

Digital Health Transformation and Healthcare Inequality: Implications for Pharmaceutical Services, Nursing Practice, and Social Development

Nasser Mansour Nasser Alhusaini[1], Huda Shuail Aldalbahy[2], Yahya Ali Salah Alzhrani[3], Mughram Ayidh Awadh Asiri[4], Naji Awdah Al ghamdi[5], Mohammed Motlaq Alsolami[5], Amal Ali Atallah Alharbi[6], Monerah Suliman Abdullah Talian[7], ADEL Mohammed HUMEDI[8], Abdullah Mohammed Bariq Alqarni Alsuhymi[4], Ahmad Aboud S Alotaibi[9], Naif Ebaid Saeed Aletaby[9], Essam Mubarak Eid Aljameeli[9]

[1]Social service specialist, Public Health inMakkah, Ministry of Health, Saudi Arabia.
[2]Social service specialist, Prince mohmmad bin abdulaziz hospital in Riyadh, Saudi Arabia.
[3]Social Specialist, Al-Hujrah Hospital, Al-Baha, Saudi Arabia.
[4]Nurse Technician, King Abdulaziz Hospital Jeddah First Health Cluster, Saudi Arabia.
[5]Nursing Technician, King Abdulaziz Hospital, Saudi Arabia.
[6]Nursing Technician, Mlqia Health Center, Saudi Arabia.
[7]Nursing Technician, Dilam Primary Health Care, Saudi Arabia.
[8]Nursing Technician, Al-Tuwal General Hospital, Saudi Arabia.
[9]Pharmacist, King Faisal Hospital in Makkah, Saudi Arabia.

Abstract
Digital health transformation is a growing part of healthcare systems that is driving change in how healthcare services are delivered, managed, and accessed, including through the use of digital technologies, like telemedicine, mobile health applications, electronic health records, artificial intelligence, electronic prescribing, remote patient monitoring and digital health information systems. The innovations provide potential for improving the efficiency of the health services, robust clinical decision making, better pharmaceutical service delivery and increased access to nursing and community based health services. But not everyone is equally affected by the advantages of digital transformation. Persistent digital health inequalities are driven by a variety of socioeconomic, geographical, educational, digital literacy, internet connectivity, technological infrastructure and affordability factors. The difference is especially pronounced in low and middle-income countries where healthcare resources are limited and there is not equal access to digital infrastructure that can facilitate the adoption and effectiveness of digital health interventions. In this review, digital health transformation and health inequality is examined, focusing on pharmaceutical services, the nursing profession and social development. It examines the impact of digital technologies on medication management, pharmaceutical access, patient monitoring, nursing tasks, health workforce development and health system performance. The review also explores the impact of digital exclusion on vulnerable groups, such as older people, people with low incomes, rural communities and people with low digital literacy. The literature shows that, when supported by adequate infrastructure, institutional capacity and inclusive implementation strategies, digital health technologies can enhance the access to health services, continuity of care, medication safety and collaborative working among professionals. However, a poorly designed digital intervention has the potential to exacerbate the inequalities of its users, particularly when it benefits those with higher technology and money resources. The review highlights the need for equitable policies that enable digital health, affordable connectivity, building digital skills, training the workforce, safeguarding data, and enabling governance of healthcare to include everyone. It advocates digital transformation not only as a technological modernization process, but also as an approach to bringing a sustainable social development, equitable access to healthcare and strengthening of pharmaceutical and nursing services.

Keywords: Digital health transformation; healthcare inequality; pharmaceutical services; nursing practice; digital health literacy; health equity; social development.

1. Introduction

The digital transformation of health is a major development in the modern healthcare landscape, and it is transforming the organization, delivery, monitoring, and evaluation of healthcare services. The growing role of ITCs in health healthcare has led to opportunities to enhance the accessibility of services, clinical efficiency, patient engagement, and healthcare administration. In the context of digital health, electronic health records (EHRs), telemedicine, mobile health (mHealth), artificial intelligence (AI), electronic prescribing, digital pharmaceutical management systems, wearable monitoring devices, and health information exchange (HIE) platforms are just a few examples of various technological interventions. These technologies enable the sharing, storage, processing, and access to health data, which can be used to inform evidence-based decision-making and more coordinated health care delivery (Abernethy, et al., 2022).

The rise in the importance of digital health transformation has been closely linked to the need to tackle the healthcare system issues that have long been a challenge, such as poor healthcare infrastructure, a lack of healthcare professionals, high healthcare costs, geographical barriers to access, and the increasing demand for healthcare services. Some of these challenges can be addressed with digital technologies such as remote consultations, better communication between health care professionals, disease surveillance and access to medical information. Digital health is an integral element of health system strengthening and universal health coverage, and the World Health Organization (WHO) views digital health as a key part of health care (Emmanuel, 2024).

Yet digital health transformation has added a new layer to the healthcare inequalities. Digital technologies can promote access to health services, but need to be evaluated as much as for their potential in improving access as for their capacity to be accessed, understood and used effectively by individuals. Internet access and mobile device ownership, digital literacy, income, education, language, disability, and geographical location can affect the ability of individuals to take advantage of digital healthcare services. As a result, advances in technology do not necessarily equate with equitable health outcomes. In their scoping review of digital health technologies and inequalities, Badr and colleagues (2024) showed that digital health interventions have the potential to exacerbate social and healthcare inequalities and to affect certain groups of people disproportionately (Aminabee, 2024).

Digital transformation and healthcare inequality have a special significance in low- and middle-income countries (LMICs) where health systems often suffer from resource limitations. Some rural communities may have poor access to broadband, inadequate electricity service, a lack of a smartphone, or lack trained health workers. These challenges may hinder the use of telemedicine, electronic medical records, remote patient monitoring, and digital pharmaceutical services. In sub-Saharan Africa, digital health solutions have offered opportunities to enhance community healthcare services, disease monitoring, and patient engagement. But inequities in access to digital infrastructure and technological resources persist in shaping access and sustainability of these interventions. Lately, works that focus on social and digital determinants of health in Africa emphasize the need to work on both socioeconomic and geographical inequalities and technological development. (Hernandez, 2023)

At the pharmaceutical level, the Digital transformation has significantly affected the procurement of medicines, prescription management, pharmaceutical supply chain, dispensing process, pharmacovigilance and patient adherence. Electronic prescribing systems may help to minimize communication issues associated with prescribing and electronic medication records may contribute to medication reconciliation and continuity of pharmaceutical care. Digital systems for inventory management can also enhance medicine accessibility by boosting stock monitoring and smoothening the supply chain. However, such improvements may be constrained in health-care settings in which technological facilities are not adequate, financial resources are limited, and staff are not sufficiently trained. Also, those who do not have access to digital medication information or remote pharmaceutical consultations will face disadvantages versus those with reliable access to the Internet.

Equally important is the implications of digital health transformation for nursing practice. As the healthcare landscape continues to evolve, nurses are increasingly engaged with EHRs, telehealth, clinical decision support, remote monitoring, and patient care mobile applications. These technologies can enhance clinical documentation, communication, patient assessment and continuity of care. Digital nursing also helps to foster professionals' development and wider involvement in healthcare policy and management. But, as nursing practice becomes more digital, issues arise regarding technological skills, workload, data privacy, professional accountability and maintaining interpersonal relationships in patient care. In 2021, a nursing research integrative review showed that advancing digital health policy and practice are increasingly becoming the work of nurses and midwives, and that there is a need for more systematic institutional support and professional development (Emmons et al., 2024).

While some literature has already explored the digital health technologies, digital nursing, pharmaceutical innovation, and healthcare inequality, there is a lack of multi-disciplinary knowledge of how these developments are intertwined. More specifically, a comprehensive approach to the relationship between technological access, service equity, nursing practice, and social processes is urgently needed (Satyanarayana et al., 2023).

Hence, this review explores the digital health transformation and healthcare inequality, its implication for pharmaceutical services, nursing practice and social development. It seeks to understand the key dimensions of digital health transformation, looks to social and technological determinants of inequities, considers implications for the pharmaceutical and nursing industry, accounts for the socioeconomic impact, and considers approaches to enable digital health systems to be inclusive and equitable.

2. Methodology

2.1 Research Design

The study is a structured narrative review of the link between digital health transformation and healthcare inequality with a particular focus on pharmaceutical services, nursing practice and social development. The narrative review design was deemed to be a suitable design for this research as the topic covers a range of technological interventions, health professions, socioeconomic determinants and health system outcomes that cannot be considered from one clinical or methodological lens. The method enables the incorporation of empirical research, systematic reviews,

scoping reviews, theoretical work, and international policy papers, to create a multi-disciplinary understanding of digital health equity.

The review is guided by the aim of finding common themes, assessing the interactions between digital technologies and accessibility to healthcare and looking at the disparity in the impact of digital technology on healthcare for different population groups. Specifically, the focus is on evidence from low and middle income countries and reference to international evidence is used to derive broader theory and practice implications.

2.2 Literature Search Strategy

Literature was searched using major academic and health care information databases such as PubMed/MEDLINE, Scopus, Web of Science, CINAHL, and Google Scholar. Other recognised healthcare policy and research organisations were consulted for additional materials. The literature search was primarily conducted on publications between 2010 and November 2024; however, where they provided a foundation of theory, earlier works were included. The keywords used include digital health transformation, digital health inequality, health inequality, digital divide in health, telemedicine, mobile health, electronic health records, pharmaceutical services, telepharmacy, digital nursing, nursing informatics, medication management, health equity, digital literacy, social determinants of health, and social development.

Search terms were used to find publications that discussed the link between digital technologies, healthcare delivery and social inequalities and Boolean operators were used in combination with the search terms to do this. Searches also included using different versions of the terms to account for variations in the terms used to describe digital health interventions in the fields of pharmaceutical sciences, nursing, public health, and health policy research.

2.3 Inclusion and Exclusion Criteria

The literature that was reviewed was considered relevant for the research goals and objectives, because it contributes to the methodology and because it discusses the issues of digital health transformation and the inequalities in healthcare.

To be included in the studies, they had to focus on digital health accessibility, digital healthcare technologies and services, healthcare inequality, pharmaceutical service delivery, nursing practice, and social and economic impacts of healthcare digitalization. The following types of evidence were included: systematic reviews, scoping reviews, integrative reviews, narrative reviews, empirical investigations, and relevant international policy documents.

Publishments that focus on the experiences of under-reserved populations, including people who live in rural areas, live on low incomes, work in resource constrained healthcare systems, and lack digital literacy received priority. The relevance of research on implementation of digital healthcare in LMICs was also seen as particularly pertinent.

Articles were omitted if they were technical articles on software development only, not relevant to the research goals, or if they failed to make a clear contribution to the discussion of healthcare accessibility, equity or professional practice. Technological publications that didn't relate to healthcare were also taken out.

2.4 Literature Screening and Selection

The literature screening process entailed first screening the titles and abstracts of the publications to determine which publications met the aims of the review. Those publications which were found to be potentially eligible were then analyzed in greater depth to assess their relevance to pharmaceutical services, nursing practice, health disparity and social development.

Special focus was placed on how technology interventions were connected with the perceived effects on health care access, health care outcomes, practice and socio-economic factors. In cases of multiple publications that covered similar themes, preference was given to review articles, publications with well-described methodology, and publications that provided substantial evidence or policy insights.

2.5 Data Extraction and Thematic Analysis

Information was arranged on the basis of three criteria: publication features, research aims, technological interventions, study samples, healthcare environments, and important conclusions. The information gathered was analysed to detect the trends, variations in research results and to pinpoint issues concerning digital accessibility of healthcare services and inequalities.

The literature was thematically synthesized into five main analytical categories: digital health transformation and technological access; socioeconomic and geographical determinants of digital healthcare inequality; implications for pharmaceutical services; implications for nursing practice; and social development, health equity, and universal health coverage.

The thematic approach allowed for the integration of the evidence from various health care disciplines and the discovery of relationships between digital infrastructure, professional capacity, patient experiences, and health care outcomes.

2.6 Quality Considerations and Limitations of the Review

The credibility of sources of publication, clarity of research goals, appropriateness of research designs, transparency of reported results, and relevance to the goals of the review were taken into consideration. Focusing on peer-reviewed publications and authoritative policy documents helped to bolster the trustworthiness of the synthesis.

The review is, however, subject to constraints presented by the diversity of DHIs, variations in healthcare systems, variations in research methodologies and geographical unevenness in the literature available. Digital healthcare technologies are developing quickly as well, so results from previous research may not necessarily represent the

present state of the technology and implementation contexts. Moreover, the majority of evidence in some instances is based on high-income countries making findings less generalizable to low-resource health care settings.

3. Findings and Discussion

The literature analyzed shows that digital health transformation is transforming the provision of health services, ranging from better information management to offering more remote access to health services, to the delivery of pharmaceutical services, to better clinical decision-making, and to better collaboration amongst professionals. These advances, however, will only have a positive impact on population health if technological resources, institutional readiness, socioeconomic factors and the digital skills of health care professionals and patients are distributed appropriately (Longhini et al., 2022).

The synthesis results in six related themes: Digital health technologies and Healthcare accessibility; Socioeconomic determinants of Digital healthcare inequality; Transforming the pharmaceutical service; Digital nursing practice; Social and economic development; Strategies to reach equitable Digital healthcare.

3.1 Digital Health Transformation and the Changing Landscape of Healthcare Delivery

3.1.1 Adoption of Digital Health Technologies in Healthcare Systems

The digital transformation has added a plethora of technologies to the healthcare delivery landscape, such as electronic health records, telemedicine, mobile health apps, and artificial intelligence, remote patient monitoring, and cloud-based healthcare information systems. These technologies help to move from the traditional and mostly facility-based healthcare delivery system to a more connected, information-based, patient-centred healthcare system (Kashani et al., 2023).

EHRs have taken on a greater significance in making patient records readily available and organized. Electronic systems can help address information fragmentation and facilitate continuity of care by providing healthcare professionals with clinical history, lab results, diagnosis, prescriptions and treatment records. Likewise, there are telemedicine platforms to allow patients to connect with healthcare providers remotely, which can help lower geographical constraints and avoid unnecessary hospital visits.

Mobile health technologies have also helped to increase the range of community-based healthcare interventions. Mobile apps and text messaging systems can be used to facilitate appointment reminders, health education, treatment adherence, maternal health tracking and chronic disease management. For instance, individuals with diabetes or hypertension can get digital reminders and educational content to help them stay on track with their medications and follow their health plans.

Moreno et al., (2020) point to a number of interrelated levels that are necessary to ensure digital health equity: individual capabilities, community conditions, healthcare systems, policy environments, and intervention design. This indicates that digital transformation is not just about technology infrastructure; it also involves setting up institutional and social contexts that can help various population groups have access to digital services.

3.1.2 Telemedicine and the Expansion of Healthcare Accessibility

Telemedicine is a key element of the healthcare transformation that allows healthcare professionals to meet patients, monitor them, and offer some follow-up care without having to ask them to travel to a healthcare centre. This is not insignificant news for peoples in geographically isolated areas, which may have a limited number of health care professionals and long distances to travel to access services.

For remote consultation, opportunities may be enhanced for access to primary health care, specialist advice, maternal health information and chronic disease management in rural communities. Moreover, telemedicine can enhance the communication between the health care facilities, enabling the lower level facilities to receive professional assistance from the referral hospitals (Memon et al., 2023).

But factors such as internet access, power access, the cost of devices, language and digital literacy affect the accessibility benefits of telemedicine. People with limited or no Internet access or access to a computer might not have access to services that rely on Internet communication. Likewise, older adults and persons with disabilities might experience problems with a digital consultation platform that has not been created with accessibility in mind.

Alami et al (2023) highlight that digital health equity needs to be inclusive, taking up cultural, educational, geographical, socioeconomic and personal restrictions into account. Their findings show that not all digital healthcare services are equally accessible, participating or bringing benefits to all population groups.

3.1.3 Artificial Intelligence and Data-Driven Clinical Decision-Making

AI is gaining traction in healthcare systems to aid diagnostics, clinical decision-making, medical imaging analysis, risk prediction, and patient monitoring. By combining machine learning algorithms with extensive clinical data, patterns can be recognized that can help healthcare professionals better identify disease risks and determine the right interventions to make.

In the field of pharmaceutical services, AI-powered systems can assist in the decision-making associated with pharmaceutical management, such as identifying potential drug interactions, flagging unusual prescription patterns, and aiding in personalized medication reviews. In the healthcare industry, predictive analytics can help alert practitioners about patients who might need more surveillance or care.

However, there are significant equity concerns with AI-based healthcare systems, even with these opportunities. Bias in the algorithm could exist when applied to different demographic groups if they are developed with incomplete or

unrepresentative datasets. For instance, the clinical conditions of patients in rural or resource-limited healthcare systems might not be well captured by prediction models that are largely derived from data from high-resource hospitals (Nwanesi, 2024).

Moreover, some parts of the population might be exposed to more technologically sophisticated systems than others in the event of different healthcare institutions having different technical capacities.Therefore, when implementing AI, it is important to have clear governance, representative datasets, clinical validation, human oversight, and continual evaluation of performance on population subsets.

3.2 Socioeconomic Determinants of Digital Healthcare Inequality

3.2.1 Digital Infrastructure and Geographical Disparities

Technological infrastructure is one of the key factors enabling digital healthcare access. Reliable internet connectivity, electricity, appropriate devices, secure information systems, and technical support are essential for implementing digital healthcare interventions. Generally urban facilities have better opportunities for accessing technological infrastructures than do many rural facilities. This difference may affect the accessibility of electronic medical records, telemedicine, digital diagnostic tools, and patient-monitoring via remote systems (Cheng et al., 2013).

Hospitals, clinics, and other health facilities in these resource-limited settings could be facing issues with electricity, network coverage, financial constraints, and technical staff. These challenges impact healthcare providers and patients, limiting the ability of digital interventions in healthcare to be effective.

Research evidence on the implementation and adoption of digital health interventions for NCD management in LMICs highlights the increasing importance of digital technologies in primary health care and provides insights into barriers to implementation and adoption that impact the effectiveness of these interventions (Hazin et al., 2013). The geographical digital divide is thus not just a technological infrastructure issue. It is a manifestation of disparities in resources, institutions and access to key health care services.

3.2.2 Income Inequality and Affordability of Digital Healthcare

Economic disparity has a strong impact on people's capacity to engage with digital health care systems. Some mobile health solutions can lower the cost of getting to health care facilities, but using digital health services can be challenging because it requires using a smartphone, Internet, subscription to Internet, data bundle, electricity, and in some cases, extra consultation fees.

The lower-income households might not be able to afford spending money on digital devices or internet subscriptions because they lack the funds to cover other expenses like food, housing, education, and transportation. For this reason, there may be significant financial barriers for individuals who can benefit from remote healthcare services to access them (Tamrakar et al., 2024).

Digital health has the potential to cause indirect costs. For instance, the patient might have to buy a device that is compatible, have to expend repeated connectivity or have to travel to places where the internet is available.

Such disparities illustrate the need to think about the affordability of digital health services in addition to the costs of conventional health services. These can be mitigated through the use of subsidised connectivity, platforms that are accessible, public investment in infrastructure, and the provision of affordable, community-based digital services.

3.2.3 Digital Literacy, Education, and Population Vulnerability

Digital literacy is defined as knowledge and skills of accessing, understanding, assessing and effectively using digital technologies. In healthcare, digital literacy has a complex impact on how patients access online consultations, understand electronic healthcare information, access mobile health applications, and communicate with healthcare professionals via online platforms (Lupton, 2017).

People with low levels of education can struggle to comprehend digital health information, navigate applications and find trusted medical information. Limited access may also be caused by the use of different languages and unfamiliar technical jargon.

Barriers may be experienced by older adults, people with disabilities, those in remote areas and low-income populations. These challenges can escalate if the transition to digital services for health care happens instead of the face-to-face services without an alternative plan.

Qoseem et al. (2024) highlight inequalities in the access and use of digital health as key issues and calls for actions to promote equity-oriented implementation strategies. In a similar fashion, Ricciardi et al. (2019) highlight the need to consider individual, social and structural barriers in the design of interventions to be used in a digital healthcare context. The results indicated that digital literacy needs to be looked at not just as a technologic skill but as a vital part of the accessibility of healthcare.

3.3 Implications of Digital Health Transformation for Pharmaceutical Services

3.3.1 Electronic Prescribing and Medication Management

Digital health transformation has made a notable impact on the field of healthcare, particularly within the pharmaceutical sector, by integrating electronic prescribing, electronic medication records, digital dispensing systems, and computerized clinical decision-support tools (Hameed et al., 2024).

Electronic prescribing is a system that enables authorized health care practitioners to send a prescription electronically to a pharmacy, which helps to minimise handwritten prescriptions and helps health care professionals and pharmacists communicate with each other. These systems may enhance readability of prescriptions, assist with medication reconciliation and aid to identify selected medication-related problems. Electronic medication records can also alert

pharmacists to review a patient's medication history, alert for drug interactions and track medication changes. These functions are especially crucial for patients with chronic diseases who might need to take multiple medications and frequent follow-up (Hoagland et al., 2024).

However, there are risks associated with e-prescribing. Inaccurate data could be entered, inappropriate clinical alerts might be issued, and interoperability issues can cause new medication-related errors. Professional judgement should thus be preserved as best practice in digital systems.

In their systematic review of digital health technologies in pharmaceutical care in LMICs, Woods et al. (2024) looked at the effectiveness and implementation experiences of these technologies and emphasized the need to understand contextual factors that can affect their implementation.

3.3.2 Telepharmacy and Access to Pharmaceutical Care

Telepharmacy is the delivery of specific pharmacy services using telecommunication and digital technologies. It can support patient education about medications, prescription review, treatment monitoring and pharmacist–patient communication for those who have poor access to traditional pharmacies (Turnbull et al., 2024).

Telepharmacy provides opportunities to bring the pharmaceutical expertise to rural communities beyond the walls of well-equipped hospitals and urban pharmacies. Chronic condition patients can be provided remote counselling on prescribed medications, adherence to treatment, potential side effects and necessary follow-up.

Digital communication channels can also enhance collaboration between physicians, nurses and pharmacists. This is especially true in a multidisciplinary healthcare setting where managing medications is required to be coordinated (Endalamaw et al., 2023).

Telepharmacy, however, needs to be properly regulated, have secure communication systems, ensure reliable connectivity, and include prescription verification and patient information protection systems. Do not presume that a remote pharmaceutical consultation can replace clinical assessment or all aspects of dispensing.

In 2024, researchers conducted a scoping review of e-pharmacy in India, which revealed several potential benefits such as access to medicines, supply chain management, and service convenience, as well as challenges concerning access in rural areas, lack of internet connectivity, and digital literacy.

3.3.3 Digital Pharmaceutical Supply Chains and Medicine Availability

The use of digital technologies has provided possibilities for enhancing the use of the pharmaceutical supply chain including electronic procurement systems, inventory monitoring, stock management and tracking medicine distribution (Goodyear-Smith, 2019).

Digital inventory systems are useful for healthcare establishments to keep an eye on the supply of medicines, determine which ones are in short supply, follow medicine expiration dates, and optimize procurement processes. These systems can help minimize administrative inefficiencies and facilitate better decision-making regarding the allocation of pharmaceutical resources.

Effective digital supply-chain management is especially crucial in resource-limited healthcare environments where medicine shortages can affect continuity of care and cause a strain on patients' finances.

For instance, primary health care facilities can use electronic inventory monitoring to detect shortages of essential medicines before they get critical. This information can then be conveyed to the procurement departments or distribution centres to enable timely replenishment (Tromp, 2022).

Still, digital supply-chain systems need to be reliable, have trained staff, allow for facility integration, and have sustained financial resources. Despite its capabilities, a digital inventory platform cannot solve the problem of shortage of medicines if affected by the lack of adequate budgets for procurement, distribution or insufficient national pharmaceutical production. Digital transformation should thus be part of and complement wider pharmaceutical policies aimed at improving the affordability of medicines, improving medicines procurement, quality assurance, and medicines distribution.

3.3.4 Pharmacovigilance and Medication Safety

Pharmacovigilance is the process of detection, assessment, understanding and prevention of adverse effects and other medicine related problems. Digital platforms can enhance pharmacovigilance by enabling the dissemination and sharing of adverse drug reactions reports from healthcare professionals and patients (Morris et al., 2022).

The use of electronic reporting systems can help identify new safety issues, facilitate information sharing and enhance regulatory oversight. Pharmaceutical information systems could also be integrated into EHRs in order to enhance access to information for medication-related outcomes assessment.

However, digital pharmacovigilance systems can lead to incomplete evidence if healthcare professionals are not trained in the system or if there are issues with accessing reporting systems. These technological advances may have limited effect on underreporting, however.

The use of digital pharmacovigilance should include easily accessible reporting channels, professional training, data checking, and good communication between healthcare institutions and regulators.

3.4 Implications of Digital Health Transformation for Nursing Practice

3.4.1 Electronic Nursing Documentation and Clinical Information Management

The digital revolution has revolutionized nursing documentation, with the adoption of electronic nursing records, computers for patient monitoring, and hospital information systems.

By streamlining the process of recording patient evaluations, medication administration, vital signs, care plans, and clinical observations, electronic nursing documentation helps nurses to keep patients' information in a structured digital system. These records provide better accessibility of information and enable communication between health care professionals (Woods et al., 2024).

For instance, electronic medication administration records can be used to confirm medication orders and to record medication administration by nurses. Likewise, a seamless clinical record can facilitate the continuity of care across different departments within the hospital or even between different healthcare centres (Hameed et al., 2024).

However, if the electronic documentation system is not well designed, or needs to be entered multiple times, it may cause an administrative burden. Nurses may also have problems with the new platforms, especially if training and technical support from the institution are not provided. Digital nursing systems should thus be built to take into consideration the clinical workflows and patient care requirements and not solely on technological concerns.

3.4.2 Telehealth Nursing and Remote Patient Monitoring

Telehealth nursing allows for the delivery of specific health care services using phone, video, mobile apps and remote monitoring devices. These strategies can enhance patient follow-up after chronic disease diagnosis and treatment, provide an opportunity for health education, help support maternal and child health care, and improve communication with those in remote locations (Ricciardi et al., 2019).

Additionally, remote patient monitoring can support monitoring of specific health parameters; this can be helpful for healthcare providers to determine if there are changes that need additional clinical investigation.

For instance, patients with hypertension might rely on authorized digital blood pressure monitors that can take a blood pressure reading which they can then share with their healthcare provider. Likewise, remote examinations can facilitate nurses to educate and follow up patients who have challenges to attend healthcare facilities regularly.

But, there are limitations to telehealth nursing. Interactions conducted at a distance may not yield enough information to make diagnoses, take immediate action, or follow-up diagnostic procedures that require physical interaction. Therefore, reliable clinical protocols are needed to establish when a patient has to be assessed in person (Qoseem et al., 2024).

3.4.3 Nursing Informatics and Professional Competence

Nursing informatics is the integration of nursing knowledge, information and communication technologies for the purpose of enhancing clinical practice, healthcare management, education, and research. With the advent of digital systems in healthcare, nurses need to possess skills in electronic documentation, digital communication, interpreting clinical information, protecting patient privacy, and providing digital-enabled patient care (Tamrakar et al., 2024).

As such, the incorporation of digital skills in nursing education is becoming more and more relevant. Nursing programs should include hands-on experience with electronic health records, telehealth, clinical decision support, digital ethics and health information management.

During the 2024 integrative review of nursing and midwifery's contribution to digital health, four general themes were identified in 24 publications, showing that nurses and midwives play a role in digital health leadership, though limited and not yet enshrined in a systematic, widespread approach. This discovery underscores the importance of increasing the role of nurses in digital health planning, policy making, technologic design, and institutional decision making.

3.4.4 Digital Transformation, Nursing Workload, and Patient-Centred Care

Digital systems can have a positive impact on information management, but this new technology can impact the nursing workloads and professional relationships introduced. Systems that are not integrated can force nurses to dedicate more time to logging pertinent data, troubleshooting technical issues and managing digital alerts, among other things, across various platforms. Direct patient interaction time may be limited while these responsibilities are still carried out, unless patient care processes are reconfigured.

However, there are certain concerns in the area of interpersonal relations when using digital health. Empathy, communication, clinical observation and emotional support are integral to the nursing practice and automated systems can not be a perfect substitute for them (Hazin et al., 2013).

Digital tools should therefore reinforce, not replace, the human aspect of care provided by nurses. They should be measured not just by their ability to document efficiently, but also by their impact on the patient, safety, continuity of care, and professional satisfaction.

3.5 Digital Health Transformation and Social Development

3.5.1 Digital Healthcare and Human Capital Development

Healthcare is a key component of human capital development, as population health affects participation in education, productivity in the labor force, welfare in the family and economic participation. Digital healthcare can contribute to the development of human resources by increasing access to health information, enhancing disease prevention, improving the continuity of treatment and early detection of targeted health problems (Cheng et al., 2013).

Mobile health education can help raise awareness around topics such as maternal health, childhood immunisations, nutrition, reproductive health and non-communicable diseases, for instance. When information is available, accessible, understandable and reliable, such interventions can enhance health knowledge and aid in informed health care decision making.

Better access to healthcare information could also enhance the individual and community's ability to engage in disease prevention and health promotion. However, the potential for digital health education relies on the accessibility of the right language, user-friendly content, accurate information, and adequate technical resources (Alami et al., 2023).

3.5.2 Digital Health, Employment, and Healthcare Workforce Development

Healthcare systems are facing new opportunities for professions and skills due to digital transformation. They range from health informatics, digital health administration, telehealth coordination, pharmaceutical information management, health data analysis, to digital healthcare support.

The growth of digital healthcare services can also enable professionals to collaborate and continue education, such as between nurses and pharmacists, physicians and other health care workers. But, as technology changes, there is the potential for inequalities to increase between those who are adequately trained in digital and those without access to digital professional development (Nwanesi, 2024).

Healthcare institutions should thus continue to invest in continuing education, digital skills development and institutional support to avoid the technological advancement that will negatively impact on specific professional groups.

3.5.3 Healthcare Inequality and Socioeconomic Exclusion

There is a strong relationship between healthcare inequality and socioeconomic inequality. People living in poverty, with poor access to education and schools, people who live in rural areas far from services and people who have poor social infrastructure may be subject to multiple barriers to traditional and electronic health services at the same time.

These disadvantages could be further exacerbated by the introduction of digital only healthcare pathways, where patients are expected to log in to an online healthcare portal, access e-payment systems, download a mobile app or book an online consultation without support (Memon et al., 2023).

For instance, a person residing in a far-flung area can have a mobile health application however may not have constant connectivity or the financial resources to utilize it routinely. Likewise, a senior citizen can get digital reminders but have trouble accessing and comprehending the information. These are examples of conditions where the presence of digital healthcare infrastructure does not imply meaningful access. To make these digital health tools more equitable, they need to be complemented by community outreach, reachable healthcare infrastructure, social protection mechanisms, and alternative service delivery.

3.5.4 Digital Health and Universal Health Coverage

The goal of achieving universal health coverage is for people and communities to receive necessary health care without suffering financial hardship. Digital health technologies have the potential to help this goal in a number of ways, such as enhancing the co-ordination of services, supporting healthcare administration, and reaching underserved populations by providing selected services (Moreno, 2020).

Digital health interventions should, however, be assessed based on their impact on equity of access to health care and not on the number of apps launched or consultations delivered.

WHO's 2023 guidance on the assessment of digital technologies and health financing highlights the need for attention to understanding the potential of digital systems to affect functions and health financing policies of universal health coverage. It also acknowledges that technology can't necessarily create better health financing or fair service provision.

Thus, the link between digital health and UHC relies on the successful implementation of sustainable financing, readily available services, sensible regulation, and equity-oriented health policies, in addition to technological innovation.

3.6 Major Challenges Affecting Equitable Digital Health Transformation

3.6.1 Data Privacy, Cybersecurity, and Patient Confidentiality

Digital healthcare systems gather and handle individual and clinical touchable data, such as medical records, diagnoses, prescriptions, laboratory findings, and demographic information.

Higher sharing of health data poses risks of unauthorized access, unwarranted disclosure, cyberattacks, and improper use of personal data. Without trust in the collection, storage, sharing of patient information, patients can be hesitant to use digital healthcare services (Kashani et al., 2023).

Therefore, healthcare organizations need to have the right data governance processes, access control, encryption, employee training, cybersecurity surveillance, and clear privacy policies. Special care should be taken of vulnerable individuals who might not be aware about digital consent and information sharing protocols.

3.6.2 Institutional Capacity and Financial Sustainability

The adoption of digital health technologies requires significant investment in infrastructure, connectivity, software development, software maintenance, cybersecurity, and training of professionals. It may be difficult for healthcare institutions with tight budgets to sustain digital infrastructure once it is in place. Other issues of sustainability can be caused by fragmented information systems and relying on external technology providers (Longhini et al., 2022).

The strategies for achieving digital transformation in LMICs should thus be grounded in pragmatic financing models, institutional roadmaps, suitable infrastructure, and public-private partnerships between healthcare providers.

3.6.3 Interoperability and Fragmentation of Healthcare Information Systems

Interoperability is the capability of disparate digital health systems to provide effective exchange, interpretation and use of data. The lack of interoperability may lead to patient data silos, duplicate diagnostics, communication barriers, and challenges in healthcare coordination among different healthcare organizations (Ezeamii et al., 2024).

For instance, a primary health care provider could treat a patient and then refer him to a hospital that does not have an electronic information system that can access the patient's past health care records.

This disintegration can be detrimental to the promise of digital healthcare transformation. It is therefore critical to establish common data standards, secure information sharing protocols and interoperable national health information systems to enable coordinated healthcare delivery.

3.6.4 Professional Resistance and Limited Digital Skills

Lack of training or workload burden, unfamiliarity with new technologies, and insufficient involvement of healthcare professionals in technology planning decisions can be factors that impact the adoption of digital healthcare technologies (Emmons et al., 2021).

One of the challenges nurses, pharmacists and other health care providers face is when the introduction of digital systems occurs without proper consultation, training, and technical support. Professional engagement is necessary across the entire planning, implementation, evaluation and improvement process of effective digital transformation.

3.6.5 Ethical Challenges and Algorithmic Inequality

The ethical implications of AI and automated decision-making tools include issues of transparency, accountability, fairness, and clinical responsibility. Historical healthcare disparities can be perpetuated in the form of discriminatory patterns in diagnosis, risk prediction, or treatment recommendations within algorithms (Hernandez, 2023).

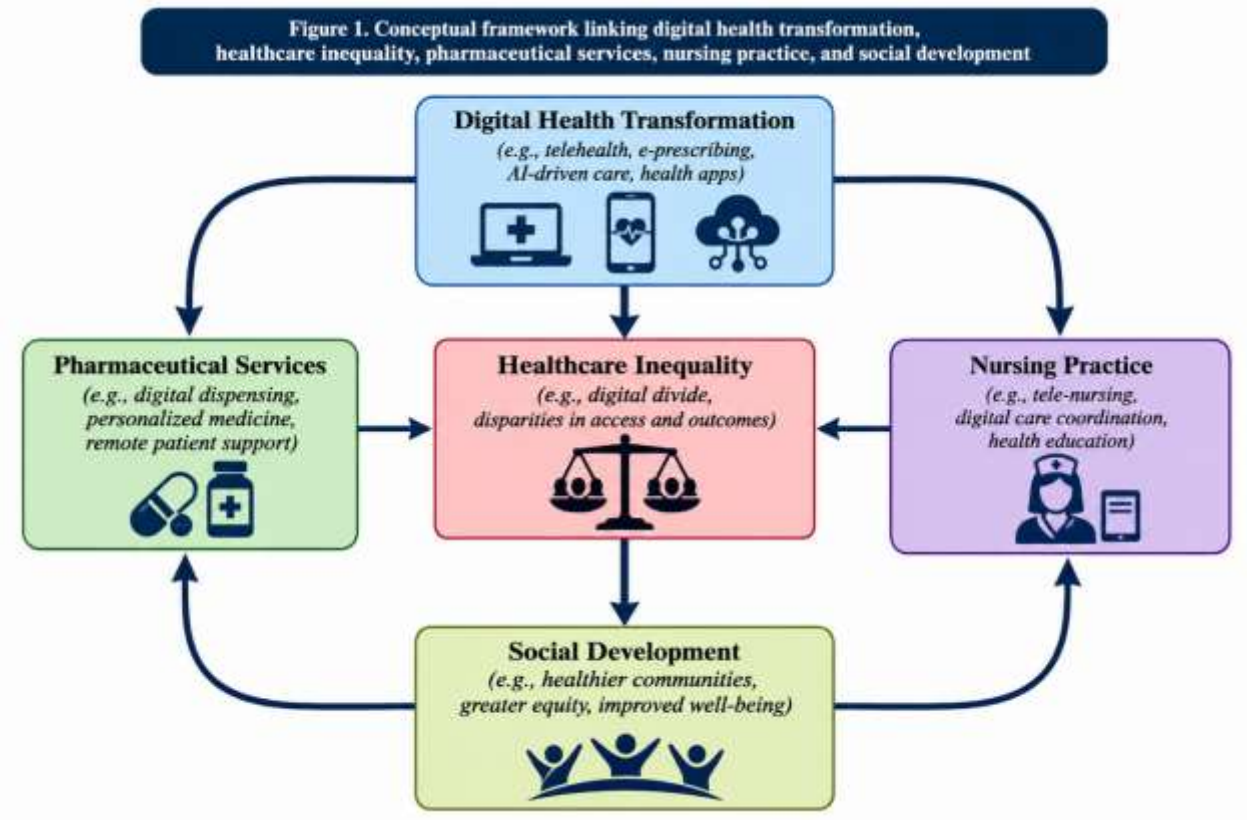
Healthcare organizations would therefore need to put in place measures to assess the performance of algorithms in various population and socio-economic sub-groups. Important clinical decisions must continue to be made by humans.

3.7 Conceptual Framework for Digital Health Transformation and Healthcare Inequality

The findings from the literature analysis indicated that digital health transformation can impact healthcare equity by leveraging the interplay of technological infrastructure, socioeconomic determinants, institutional capacity, and professional competences.

Digital health technologies are the main intervention, with socioeconomic and technological conditions affecting the availability and effective use of it. Digital transformation also has significant impacts on health care delivery, particularly via pharmaceutical and nursing services. These paths in turn shape the outcomes for patients, access to health care, social inclusion, and larger development.

Figure 1. Conceptual framework linking digital health transformation, healthcare inequality, pharmaceutical services, nursing practice, and social development.



Source: Authors' conceptual synthesis based on the reviewed literature.

The framework shows that transformation does not directly result in health equity outcomes. Rather, its impact is tempered by technological infrastructure, cost, personal skills, and institutional preparedness. In areas where these enabling conditions exist, digital technologies can reinforce the pharmaceutical services, nursing practice and patient outcomes. When they don't exist, digital transformation can perpetuate or exacerbate health inequities.

3.8 Summary of the Major Findings

The reviewed evidence resulted in several interrelated findings related to digital health transformation and healthcare inequality. The results are presented in a tabular format in Table 1.

Table 1. Major thematic findings on digital health transformation and healthcare inequality

Thematic area	Major findings	Implications
Digital healthcare technologies	Telemedicine, AI, mHealth and EHRs expand healthcare delivery opportunities.	Improved coordination and potential access to services.
Digital infrastructure	Connectivity, electricity and device availability influence technology adoption.	Infrastructure inequalities may reinforce healthcare disparities.
Socioeconomic determinants	Income, education, age and digital literacy influence digital participation.	Vulnerable populations require targeted support.
Pharmaceutical services	Electronic prescriptions, telepharmacy and digital inventory systems support pharmaceutical care.	Potential improvements in medication management and medicine accessibility.
Nursing practice	Digital documentation, remote monitoring and nursing informatics transform clinical workflows.	Greater need for digital competencies and professional support.
Social development	Digital health can support health education, workforce development and service inclusion.	Potential contribution to human capital and socioeconomic development.
Data governance	Digital health creates privacy, cybersecurity and algorithmic fairness concerns.	Strong regulation and accountability are necessary.
Universal health coverage	Digital technologies can support health system strengthening but cannot independently eliminate structural inequalities.	Equity-oriented financing and inclusive health policies are essential.

Source: Authors' synthesis of the reviewed studies.

3.9 Strategies for Promoting Equitable Digital Health Transformation

The results show that a coordinated effort between the governments, healthcare institutions, pharmaceutical professionals, nursing organizations, technology developers and communities is needed to reduce healthcare inequality.

Table 2. Recommended strategies for promoting equitable digital healthcare

Strategic area	Recommended interventions	Expected contribution
Digital infrastructure	Expand affordable internet, electricity and device accessibility, particularly in underserved areas.	Reduces geographical and technological exclusion.
Digital literacy	Introduce community-based digital health education and patient support.	Improves effective utilization of digital services.
Pharmaceutical services	Strengthen regulated telepharmacy, electronic prescriptions and digital inventory management.	Improves pharmaceutical coordination and access.
Nursing education	Integrate nursing informatics and digital healthcare competencies into professional training.	Strengthens clinical competence and workforce readiness.
Inclusive technology design	Develop accessible, multilingual and disability-inclusive platforms.	Improves participation among vulnerable populations.
Data governance	Strengthen cybersecurity, patient confidentiality and ethical AI governance.	Builds trust and protects patient information.
Health financing	Support affordable digital services and sustainable healthcare technology investment.	Reduces financial barriers to participation.
Institutional collaboration	Promote interoperability and coordination between healthcare facilities.	Improves continuity and integration of care.
Community participation	Involve patients and underserved communities in digital health planning.	Improves relevance, acceptability and adoption.
Monitoring and evaluation	Assess digital health outcomes according to socioeconomic and geographical differences.	Identifies and addresses emerging inequalities.

Source: Authors' recommendations based on the reviewed evidence.

3.10 Implications for Healthcare Policy, Research, and Practice

The results have several implications for health care policy, health profession practice, and future research. The first step is for governments to acknowledge digital health equity as an integral part of their national healthcare development plans. The policies of digital transformation should emphasize more on affordability, infrastructure, accessibility and disadvantaged population needs than on technological modernization (Aminabee, 2024).

Second, there is a need to integrate digital technologies into medication management, pharmaceutical supply chains, prescription monitoring and patient counselling within pharmaceutical institutions. Integration, however, should include suitable regulation, quality assurance, and systems to safeguard patients who aren't able to use digital pharmaceutical services.

Third, the nursing institutions should bolster the IT skills of undergraduates, postgraduates and practicing nurses by providing them with IT education at undergraduate level, postgraduate level and continuing professional development. Design and evaluation of digital healthcare systems should involve nurses to ensure technologies are in line with clinical realities and patients' needs.

Fourth, healthcare institutions need to put in place the right governance to deal with data protection, algorithmic accountability, cyber security, and interoperability issues. These measures are especially vital in an era where healthcare systems are becoming increasingly reliant on information systems that are interconnected and on AI-driven decision-making.

Lastly, ongoing research is needed to examine the long-term impacts of digital health interventions on health equity, especially in LMICs. Additional empirical studies are required to establish if digital health will enhance access for the disadvantaged and/or if it will primarily benefit individuals with more socioeconomic and technological access.

For a more holistic grasp of the impact of digital transformation on healthcare equity, it would benefit from various forms of research such as longitudinal studies, comparative investigations, and multidisciplinary research involving pharmacists, nurses, physicians, public health professionals, economists, and social scientists.

4. Conclusion

Digital health transformation is a key milestone in the current healthcare landscape, which presents opportunities to enhance the accessibility of services, the management of pharmaceuticals, nursing practice, patient monitoring and the efficiency of healthcare systems. These technologies could serve to improve coordination of care, improve access to necessary services, and have other benefits.These technologies could support better care coordination, increase access to necessary care, and have other benefits. But, the results of this review show that the socioeconomic context, digital literacy, geographical location, infrastructure availability, and affordability and institutional capacity can affect the benefits of digital transformation. In the pharmaceutical sector, digital technologies can enhance prescriptions, monitoring of medications, pharmaceutical supply chains and access to professional counselling, while in nursing, electronic documentation, telehealth, clinical information management, and remote patient monitoring can benefit the practice. However, challenges to training, technology fragmentation, privacy issues and disparities in access to digital tools can compromise these benefits, and can pose further professional and healthcare challenges. Equitable digital healthcare can play a role in social development beyond clinical practice, through enhanced population health, human capital development and enhanced health care worker knowledge and skills, and even better universal health coverage. But the exclusion of vulnerable groups from accessing and/or effectively engaging with technology-based services can compound inequalities, however. The review thus highlights the need for digital health policies that are truly equitable, cost-effective digital health technology, including technological infrastructure, digital literacy programmes that are inclusive, digital health professionals' capacity development, data governance, and sustainable digital health financing. Finally, digital health transformation should be embedded in a broader development strategy for the health system that addresses social injustice, professional accountability and equal access to health care and includes technological innovations. The success of it should be judged not just on the uptake of new technology but how it enhances health care and on the extent to which it diminishes inequalities between population groups.

References

1. Abernethy, A., Adams, L., Barrett, M., Bechtel, C., Brennan, P., Butte, A., ... & Valdes, K. (2022). The promise of digital health: then, now, and the future. *NAM perspectives*, *2022*, 10-31478.
2. Alami, H., Rivard, L., Lehoux, P., Ag Ahmed, M. A., Fortin, J. P., & Fleet, R. (2023). Integrating environmental considerations in digital health technology assessment and procurement: Stakeholders' perspectives. *Digital health*, *9*, 20552076231219113.
3. Aminabee, S. (2024). The future of healthcare and patient-centric care: Digital innovations, trends, and predictions. In *Emerging technologies for health literacy and medical practice* (pp. 240-262). IGI Global Scientific Publishing.
4. Cheng, M. Y., Raisch, P. D. D. W., Borrego, P. D. M. E., & Gupchup, P. D. G. V. (2013). Economic, clinical, and humanistic outcomes (ECHOs) of pharmaceutical care services for minority patients: a literature review. *Research in Social and Administrative Pharmacy*, *9*(3), 311-329.
5. Emmanuel, B. (2024). Digital Transformation and Global Socioeconomic Inequality. *Steadfast Journal in Multidisciplinary Studies*, *1*(1), 29-41.

6. Emmons, R. P., Harris, I. M., Abdalla, M., Afolabi, T. M., Barner, A. E., Baxter, M. V., ... & Wease, H. (2021). Impact of remote delivery of clinical pharmacy services on health disparities and access to care. *Journal of the American College of Clinical Pharmacy*, *4*(11), 1492-1501.
7. Endalamaw, A., Khatri, R. B., Erku, D., Nigatu, F., Zewdie, A., Wolka, E., & Assefa, Y. (2023). Successes and challenges towards improving quality of primary health care services: a scoping review. *BMC Health Services Research*, *23*(1), 893.
8. Ezeamii, V. C., Okobi, O. E., Wambai-Sani, H., Perera, G. S., Zaynieva, S., Okonkwo, C. C., ... & Obiefuna, N. G. (2024). Revolutionizing healthcare: how telemedicine is improving patient outcomes and expanding access to care. *Cureus*, *16*(7).
9. Goodyear-Smith, F., & Ashton, T. (2019). New Zealand health system: universalism struggles with persisting inequities. *The Lancet*, *394*(10196), 432-442.
10. Hameed, K., Naha, R., & Hameed, F. (2024). Digital transformation for sustainable health and well-being: a review and future research directions. *Discover Sustainability*, *5*(1), 104.
11. Hazin, R., Brothers, K. B., Malin, B. A., Koenig, B. A., Sanderson, S. C., Rothstein, M. A., ... & Kullo, I. J. (2013). Ethical, legal, and social implications of incorporating genomic information into electronic health records. *Genetics in Medicine*, *15*(10), 810-816.
12. Hernandez, M. F., & Rodriguez, F. (2023). Health techequity: opportunities for digital health innovations to improve equity and diversity in cardiovascular care. *Current Cardiovascular Risk Reports*, *17*(1), 1-20.
13. Hoagland, P. A., & Kipping, C. C. S. (2024). Challenges in promoting health equity and reducing disparities in access across new and established technologies. *Canadian Journal of Cardiology*, *40*(6), 1154-1167.
14. Kashani, K. B., Awdishu, L., Bagshaw, S. M., Barreto, E. F., Claure-Del Granado, R., Evans, B. J., ... & Mehta, R. L. (2023). Digital health and acute kidney injury: consensus report of the 27th Acute Disease Quality Initiative workgroup. *Nature Reviews Nephrology*, *19*(12), 807-818.
15. Longhini, J., Rossettini, G., & Palese, A. (2022). Digital health competencies among health care professionals: systematic review. *Journal of medical Internet research*, *24*(8), e36414.
16. Lupton, D. (2017). *Digital health: Critical and cross-disciplinary perspectives*. Routledge.
17. Memon, M. suleman, Unar, I. N., & qureshi, K. (2023). Arsenic Adsorption on Designed Packed Bed Column using Chemically Modified PAN Fiber- A Simulation and Modeling Studies. *International Journal of Applied and Natural Sciences*, 1(1), 51–58. https://doi.org/10.61424/ijans.v1i1.14
18. Moreno, C., Wykes, T., Galderisi, S., Nordentoft, M., Crossley, N., Jones, N., ... & Arango, C. (2020). How mental health care should change as a consequence of the COVID-19 pandemic. *The lancet psychiatry*, *7*(9), 813-824.
19. Morris, B. B., Rossi, B., & Fuemmeler, B. (2022). The role of digital health technology in rural cancer care delivery: a systematic review. *The Journal of Rural Health*, *38*(3), 493-511.
20. Nwanesi, F. (2024). An Evaluation of the Adoption Rate of Organic Fertilizers for Sustainable Agricultural Production in Nigeria: A National Case Study. *International Journal of Applied and Natural Sciences, 2*(1), 79–94. https://doi.org/10.61424/ijans.v2i1.429
21. Qoseem, I. O., Okesanya, O. J., Olaleke, N. O., Ukoaka, B. M., Amisu, B. O., Ogaya, J. B., & Lucero-Prisno III, D. E. (2024). Digital health and health equity: how digital health can address healthcare disparities and improve access to quality care in Africa. *Health promotion perspectives*, *14*(1), 3.
22. Ricciardi, W., Pita Barros, P., Bourek, A., Brouwer, W., Kelsey, T., & Lehtonen, L. (2019). How to govern the digital transformation of health services. *European journal of public health*, *29*(Supplement_3), 7-12.
23. Satyanarayana, S., MD, T. K., & Bindu, N. V. M. (2023). Breaking Barriers in Kidney Disease Detection: Leveraging Intelligent Deep Learning and Artificial Gorilla Troops Optimizer for Accurate Prediction. *International Journal of Applied and Natural Sciences, 1*(1), 22–41. https://doi.org/10.61424/ijans.v1i1.8
24. Tamrakar, N. K., Dhungana, V., Dhamala, B., & Poudel, S. (2024). Correlation Between Strength and Durability of Sandstones from the Dumri Formation, Tinau Khola Area, West-Central Nepal. *International Journal of Applied and Natural Sciences, 2*(2), 1–14. https://doi.org/10.61424/ijans.v2i2.140
25. Tromp, J., Jindal, D., Redfern, J., Bhatt, A. B., Séverin, T., Banerjee, A., ... & Cowie, M. R. (2022). World heart federation roadmap for digital health in cardiology. *Global Heart*, *17*(1), 61-61.
26. Turnbull, S. L., Dack, C., Lei, J., Aksu, I., Grant, S., Lasseter, G., ... & Ainsworth, B. (2024). Barriers and facilitators to use of digital health tools by healthcare practitioners and their patients, before and during the COVID-19 pandemic: a multimethods study. *BMJ open*, *14*(3), e080055.
27. Woods, L., Martin, P., Khor, J., Guthrie, L., & Sullivan, C. (2024). The right care in the right place: a scoping review of digital health education and training for rural healthcare workers. *BMC health services research*, *24*(1), 1011.