RESEARCH ARTICLE

Digital Frontier for Healthcare Transformation: An Integrated Care Review of Namibian E-Health Strategy

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Abstract: This paper stands at a key position in merging two prevailing trends within the healthcare public administration context: digitalization and integrated care (IC). These initiatives are introduced as solutions to solve challenges connected with the administration of chronic and multi-morbid conditions, which constitute a significant portion of healthcare expenditures in developing nations, including Namibia. In pursuit of these aims, the objectives are to navigate the digital frontier; we shall identify the obstacles hindering the development of the Namibian e-health strategy's digital health platform ecosystem (DHPE) and proffer recommendations for addressing these impediments. Ultimately, we aspire to establish an innovative DHPE-STS (Socio-Technical Solutions) that will proficiently direct the future of the Namibian e-health strategy. The prevalent fragmentation in service delivery, connected with rapid technological advancements, contributed to the inefficiencies in service delivery. To alleviate fragmentation, IC models have been implemented in developed nations and stand to significantly benefit from the advent of evolving electronic health platform solutions ecosystems (EHPs). Still, these interventions are relatively complicated and suffer from a lack of comprehensive analysis. Accordingly, this study examines these emerging solutions through an integrative literature review and a qualitative analysis, identifying 27 comprehensive platform solutions that facilitate coordination within chronic care ecosystems and develop innovative DHP oriented towards socio-technical considerations for the Namibian eHealth strategy. The findings provide an in-depth overview of the prevalent barriers and gaps associated with the 27 platform solutions examined, alongside a consolidative synthesis that conceptualizes socio-technical solution architectures, thereby integrating the components of people, processes, and technology within a multi-level IC framework. This clarifies the difficult orchestration required for managing cross-provider solutions in chronic care and enhances the understanding of researchers and decision-makers regarding the complexities and challenges inherent in healthcare transformation. Furthermore, development barriers and gaps warranting further research are also scrutinized.
Keywords: Integrated care; Digital health; Platform ecosystem; Health integration; E-Health Strategy; Socio-Technical Solutions; Fragmentation; Namibia

1 Introduction

The study addresses the collective burden of chronic non-communicable diseases in Namibia, specifically the challenges faced by the healthcare system due to financial (Debie et al., 2024), human, and infrastructure deficiencies, resulting from fragmentation in care provision(Johnson et al., 2024). This fragmentation leads to inefficiencies, discontinuities, and diminished care quality (Mukisa et al., 2024), increasing risks for patients with multiple (Nashandi et al., 2024). The study identifies digital health platform ecosystems (DHPEs) as a possible solution to enhance care coordination and reduce inefficiencies in the healthcare system (Okyere et al., 2024).

DHPEs offer a structured approach to integrating various healthcare services, promising improved quality of care through advancements in digital health technology (Hermes et al., 2020). However, Namibia's implementation of these platforms remains in the early stages. Effective digital health solutions in healthcare require socio-technical integration, unlike simpler platform models in other sectors ((Khalil, 2024). DHPs can support coordinated care across different providers and levels of healthcare (Komalasari, 2024),

especially when integrated with models like Integrated Care (IC), which prioritizes person-centred, multidisciplinary, and continuous care for chronic conditions (Williams et al., 2020).

Namibia's e-health strategy emphasizes the digitization of healthcare provision, focusing on health information and communications technologies (ICTs) for chronic disease administration. The study proposes a novel DHPE-STS (Digital Health Platform Ecosystem-Socio-Technical Solution) that combines people, processes, and technology across IC frameworks (Williams et al., 2020)This approach addresses existing challenges in Namibia's healthcare system, providing a comprehensive model for digital health transformation.

The study conducted a literature review and case study analysis of Namibia's e-health strategy, identifying 27 comprehensive platform solutions. This analysis informed the development of DHPE-STS, which provides a multi-level framework for managing chronic care across different healthcare providers. The study also outlines the barriers to implementing such platforms in Namibia and offers recommendations to enhance patient involvement in the design and use of DHPE-STS. This paper answers the following questions, what are the barriers to EHPE development in Namibia's e-health strategy and recommendations for addressing them and how should a novel DHPE-STS be designed to guide Namibian e-health strategy effectively?

The findings contribute to a richer understanding of the difficulties in digital health solutions for chronic care(Hermes et al., 2020). DHPE-STS promises significant benefits for patients, healthcare practitioners, and policymakers by fostering a coordinated approach to healthcare that addresses Namibia's unique challenges. The study also emphasizes the importance of a comprehensive information architecture for health information technology(Khalil, 2024), promoting the integration of personal health records, mobile health applications(Komalasari, 2024), and health information exchanges(Williams et al., 2020).

2 Literature review

This segment comprises three components—integrated care (IC), digital healthcare (use of ICTs in health), and evolving platform solutions—each underscoring significant literature that collectively establishes the theoretical basis for the formulation of the innovative DHPE-STS for integrated care to inform the Namibian e-health strategy.

3 Conceptual background

3.1 Integrated care (IC)

Integrated care (IC) is one of the strategies in healthcare and social services delivery intended to address issues linked with disjointed care systems by amalgamating patient data to establish a mutual comprehension and management of a patient's care(Burke et al., 2022). In the research Khalil, 2024, wrote that according to the World Health Organization (WHO)(Organization, 2018), IC is vital for individuals with chronic illnesses, and various IC frameworks are evident in the previous studies, displaying more similarities than discrepancies. The well-established Rainbow model for Integrated Care (RMIC) delineates a comprehensive structure that links patient-centred and population-needs-based care(Valentijn et al., 2013) also supported by(Khalil, 2024).

This model presents best practices for an integral platform ecosystem approach, combining medical patient integration at the micro level, health professional and governmental integration at the meso level, and system-wide integration at the macro level(Khalil, 2024).

People-focused care encompasses the entire spectrum of attention, reflecting a biological, psychological, and social outlook. It recognizes that a chronic illness is frequently a medical, psychological, and social issue concurrently(Khalil, 2024). Person-centred care diverges from the traditional disease-centred viewpoint and embraces a holistic comprehension of an individual's health and well-being, capacities, self-management skills, requirements,

preferences, and surroundings(Leijten et al., 2018). The independence of citizen-centred care allows individuals to assume responsibility for their health and well-being instead of being passive recipients of health services (Organization, 2018).

Research indicates that integrated care (IC) models are correlated with enhancements in the perceived quality of healthcare delivery, heightened patient satisfaction, augmented access to medical services, and limited empirical evidence suggesting systemic impacts on primary care, secondary care, and the overall costs of healthcare (Baxter et al., 2018). The enhancement of continuity in care is likewise associated with advantageous outcomes such as a reduction in hospital admissions, a decrease in readmission rates, positive patient experiences, and advancements in both symptoms and overall lifestyle (Baxter et al., 2018) Furthermore, a study conducted in the United Kingdom identified potential adverse patient experiences related to IC when the integration framework failed to accommodate flexibility and responsiveness to the specific needs and circumstances of patients (Davidson et al., 2021).

3.2 Digital health

The digital health and social systems, which are now mandated by progressive governments (Suter et al., 2009) such as those of Australia, Canada, Denmark, and the United States, serve an essential function in the management of chronic health conditions (Adler-Milstein et al., 2014). This paradigm has also been embraced by various African nations, including Namibia (Qoseem et al., 2024). This initiative, commonly designated as digital or eHealth, encompasses information and communication technologies (ICTs) to facilitate and oversee healthcare provision.

It combines ICTs within health-related products, services, and operational processes. Furthermore, it necessitates organizational transformations within healthcare systems and the addition of new competencies, all directed towards improving health outcomes, enhancing efficiency, and enhancing productivity in healthcare delivery (Lolich et al., 2019).

Models such as the RMIC emphasize the essential role of digital technology in promoting connections and integration within healthcare systems (Valentijn et al., 2013). This involves the utilization of technologies including electronic health records (EHRs), patient portals, eHealth, and telemedicine, which significantly enhance the capabilities of both patients and healthcare professionals (Leijten et al., 2018).

Research in the field indicates varied yet predominantly positive outcomes from digital health(Cooper et al., 2009). For instance, it supports patient self-management, boosts prevention strategies and enhances patient safety by reducing medication errors(Merchant et al., 2018). It also reduces hospitalizations and emergency service use, improves communication between patients and doctors, increases patient gratification, and fosters productivity while lowering costs(Popa et al., 2024).

However, as mentioned earlier, a significant drawback of most electronic health solutions is their limited scope, which results in poor consumer experiences for customers and caregivers(de Jong et al., 2018). This can lead to app fatigue, under-utilization, and high dropout rates. Despite these challenges, the increasing number of health applications, devices, and systems, along with more comprehensive digitization and data entry, is improving the integration of these technologies. As a result, digital platforms that enable convergence are developing(Suter et al., 2009). These platforms often have modular designs that allow different components from the Digital Health Platform Ecosystem (DHPE) to integrate smoothly, improving the user experience at the electronic interface and enhancing the overall service know-how(Cenamor, 2022a).

In industrialized nations, there is a trend towards increased consolidation and integration in healthcare systems, as indicated by Yang et al. (2015)(Emery & Trist, 1960) and their conceptualization of the four (4) stages of healthcare maturity, which include initiation, contagion,

control, and integration(Ramagem et al., 2011). While the principles guiding care and the desired structure of electronic health are well-established in academic literature, it remains unclear how these trends are unfolding on a global scale(Baltaxe et al., 2019).

3.3 Emerging platform solutions

As per the World Health Organization (WHO), Digital Health Platforms (DHPs) can be understood as a shared digital infrastructure for health information, serving as the foundation upon which health applications and systems operate to provide healthcare services consistently and cohesively(Williams et al., 2020). DHPs have the potential to establish connections throughout a network through a hub-and-spoke architectural model, wherein peripheral component providers and users connect to the platform, facilitating mutual advantages(O'Brien et al., 2023). This platform infrastructure enables the development of an applications layer, allowing for the collaborative creation of services and user interfaces(Peng et al., 2020), thereby establishing an integrated Digital Health Platform Ecosystem (DHPE) solution(Lillrank et al., 2022).

The Digital Health Platform Ecosystem (DHPE), posited as an innovative framework for Integrated Care (IC) (Emery & Trist, 1960) signifies a significant socio-technical evolution as it becomes intricately woven into and transforms the care methodologies of both patients and healthcare practitioners (Williams et al., 2020). This study establishes a connection between DHPE solutions and the functional and normative dimensions elucidated in the RMIC (Valentijn et al., 2013), which necessitates a complex synchronization among individuals, processes, and technology to guide the development of Namibia's e-health strategy. Thus, the initiation and management of DHPEs demand proficient leadership and governance to articulate the solution architecture and facilitate the interrelations among healthcare providers, technology developers, practitioners, patients, and other stakeholders (Steele Gray et al., 2021).

Orchestration entails strategic initiatives that furnish guidance and foresight to stakeholders within a given ecosystem (Dhanaraj & Parkhe, 2006). Within the framework of this investigation, orchestration significantly impacts the development of platform solutions, which includes the administration and execution of a proposed innovative care framework within Namibia's chronic care and digital health ecosystem as articulated in its e-health strategy. Therefore, while technological expansions possess substantial potential, the successful integration of innovations is contingent upon a myriad of factors that transcend mere technical expertise. Institutional pressures, the prevailing organizational culture, and the perspectives of healthcare professionals are all critical determinants in the assimilation of emerging technologies, in addition to challenges related to data interchange networks, privacy issues, and resource constraints (Khalil, 2024).

In conclusion, many countries around the globe are coming up with innovative solutions to balance Integrated Care (IC) and the use of ICTs as an evolution of chronic care management. This investigation explores Digital Health Platform Ecosystems (DHPEs), suggesting technology as a fundamental component with concepts such as socio-technical solutions (STS) that integrate both social and technological elements. The intention is to enhance comprehension among scholars and policymakers concerning these multifaceted initiatives, foster awareness and help with their development, implementation, and application.

4 Method

This research is an exploratory inquiry aimed at critically evaluating the Namibian e-health strategy alongside a proposed innovative Digital Health Platform Ecosystem for enhanced Socio- Technological Solutions (DHPE-STS) from literature, which conceptualizes socio-technical solution architectures by integrating the components of individuals, processes, and technologies within a multi-tiered Integrated Care (IC) framework. To fulfil the aims of

this research, we employed content and thematic analysis of the existing literature and extracted pertinent information, including definitions and components of DHPE solutions.

In February 2024, we conducted a targeted information search in the Web of Science database, focusing on digital solutions for managing chronic and multi-morbid conditions within integrated care (IC) models. Keywords used included digital technologies, chronic conditions, and integrated care. Out of an initial 1,501 articles, 962 were deemed relevant after filtering out review papers and irrelevant fields. Inclusion criteria focused on empirical studies that described comprehensive, digitally driven approaches addressing multiple IC components, such as remote monitoring, patient-centred care, and care coordination. Exclusions included theoretical papers, narrowly focused digital solutions, and overly technical studies.

The abstract screening yielded 81 articles, further reduced to 51 after full reading. Content analysis of 41 articles followed, extracting solution details, target users, purposes, outcomes, and challenges. Using an abductive approach, the researchers iteratively categorized information from the articles to existing literature. Twenty-four articles were later excluded for being overly focused on limited IC dimensions, resulting in a final selection of 27 papers that discussed socio-technical developments in IC. This study aimed to qualitatively describe various aspects of digital health solutions without an exhaustive or quantitative review.

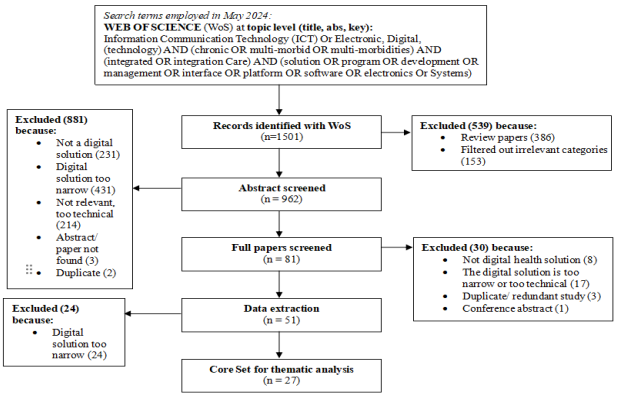


Fig 1. Literature Search Strategy

In this phase, thematic analysis was conducted, starting with the creation and validation of a coding scheme developed in collaboration with a supervisor. The coding scheme was examined on a subset of data, refined, and used to guide the classification of themes, with continuous reference to the pieces to confirm and complement preliminary findings. Higher-order themes like "barriers" were identified, highlighting key challenges in developing and implementing digital health solutions. Although one researcher performed the coding, supervisors acted as advisors to validate the process.

5 Results and Analysis

5.1 Issues targeted and solution generalizability

Although the solutions exhibited some variation in focus, they aimed to address the growing occurrence of chronic conditions, the necessity for holistic patient attention, and the incorporation of health information systems (Follen et al., 2007). Furthermore, challenges were classified and addressed across several levels—systemic (macro), service provider (meso), and patient (service provider) (micro). For instance, Chan et al. (2014) identified issues such as complex multi-system attention procedures, lack of cyclic assessments, medical inertia, poor management adherence, and fragmented care, all contributing to inadequate risk factor management and underutilization of potentially life-saving medications(Ramagem et al., 2011).

The disintegration (fragmentation) and lack of attention coordination were a recurring theme, particularly within networks involving specialists, general practitioners, and community caregivers(Chehade et al., 2020). This challenge was especially pronounced when sharing information across organizational and professional boundaries (Barberan-Garcia et al., 2018). Standard Electronic Health Record (EHR) systems lacked the necessary cross-organizational connectivity, resulting in increased workload for healthcare professionals searching for pertinent information(Mougiakakou et al., 2011), and patients receiving suboptimal care (Kawamoto et al., 2021).

Moreover, the absenteeism of actual data posed substantial challenges, contributing to delayed treatments, uninformed decision-making, inefficient resource utilization, and increased medical errors (Follen et al., 2007).

5.2 Patient care and organizational arrangement

Among the 27 studies, 17 were explicitly anchored in IC principles, underscoring the importance of person-centred care across primary, community, and social care environments. The principal objective was to improve accessibility, characteristics, and continuity of services, particularly for individuals experiencing complex needs and multimorbidity. Furthermore, numerous solutions exhibited common characteristics, like connections to community resources, encouragement of patient self-management, coordinated system architecture for service delivery, clinical decision-making support, and the amalgamation of medical information systems.

Most of these solutions are a mixture of emerging tendencies such as integrated behavioural health, leveraging community resources for social determinants of health, and the development of population health infrastructure including the use of ICT. Other trends include using digital health for self-management support and applying complexity science (Glasgow et al., 2019). These solutions align with Integrated Care (IC) principles, further supported by mandates from global institutions. Examples include directives from the WHO (Wang et al., 2021), the Institute of Medicine, and the Institute for Healthcare Improvement (IHI) in the U.S. (Dinsmore et al., 2021) , (Spring et al., 2019), (Anderson et al., 2017). Additionally, China's "three-manager" model for chronic care (Wang et al., 2021),), regional IC strategies in India for chronic disease management (Patel et al., 2020), and similar approaches in the EU (Barberan-Garcia et al., 2018) (Batlle et al., 2021)support this alignment. These frameworks also coincide with the growth of value-based payment models and IHI's "Triple Aim," which emphasizes enhancing care quality, improving patient experiences, and reducing costs (Anderson et al., 2017). Altogether, these approaches are consistent with IC principles.

5.3 Solution results (outputs)

Most studies in the literature reviewed used randomized controlled trials (RCTs) and showed positive impacts (Batlle et al., 2021), (Agarwal et al., 2019) with twenty interventions yielding beneficial outcomes, five showing no discernible effects, and one confirming technical feasibility without practical healthcare evidence (Mougiakakou et al., 2011). Positive effects included improved clinical metrics like reduced BMI (Chan et al., 2014), (Wang et al., 2021), (Cushen et al., 2022), decreased hospitalization rates (Mateo-Abad et al., 2020)), shorter hospital stays, fewer re-admissions, cost savings (Brown et al., 2019), better patient self-management (Batlle et al., 2021), (Pérez-Rodríguez et al., 2020) enhanced communication (de Jong et al., 2018b), higher satisfaction (Kawamoto et al., 2021)and improved care planning for multi-morbidity cases (Follen et al., 2007). One study, however, noted that partial reimbursement limits effective implementation, suggesting the need for a streamlined program with added care managers or lower-wage staff (Glasgow et al., 2019).

5.4 Process architectural dimension

DHPE-STSs utilized structured methodologies to synchronize care processes with established clinical guidelines, thereby formulating frameworks often referred to as "service," "care," or "process architectures" that delineated roles and responsibilities (Wang et al., 2021), (Patel et al., 2020).

19 interventions implemented frameworks such as care pathways, individualized management plans, and patient empowerment strategies to enhance organized care processes, encompassing a spectrum from general to specific applications. Significantly, the "three-manager model" in China designated a general practitioner(Wang et al., 2021), nurse, and specialist for each patient with a chronic disease, while alternative interventions delineated multi-actor pathways across diverse environments (Mateo-Abad et al., 2020). Individualized care plans, action plans, and

follow-up interventions were meticulously crafted to address patient-specific needs, thereby facilitating care continuity and transitions, exemplified by the CareWell intervention for patients with multi-morbidity. Holistic assessments permitted the development of personalized plans through collaborative decision-making, bolstered by digital tools designed to optimize workflows within clinical environments and across various disciplines (Voigt et al., 2020).

5.5 Social Dimension

The orchestration of care within integrated care (IC) frameworks necessitates a detailed strategy of human resources and assets, as dependence exclusively on information and communication technology (ICT) is inadequate. Care coordinators, predominantly comprising nursing professionals alongside positions such as "care managers" or "health connectors," assume a pivotal function in these frameworks by enhancing patient support and facilitating communication among healthcare practitioners. Certain models adopt distinctive coordination methodologies, integrating informal caregivers, volunteers, or even team-based roles supervised by medical experts (Anderson et al., 2017) (Barberan-Garcia et al., 2018), thereby promoting adaptability and expansiveness in support mechanisms. Coordinators are tasked with many responsibilities, ranging from patient coaching and transitional support to technical operations such as data interchange and record modifications, thereby ensuring the perpetuation of patient-centred care (Dinsmore et al., 2021).

Nineteen IC models capitalize on such teams to interconnect previously disparate networks, thereby promoting information exchange(Anderson et al., 2017) (Barberan-Garcia et al., 2018), assessment, follow-up, and comprehensive patient empowerment. Certain models facilitate remote care for patients confined to their homes, while interdisciplinary teams collaborate to ensure a seamless care experience. This organizational structure enables caregivers to respond dynamically to the evolving conditions of each patient and deliver extensive support across both clinical and community environments(Chehade et al., 2020).

IC solutions also prioritize community affiliations and patient empowerment, addressing both health-related and social determinants. Although only a limited number of solutions effectively integrate social data, the majority establish connections with community resources and services to perpetuate care beyond traditional clinical environments(Brown et al., 2019). Community volunteers and primary care networks play a critical role in bridging the gap between healthcare and social care, as exemplified by models such as Health TAPESTRY and ACTS(Dolovich et al., 2015). Empowerment initiatives centre on self-management, employing strategies that educate patients, establish participatory health objectives, and provide tools for self-monitoring, thereby ensuring that patients engage actively in their care trajectories. This comprehensive approach cultivates sustained engagement, intending to enhance patient outcomes and satisfaction(Dolovich et al., 2015).

5.6 Technological Dimension

Effective coordination within the healthcare sector necessitates the comprehensive exchange of information among all members of the care network to guarantee the delivery of high-quality healthcare services(Mateo-Abad et al., 2020). In this regard, digital health platforms and ecosystems (DHPEs) have been established featuring multi-faceted cloud-based connectivity, encompassing electronic health records (EHRs), patient self-management tools, and capabilities for remote monitoring. These systems, commonly referred to as chronic disease management systems (CDMSs) (Batlle et al., 2021)(Shelton, 2002), foster communication and collaborative efforts among healthcare practitioners, patients, and caregivers (Shelton, 2002). In the case of Namibia, there is a unit called the Centre for Disease Control (CDC).

Remote monitoring instruments—encompassing medical devices, digital evaluations, and sensors—bolster

both patient independence and continuous oversight by caregivers. These instruments enhance safety by allowing healthcare providers to monitor patients' health conditions, detect potential risks, and react to changes in real-time, frequently supported by automated alerts and reminders derived from patient-generated health data (Dinsmore et al., 2021). The degree of integration with EHRs varies; whereas certain DHPE solutions have achieved partial integration with the EHRs of healthcare providers, others operate as standalone platforms. Systemic integration proves more efficacious in areas where DHPEs are developed in conjunction with public health systems, thereby facilitating seamless communication across diverse levels of care. Technical interoperability, accomplished through standards such as SMART on FHIR(Wang et al., 2021), endorses modular architectures that ease data exchange and integration across an array of healthcare applications(Dinsmore et al., 2021).

Decision-support tools are pivotal within DHPEs, providing automated diagnostics, risk stratification, reminders for clinical follow-ups, and personalized care planning. These tools enhance operational efficiency and improve the decision-making processes for both healthcare providers and patients(Shelton, 2002).

Although DHPEs are still undergoing development, they have exhibited promising clinical outcomes. These platforms optimize workflows, encourage patient self-management, and assist healthcare professionals in delivering timely, data-informed care. Collectively, DHPEs facilitate the provision of appropriate care at the opportune moment, thereby enhancing patient outcomes and advancing the efficiency of the healthcare system(Voigt et al., 2020),(Glasgow et al., 2019).

6 Discussions

Health care is undertaking a renovation driven by digitization and Integrated Care (IC) initiatives aimed at enhancing the excellence of care (Cenamor, 2022b),(Chelberg et al., 2024) improving the experiences of both patients and caregivers, and reducing costs associated with managing chronic and multi-morbid conditions (Arnetz et al., 2020). This study highlights a growing trend in publications focusing on the development and testing of digital health platforms that include people, processes and technology.

Our paper covered numerous settings, including primary care, expert care, rehabilitation, and long-standing care, with a focus on routine, avoidance, and aided living. Despite distinctions, the 27 studies (papers) showed a significant merging of shared Integrated Care (IC) principles, such as reducing care fragmentation, providing coordinated team-based care, extending attention (care) to the public and home, reducing unnecessary hospital trips, and allowing patient self-management(Ribaut et al., 2024). While the architectures and digital tools varied, commonalities allowed for a generalized understanding of DHPE-STSs.

6.1 People, Processes and Technology

Based on key findings from Integrated Care (IC) literature, combined with the well-known People, Process, and Technology (PPT) outline from provision and processes management, the architecture of DHPE-STS can be understood through three main elements: people (social), processes, and technology(Kawamoto et al., 2021). In this approach, IC principles provide the guiding values for managing chronic care, while the PPT framework focuses on how these elements function at different levels (micro, meso, and macro)(Chelberg et al., 2024). These shared principles help align goals within the DHPE and guide its development, including training and reorganizing staff, adjusting processes, and adopting new technologies(Chelberg et al., 2024).

People - multi-dimensional and cross-organizational teams are important for Integrated Care (IC) solutions; deprived of them, care remains fragmented. IC models aim to provide a complete approach to care that considers a patient's social surroundings and life experiences(Khalil, 2024). This vision includes involving community workers,

psychological health professionals, and society members to understand and meet patients' requirements. Care coordination roles are common in most IC solutions, indicating that technology often supports these efforts, especially when specialized skills are needed. Even personal management applications require human resources capacity to help train, support, and motivate patients(Ribaut et al., 2024).

This review points out the potential to expand care by connecting with local community services and using resources like peer groups, NGOs, and health centers to improve patient care. There is also a need to involve policymakers and decision-makers in creating solutions that can be scaled up to benefit larger populations(Iqbal et al., 2024). Important factors include developing new roles for cross-organization coordination, providing training, engaging users, improving patient experience, empowering patients, encouraging teamwork, expanding care into the community, involving policymakers, and associating with countrywide and worldwide IC guidelines(Chelberg et al., 2024).

Processes – Aligning processes with Integrated Care (IC) is fundamental for creating efficient roadmaps across different establishments and systems. Key strategy aspects focus on determining what information is needed to guide the next steps in patient care, which helps build process architectures and develop ICT solutions. For example, Wang et al. (2021) identified standard tasks for managing conditions like hypertension, Type 2 diabetes, and COPD outside hospitals, leading to the creation of a universal care pathway. This pathway serves as a foundation for decision support systems and technical structures(Arnetz et al., 2020).

Wang et al.'s solutions demonstrate the need for multi-level process designs that balance standardization with personalization, aiming to meet both general and individual patient needs. These processes should ensure efficiency, quality of care, and a seamless experience by using technologies that can adapt, case managers to coordinate care across different environment(Iqbal et al., 2024). This will enhance the linkage between healthcare providers and the public.

Preventive care processes were included in several solutions, highlighting the need for more proactive approaches to tackle the origin causes of illnesses in link with IC principles(Iqbal et al., 2024). Despite the importance of administrative, organizational, and financial processes in care management, few studies have focused on these areas.

Technology – Implementing Digital Health Platform Ecosystems (DHPE-STSs) requires substantial technological capabilities to create connections across different levels of the ecosystem. The findings suggest that it is technically feasible to integrate DHPEs with existing systems, such as Patients Health Records (PHRs), and to link applications across platforms using open APIs and interoperability standards like FHIR(Bente et al., 2024).

Notwithstanding these advancements, obstacles persist in the administration and financing of integrations that span multiple institutions and levels. The integration of novel programs into pre-existing public infrastructure has the potential to facilitate scalability and regional implementation (Khalil, 2024)The development of digital health tools ought to occur concurrently with the formulation of policies that endorse their extensive adoption, with frameworks such as the European Interoperability Framework (EIF) serving as instrumental in the execution of digital health systems for the management of personal health information (Bente et al., 2024)

From the customers' point of healthcare providers, there exists substantial potential for enhancing clinical decision-making and automating care processes through the utilization of instruments such as patient self-assessments, triage functionalities, symptom monitoring, automated notifications, and evidence-based decision support systems. This advancement could facilitate increased operational efficiency and an improved standard of care. Furthermore, sophisticated care pathways designed for the management

of multimorbidity, along with the application of machine learning techniques for personalized care, present considerable opportunities for advancement (Peng et al., 2020).

From the affected role perspective, digital tools like public portals can empower self-care and enhance data exchange, improving communal clinical responsiveness. Telemonitoring capabilities further support patient self-government and accessibility, although data privacy and security concerns persist as we advance toward healthcare 4.0. Population-level planning and data integration, supported by big data analytics, are also crucial for addressing the needs of diverse patient groups and managing the growing population of older adults with chronic conditions(Peng et al., 2020).

Key technical elements include system integration for data sharing, patient portals, patient-generated health data (PGHD), personalized care plans, case management, digital care passageways, programmed protocols, decision-support tools, telemonitoring, and data analytics(Khalil, 2024).

The IC DHPE-STS structure contributes to Health Information Systems (HIS) and Health Management research by offering a far-reaching view of platform solutions for chronic care is an important part of public administration. It emphasizes designing patient-centric technologies that engage the public in health needs and processes in the process of making decisions. This framework provides a broader perspective on emerging solutions, highlighting the need for integrative approaches that involve both technical and patient-centred considerations(Khalil, 2024).

6.2 Barriers and Recommendations

Fragmentation: The presence of numerous silo systems remains a major challenge. Integrating these systems is critical for creating a unified DHPE platform, but it is also technically and administratively complex. These findings are in line with the previous researchers who wrote that aligning disparate systems and platforms presents significant technical challenges that are often underestimated (Joel & Oguanobi, 2024a; Towett, Snead, Grigoryan, & Marczika, 2023).

Addressing these technical hurdles requires collaborative work from multiple participants, including governments, healthcare providers, technology designers, international organizations and the public. Establishing global standards for data formats and healthcare terminologies is vital to achieving interoperability. Adopting international health information standards, such as HL7 and FHIR (Fast Healthcare Interoperability Resources), can significantly facilitate smoother data exchanges (Balch et al., 2023; Benson & Grieve, 2021).

Data security and privacy also pose significant challenges: necessitating the development of a common framework that respects national regulations while maintaining high-security standards. International cooperation is fundamental to address these issues, along with the implementation of advanced security technologies like blockchain to enhance the integrity and confidentiality of health data. Furthermore, bridging infrastructure disparities requires investments in health IT infrastructure, especially in less developed regions. International aid and partnerships can play an essential role in upgrading technology and training healthcare IT specialists to support integrated EHR systems (de Villiers, 2021; Jacks, Ajala, Lottu, & Okafor, 2024).

Integration Challenges: The 2023 assessment revealing over 60 silo systems in the Ministry of Health in Namibia(Nashandi et al., 2024). Consolidating these systems into a comprehensive DHPE solution will require significant time, resources, expertise, and stakeholder collaboration. These outcomes of our study are in line with the conclusion that interoperability issues represent one of the most substantial technical encounters in integrating Electronic Health Record (EHR) systems. A primary obstacle is the absence of standardized data formats, as EHR systems around the world often employ different data structures, complicating information exchange (Tayefi et

al., 2021). For instance, while one country's system might store patient information in a particular format, another may use a completely different schema. This inconsistency means that data cannot be seamlessly shared or interpreted across systems without extensive reformatting or translation, leading to potential errors and inefficiencies (Gamal, Barakat, & Rezk, 2021; Jambol, Sofoluwe, Ukato, & Ochulor, 2024; Ochulor, Sofoluwe, Ukato, & Jambol, 2024).

Moreover, variations in healthcare terminologies and coding systems further intensify interoperability challenges. Health information systems employ different coding standards for diagnoses, treatments, and procedures. For example, while the International Classification of Diseases (ICD) is used globally, different countries might utilize various versions and extensions, and some regions may rely on distinct local terminologies. These inconsistencies complicate efforts to ensure that health data is accurately interpreted across borders (Igwama et al., 2024). Misinterpretation due to inconsistent coding can result in inappropriate treatments, misdiagnoses, and other critical issues that undermine patient safety and care quality (Duggineni, 2023; Lapalme, Corbin, Tastet, Avram, & Hussin, 2024).

Countries with less developed infrastructure like Namibia may find it challenging to support the advanced capabilities needed for integrated EHR systems, such as real-time data exchange, high availability, and robust disaster recovery features (Organization, 2020; Yang & Gu, 2021).

Stakeholder Participation: Effective participation from executive leadership, professionals, and patients is crucial for the DHP's success, yet there is a noticeable lack of engagement from these key groups. These are in line with previous researchers who concluded that the integration of electronic platforms in healthcare continues to face substantial challenges related to technological resistance and patient adoption. Although the COVID-19 pandemic accelerated the uptake of digital solutions, the public (patients) in developing and low-resource countries encounter substantial obstacles and require guidance in implementing and using digital health applications and services. Solving the challenges of resistance to change, enhancing user engagement, and encouraging widespread adoption of digital platforms among healthcare providers remain significant challenges. Addressing these issues necessitates comprehensive strategies that take into account the unique needs and contexts of diverse patient populations, aiming to bridge the digital divide, alleviate technological anxiety, and promote equitable access to healthcare technologies(Chibuike et al., 2024). According to social capital theory, increased social interactions and connections lead to the development of greater trust, facilitating the smooth exchange of information within a framework of regulations, norms, and cultural contexts. Gaining access to social capital networks requires human capital with the skills and abilities to build trust among network members, supported by formal or informal social rules. The new institutional theory posits that institutional rules, rooted in cognitive, normative, and regulative network structures, govern behavior and serve as safeguards against opportunism. These rules are shaped through social interactions and can potentially alter the norms and values of individuals or organizations through cultural approaches, as well as through information, persuasion, and education (March 1989; Powell & DiMaggio, 2012). However, rules that enforce strict boundaries within domains may hinder the creation and growth of mutual trust, which is essential for building sustainable relationships.

Infrastructure limitations represent another significant obstacle to the successful implementation of digital health platforms(Qoseem et al., 2024). The literature often points to the inadequacy of IT infrastructure in many regions, particularly in developing countries, as a major constraint on the deployment of these technologies.

6.3 Development of IC and DHPE-STS Framework as lesson learned

According to the 27 papers we have read for this study,

Integrated Care can be aligned with interrelated dimensions: Process, Social, and Technology, each addressing different aspects of a Digital Health Platform Ecosystem (DHPE) - Socio-Technical Solutions (STS) architecture.

The process dimension focuses on how care is delivered and coordinated within the digital health ecosystem. It emphasizes a person-centred approach by designing individualized pathways and holistic care plans tailored to the patient's needs and goals. This includes providing multiple entry points and channels for patients to access care. It is therefore important that the design, implementation and evaluation of any electronic platform should include processes that have simple linkages between government, hospitals and the public. Without this relationship, digital health initiatives may not achieve the desired objectives.

The social dimension of integrated care highlights the importance of involving people at all levels of the care process, including patients, caregivers, community teams, decision-makers, and policymakers. It advocates for a person-centred approach where care is custom-made to the patient's specific context and needs, encouraging the inclusion of informal caregivers and community-based teams. Patient empowerment plays a crucial role, with a focus on self-management education, coaching, and motivation to enable patients to take an active role in managing their health. The consideration of the public perspective is important because it increases awareness and public trust in the health system.

It is therefore important that digital platforms that are inclusive of process and social should have a technology dimension that focuses on the digital tools and platforms to support integrated care delivery. It involves the use of digitized assessments, patient action plans, and comprehensive integration of health and social data to create personalized care experiences. Technology enables the implementation of self-monitoring devices, patient portals, and remote care solutions, which facilitate patient empowerment and self-management. Technology is important but can only function very well if processes and society are aligned to the technological initiatives and all are aiming at improving the patient's care.

6.4 Limitations and Future Studies

Platform-based ecosystem solutions that are designed for Integrated Care (IC) encompass socio-technical architectures that require as much focus on people and process design as on technological development. The Platform Ecosystems that are Socio-Technical Systems oriented discussed in this study are still in their early stages of development, especially in Namibia. Additional research is crucial to guide their additional development, acceptance, cascading, and institutionalization to achieve broader complete transformation. For instance, a clear plan for regional or rural area deployment could be valuable in maintaining momentum beyond initial implementation studies. Both the 27 reviewed solutions and the Namibian case study, which is still in its early phase, did not provide a complete understanding of the comprehensive processes required.

Future research should also focus on underserved citizens, such as those in rural areas, where digital and computer-generated healthcare could significantly improve access to services. Addressing the digital literacy gap among older adults and reducing the burden on healthcare workers are also essential areas for development. Efforts to improve patient-centricity should include gathering continuous feedback, enhancing training, and ensuring personalized communication to empower patients in managing their health. Additionally, the use of DHPEs in preventive care and early detection programs could shift healthcare towards a more proactive approach. Lastly, to advance the field, it is necessary to reconcile the varied terminology in digital health and establish a standardized language for concepts like ecosystems, platforms, care pathways, and self-management plans.

This review narrowed its focus by using the research words "integration" and "integrated" to limit the types of

digital health solutions considered. Additionally, the focus on complexity and addressing care fragmentation may have unintentionally excluded simpler but valuable solutions. To enhance future research on digital health patient engagement through self-tracking systems (DHPE-STSs), it would be beneficial to broaden the scope to include a more wide-ranging review and incorporate grey literature. Identifying the importance of customers' empowerment and engagement in Integrated Care (IC), future studies should examine how these platforms can become more patient-centric, fostering increased patient participation in their care processes.

In summary, the digital health environment is currently too complex, with an increasing number of service providers offering different solutions. However, there is a clear development toward market consolidation as telehealth services grow in scope and expand across regions. As person-centred care models, such as at-home care for older adults, continue to gain popularity, solutions like those explored in this study are expected to become more widespread and interconnected. This integrative review lays a foundation for understanding evolving digital health patient engagement self-tracking systems (DHPE-STSs), describing their multi-layered architecture that includes Process, People, and Technology (PPT) components. Additionally, the study consolidates varied findings into frameworks that serve as decision-making aids, process architectures, and patient inspiration guides, supporting navigation and management in this evolving field.

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