L, Kennelty K. Evaluation of a Telehealth-Based Pharmacist Led Chronic Care Management Program. J Pharm Pract 2024;37:933–9. https://doi.org/10.1177/08971900231196624.

[10]. Moturu D, Potineni RB, Rayana S, Shaik MN, Maddu NS, Grandhi KS. Observational study of hemodynamic events during interfacility transit of critically ill patients in a 5G tele-ambulance connected to Tele-ICU. The Egyptian Journal of Critical Care Medicine 2025;12:8. https://doi.org/10.1007/s44349-025-00019-z.

[11]. Trinh S, Skoll D, Saxon LA. Health Care 2025: How Consumer-Facing Devices Change Health Management and Delivery. J Med Internet Res 2025;27:e60766. https://doi.org/10.2196/60766.

[12]. Kilfoy A, Chu C, Krisnagopal A, Mcatee E, Baek S, Zworth M, et al. Nurse-led remote digital support for adults with chronic conditions: A systematic synthesis without meta-analysis. J Clin Nurs 2025;34:715–36. https://doi.org/10.1111/jocn.17226.

[13]. Fynn J, Lamptey M, Coote G, Twigg MJ, Newman J, Lingard S, et al. A mixed methods evaluation of a shared electronic health record between general practice and community pharmacy. Int J Clin Pharm 2025. https://doi.org/10.1007/s11096-025-01972-6.

[14]. Alessa T. Anticipations and Requirements of Individuals with Long-Term Health Conditions Regarding Self-Management and Digital Health Support Tools. Patient Prefer Adherence 2025;Volume 19:2901–18. https://doi.org/10.2147/PPA.S545496.

[15]. Park Y, Kim E-J, Park S, Lee M. Digital Health Intervention Effect on Older Adults With Chronic Diseases Living Alone: Systematic Review and Meta-Analysis of Randomized Controlled Trials. J Med Internet Res 2025;27:e63168. https://doi.org/10.2196/63168.

[16]. Ioakeim-Skoufa I, Cebollada-Herrera C, Marín-Bárcena C, Roque V, Roque F, Atkins K, et al. Electronic Health Records: A Gateway to AI-Driven Multimorbidity Solutions—A Comprehensive Systematic Review. J Clin Med 2025;14:3434. https://doi.org/10.3390/jcm14103434.

[17]. Warniment A, Sauers-Ford H, Brady PW, Beck AF, Callahan SR, Giambra BK, et al. Garnering effective telehealth to help optimize multidisciplinary team engagement (GET2HOME) for children with medical complexity: Protocol for a pragmatic randomized control trial. J Hosp Med 2023;18:877–87. https://doi.org/10.1002/jhm.13192.

[18]. Ram M, Afrash MR, Moulaei K, Parvin M, Esmaeeli E, Karbasi Z, et al. Application of artificial intelligence in chronic myeloid leukemia (CML) disease prediction and management: a scoping review. BMC Cancer 2024;24:1026. https://doi.org/10.1186/s12885-024-12764-y.

[19]. Nivethitha V, Daniel R, Surya B, Logeswari G. Empowering public health: Leveraging AI for early detection, treatment, and disease prevention in communities – A scoping review. J Postgrad Med 2025;71:74–81. https://doi.org/10.4103/jpgm.jpgm_634_24.

[20]. Khairat S, Morelli J, Qin Q, Wu X, Fakhreddin R, Edson BS, et al. Effect of Virtual Nursing Implementation on Emergency Department Efficiency and Quality of Care. Am J Emerg Med 2025;91:59–66. https://doi.org/10.1016/j.ajem.2025.02.024.

[21]. Charalambous J, Hollingdrake O, Currie J. Nurse practitioner led telehealth services: A scoping review. J Clin Nurs 2024;33:839–58. https://doi.org/10.1111/jocn.16898.

[22]. Conte G, Magon A, Caruso R. Digital and technological solutions in cardiovascular nursing and perspectives for a smooth digital shift: a discussion paper. European Journal of Cardiovascular Nursing 2024;23:945–9. https://doi.org/10.1093/eurjcn/zvae096.
[23]. Barksdale S, Stark Taylor S, Criss S, Kemper K, Friedman DB, Thompson W, et al. Improving Patient Health Literacy During Telehealth Visits Through Remote Teach-Back Methods Training for Family Medicine Residents: Pilot 2-Arm Cluster, Nonrandomized Controlled Trial. JMIR Form Res 2023;7:e51541. https://doi.org/10.2196/51541.
[24]. Khairat S, Morelli J, Qin Q, Wu X, Fakhreddin R, Edson BS, et al. Effect of Virtual Nursing Implementation on Emergency Department Efficiency and Quality of Care. Am J Emerg Med 2025;91:59–66. https://doi.org/10.1016/j.ajem.2025.02.024.
[25]. Borges do Nascimento IJ, Abdulazeem H, Vasanthan LT, Martinez EZ, Zucoloto ML, Østengaard L, et al. Barriers and facilitators to utilizing digital health technologies by healthcare professionals. NPJ Digit Med 2023;6:161. https://doi.org/10.1038/s41746-023-00899-4.
[26]. Conte G, Magon A, Caruso R. Digital and technological solutions in cardiovascular nursing and perspectives for a smooth digital shift: a discussion paper. European Journal of Cardiovascular Nursing 2024;23:945–9. https://doi.org/10.1093/eurjcn/zvae096.
[27]. Alanzi TM, Alanzi N, Saadah A, Abdullah Almulhim N, Almulhem J, Alshahrani R, et al. Telepharmacy and remote medication management: An empirical study from patients' perspectives. Nutr Health 2025;31:1217–26. https://doi.org/10.1177/02601060241287879.
[28]. Sankaranarayanan J, Murante LJ, Moffett LM. A Retrospective Evaluation of Remote Pharmacist Interventions in a Telepharmacy Service Model Using a Conceptual Framework. Telemedicine and E-Health 2014;20:893–901. https://doi.org/10.1089/tmj.2013.0362.
[29]. Huang W, Wang X, Chen Y, Yu C, Zhang S. Advancing drug-drug interactions research: integrating AI-powered prediction, vulnerable populations, and regulatory insights. Front Pharmacol 2025;16. https://doi.org/10.3389/fphar.2025.1618701.
[30]. Farley TM, Shelsky C, Powell S, Farris KB, Carter BL. Effect of clinical pharmacist intervention on medication discrepancies following hospital discharge. Int J Clin Pharm 2014;36:430–7. https://doi.org/10.1007/s11096-014-9917-x.
[31]. Cresswell NR, Walker ST, Harrison C, Kent F. Teaching digital interprofessional collaboration. Clin Teach 2024;21. https://doi.org/10.1111/tct.13651.
[32]. Wilson CB, Anderson T, Graham M, Murphy J, Mitchell G, Tuohy D, et al. Co-designing an interprofessional digital education resource on delirium: a student-led approach. BMC Med Educ 2024;24:1122. https://doi.org/10.1186/s12909-024-06023-8.
[33]. Cresswell NR, Walker ST, Harrison C, Kent F. Teaching digital interprofessional collaboration. Clin Teach 2024;21. https://doi.org/10.1111/tct.13651.
[34]. Hendy A, Farghaly Abdelaliem SM, Zaher A, Sadek BN, Nashwan AJ, Al-Jabri MMA, et al. Telehealth satisfaction among patients with chronic diseases: a cross-sectional analysis. PeerJ 2025;13:e19245. https://doi.org/10.7717/peerj.19245.
[35]. Hendy A, Farghaly Abdelaliem SM, Zaher A, Sadek BN, Nashwan AJ, Al-Jabri MMA, et al. Telehealth satisfaction among patients with chronic diseases: a cross-sectional analysis. PeerJ 2025;13:e19245. https://doi.org/10.7717/peerj.19245.
[36]. [36] Zhang X, Guo Z, Duan Y, Sun C, Luo J. Effectiveness of Telemedicine on Wound-Related and Patient-Reported Outcomes in Patients With Chronic Wounds: Systematic Review and Meta-Analysis. JMIR Mhealth Uhealth 2025;13:e58553–e58553. https://doi.org/10.2196/58553.
[37]. Park Y, Kim E-J, Park S, Lee M. Digital Health Intervention Effect on Older Adults With Chronic Diseases Living Alone: Systematic Review and Meta-Analysis of Randomized Controlled Trials. J Med Internet Res 2025;27:e63168. https://doi.org/10.2196/63168.
[38]. Cresswell NR, Walker ST, Harrison C, Kent F. Teaching digital interprofessional collaboration. Clin Teach 2024;21. https://doi.org/10.1111/tct.13651.
[39]. Wilson CB, Anderson T, Graham M, Murphy J, Mitchell G, Tuohy D, et al. Co-designing an interprofessional digital education resource on delirium: a student-led approach. BMC Med Educ 2024;24:1122. https://doi.org/10.1186/s12909-024-06023-8.
[40]. Kelly JT, Law L, De Guzman KR, Hickman IJ, Mayr HL, Campbell KL, et al. Cost-effectiveness of telehealth-delivered nutrition interventions: a systematic review of randomized controlled trials. Nutr Rev 2023;81:1599–611. https://doi.org/10.1093/nutrit/nuad032.
[41]. Zhang X, Guo Z, Duan Y, Sun C, Luo J. Effectiveness of Telemedicine on Wound-Related and Patient-Reported Outcomes in Patients With Chronic Wounds: Systematic Review and Meta-Analysis. JMIR Mhealth Uhealth 2025;13:e58553–e58553. https://doi.org/10.2196/58553.
[42]. Bjorvig S, Breivik E, Piera-Jiménez J, Carrion C. Economic Evaluation Methodologies of Remote Patient Monitoring for Chronic Conditions: Scoping Review. J Med Internet Res 2025;27:e71565–e71565. https://doi.org/10.2196/71565.

[43]. Park Y, Kim E-J, Park S, Lee M. Digital Health Intervention Effect on Older Adults With Chronic Diseases Living Alone: Systematic Review and Meta-Analysis of Randomized Controlled Trials. J Med Internet Res 2025;27:e63168. https://doi.org/10.2196/63168.

[44]. Haleem A, Javaid M, Singh RP, Suman R. Telemedicine for healthcare: Capabilities, features, barriers, and applications. Sensors International 2021;2:100117. https://doi.org/10.1016/j.sintl.2021.100117.

[45]. Khan R, Khan S, Almohaimeed HM, Almars AI, Pari B. Utilization, challenges, and training needs of digital health technologies: Perspectives from healthcare professionals. Int J Med Inform 2025;197:105833. https://doi.org/10.1016/j.ijmedinf.2025.105833.

[46]. Arora S, Huda RK, Verma S, Khetan M, Sangwan RK. Challenges, Barriers, and Facilitators in Telemedicine Implementation in India: A Scoping Review. Cureus 2024. https://doi.org/10.7759/cureus.67388.

[47]. Zattoni F, Carletti F, Randazzo G, Tuminello A, Betto G, Novara G, et al. Potential Applications of New Headsets for Virtual and Augmented Reality in Urology. Eur Urol Focus 2024;10:594–8. https://doi.org/10.1016/j.euf.2023.12.003.

[48]. AkaEze IS, Nwachukwu KC. Telehealth in rural areas: Bridging the gaps through policy drivers. Intelligent Hospital 2025:100027. https://doi.org/10.1016/j.inhs.2025.100027.

[49]. Lluch M. Incentives for telehealthcare deployment that support integrated care: a comparative analysis across eight European countries. Int J Integr Care 2013;13. https://doi.org/10.5334/ijic.1062.

[50]. Mathews D, Abernethy A, Butte AJ, Ginsburg P, Kocher B, Novelli C, et al. Telehealth and Mobile Health: Case Study for Understanding and Anticipating Emerging Science and Technology. NAM Perspectives 2023;11. https://doi.org/10.31478/202311e.