



Alignment of digital health value propositions to business models in sub-Saharan Africa



Authors:

Oluwamayowa O.
Ogundaini¹ 
Mourine S. Achieng¹ 

Affiliations:

¹Digital Transformation and Supply Chain Management, Graduate School of Business Leadership, University of South Africa, Midrand, South Africa

Corresponding author:

Oluwamayowa Ogundaini,
ogundoo@unisa.ac.za

Dates:

Received: 18 Mar. 2024
Accepted: 01 Aug. 2024
Published: 18 Oct. 2024

How to cite this article:

Ogundaini, O.O. & Achieng, M.S., 2024, 'Alignment of digital health value propositions to business models in sub-Saharan Africa', *Acta Commercii* 24(1), a1268. <https://doi.org/10.4102/ac.v24i1.1268>

Copyright:

© 2024. The Authors.
Licensee: AOSIS. This work is licensed under the Creative Commons Attribution License.

Orientation: Digital health delivers value in the form of efficiency, efficacy and transformation by automation and strengthening of global health care systems, according to the World Health Organization. Yet, sub-Saharan Africa's (SSA) health care systems still experience an evident misalignment between their business models (BMs) and digital health value propositions. As a result, digital health interventions (DHI) are duplicated for similar purposes; several pilot projects hardly reach country-wide implementation and health security remains unattainable, in the Fourth Industrial Revolution era.

Research purpose: The study aims to conduct a scoping review highlighting how the value-add propositions of DHI could align with health care system BMs in SSA.

Motivation for the study: The study was informed by the need to address the impact of health care business models on adopting Digital Health and advanced Industry 4.0 technologies for Health Security in the sub-Saharan Africa (SSA) context.

Research design, approach and method: The paper followed Arksey and O'Malley's five-stage scoping review guide to identify publications on the value propositions of DHI in health care systems of SSA.

Main findings: There is limited scholarly work focused on how sub-Saharan African health care system BMs cater to DHI in relation to the fast-paced advancements in technology. Drivers of value-add creation, inhibitors of digital health value capture and the requirements of BMs that support the value propositions offered by DHI were discussed.

Practical/managerial implications: Findings can assist health managers to redirect the trajectory of integrating digital health value propositions interventions in SSA health care systems towards redressing recurrent challenges that inhibit technology adoption.

Contribution/value-add: The paper highlights how the value-add propositions of digital health should be aligned to BMs of health care systems in SSA to ensure duplications are addressed and provide a move towards wide-scale implementations.

Keywords: health care system; digital health interventions; health security; business model; value-added propositions; sub-Saharan Africa.

Introduction

Sub-Saharan Africa (SSA) has experienced the widespread and increasing adoption of Digital Health Interventions (DHI) over the past 10 years (Odekunle, Odekunle & Shankar 2017; Olu et al. 2019). Digital health interventions are adopted to provide and improve access to health care services (Karamagi et al. 2022); enhance the work performance of health care professionals (Ogundaini & De la Harpe 2022); reduce health care costs (Acheampong & Vimarlund 2015) and enhance health outcomes (Achieng & Ruhode 2023). However, literature indicates that health care systems across SSA continue to experience challenges that inhibit benefits of DHIs from aiding the provision of quality health care that is accessible and affordable to all (Karamagi 2022; Oleribe et al. 2019). These challenges include a lack of accurate health data, inadequate infrastructure, poor analysis of routine health data for decision-making because of the fragmented electronic health technologies (Ndlovu, Scott & Mars 2021).

The difficulties associated with ineffectively benefitting from DHI objectives can be attributed to several inhibiting factors, one of which is health care systems' failure to embed and capitalise on the value propositions of DHI especially in the SSA context. Schiavone et al. (2021) and Pascarelli et al. (2023) highlighted the lack of appropriate (or a misalignment of) business model (BM) that drives the capabilities of DHI and optimises their associated value propositions. In this paper, the concept of BM is defined as a detailed layout of the strategy of organisations to create and capture

Read online:



Scan this QR code with your smart phone or mobile device to read online.

value to targeted customers; they are visualised on a canvas tool (Osterwalder et al. 2015). To this end, Gauthier, Bastianutti and Haggège (2018) suggest that BM can be static or dynamic. Static BMs articulate the components for harnessing value propositions for a product or service, while dynamic BMs focus on the organisations' capabilities to be adaptable to changes and innovations.

The BM adopted by an organisation should outline clearly how the value proposition of a product or service benefits customers or stakeholders and its translation to guaranteed satisfaction and sustainable positive outcomes. With regard to DHI, health care systems require context-specific and viable BMs that identify and optimise the value propositions of disruptive technologies (Hwang & Christensen 2008). Essentially, health care systems require BMs that will be inclusive of and benefit from DHI by capitalising on their capabilities to support the service delivery process, promote patients' well-being and meet the needs of other stakeholders (Velayati et al. 2022). These stakeholders include DHI developers, vendors, the governments and private investors. As a result, health care systems can leverage DHI to achieve objectives of providing quality care services and managing public health. Further, Fredriksson et al. (2017) suggest that BMs and their components should be formulated based on the purpose of the technology, context of use and intended outcomes.

Benefiting from DHI value propositions in the health care sector is critical to facilitating Universal Health Coverage (UHC), improving workforce performance and health outcomes as foundation for a sector that can establish health security. Health security is characterised by the capability of a resilient health care system to respond, adapt and deliver quality services during public health crises (Oleribe et al. 2019). A strengthened health care system guarantees health security for the citizens of the geographical population it serves and beyond. However, existing BMs in health care organisations engender care fragmentation, data discrepancies, a lack of coordination, standardisation, which continue to be the major challenges facing health care systems (Achieng & Ruhode 2023).

When health care systems lack a clear and consistent DHI implementation strategy that fits their BM, they often end up with disparate or redundant technologies that do not deliver long-term value in the delivery of health care services. Despite the increasing adoption of DHIs, it is unclear how their value proposition aligns with existing BMs in SSA health care systems towards achieving improved health outcomes, enhanced workforce performance and health security (Schiavone et al. 2021).

Health care system business models

Business models in health care are characterised by processes, a value proposition, type of facilities, resources and profit formula geared towards value creation from multiple stakeholder perspectives (Acheampong & Vimarlund 2015;

Hwang & Christensen 2008). Thus, it is argued that health care system BMs conceptualise how health care institutions deliver value to patients in terms of affordability, proximity and access to quality diagnosis and treatment management while at the same time generating revenue (Peters, Blohm & Leimeister 2015). Health care system BMs are essential because they provide a structure for institutions to organise, monitor, evaluate and reflect on how costs of investments, infrastructure, tools of work, employee workforce and standard operating practices guide processes leading up to care service delivery and outcomes. It suffices to indicate that type of care service support, which could be in-patient care, critical care, traditional patient care, telehealth care or person-centred care influences BMs.

In this paper, the authors focus on two types of BMs proposed by Hwang and Christensen (2008). The two BMs are value-adding processes and facilitated user networks. The BMs were selected as a basis through which value-add is created. This is supported by claims that the most important aspect of digital BMs is the value creation by making a process more efficient (Schiavone et al. 2021). According to Acheampong and Vimarlund (2015), value creation can be expressed through optimisation of processes. Examples of DHI value creation in health care include digitalisation of patient records for quicker retrieval, and data-driven decision making and automation of information management, which enhances the work performance of health care professionals (Olu et al. 2019). Instances of facilitated user networks include stakeholders involved in the DHI life cycle development, a multidisciplinary care coordination and collaboration to facilitate treatment plans, using DHI within and across health care institutions (Pascarelli et al. 2023).

Velayati et al. (2022) reviewed different BMs and their respective components being applied to deliver telehealth services. The authors sought to identify a suitable BM to drive commercialisation of telehealth products and services. They argued that the BMs of DHI should be determined by purpose of the technology, context of use and stakeholders who are the intended beneficiaries of the services. The benefits can either be of social or economic value-add. Majority of the BMs and their components were developed in the Global North. These BMs include Alexander Osterwalder's business canvas, telemedicine framework, business-to-customer (B2C) BMs, Johnson framework and VISOR BM framework. The value proposition of the product or service to address stakeholders' expectations and finance-related variables were identified as the most common component of telehealth BMs. They recommended synthesis of components from different BMs to commercialise telehealth.

Similarly, Acheampong and Vimarlund (2015) conducted a literature review on BM components for telemedicine to understand why the services are not successful beyond the test or pilot phase. The authors proposed a BM that prioritises value and investment in resources at its core. The authors argued that there is no 'one-size-fit-all' to developing DHI-

supported BMs because of dependent peculiar factors such as context of delivery, digital infrastructure, type of care and the health care financing system. Schiavone et al. (2021) explored a digital BM for the commercialisation of ridesharing services within the health care ecosystem to understand issues of value creation. For a health care ecosystem that is resource-intensive, Rønn et al. (2023) proposed that a circular BM might be more efficient to create and capture the value-add from DHI especially in a resource-constrained environment, such as is the case of health care systems in SSA.

Studies that have evaluated the alignment between DHI value-add propositions and BM of health care systems are relatively few and even more scanty in the SSA context. Situational political and socioeconomic realities in the context of SSA prevent health care institutions from optimally benefiting from the integration of DHI into their processes. Thus, it could be argued that there is little or no alignment between the value propositions of DHI especially with advancements in technology and health care system BMs in SSA. In the next section, the authors highlight the typical value chains of health care systems where DHI is being adopted.

Value chains in health care systems

The concept of value expressed as a tangible experience or beneficial outcome in the health sector is used to drive the development of new health products including DHIs, services and practices aimed at improving patient care, health outcomes and health security (Sibalija et al. 2021). Therefore, value chains in health care can be defined as a series of activities that involve various stakeholders in the health care sector leading to delivery of quality services, intended health outcomes and user satisfaction (Abimbola et al. 2019).

Health care system value chain activities can be divided into points-of-care including administrative, information management, clinical service, allied health and support services (Sibalija et al. 2021). Creating health care value chains is important because they help to improve quality of care, ensure patient safety, increase customer satisfaction, increase profitability, reduce costs, create competitive advantage, drive innovation, foster collaboration and to analyse constraints in the health sector. In other words, value chains highlight value propositions necessary to facilitate the delivery of quality health care, enhance work performance towards positive health outcomes.

Value chains in health care systems can be identified or determined through a properly formulated BM. As a BM typically illustrates an organisation's strategy to create, deliver and capture value, the alignment of DHI value propositions needs to be an integral part of the lifecycle activities that contribute to the overall business goals of health care institutions in SSA. In this way, a digital health implementation policy can be formulated to accommodate Industry 4.0 technology advances such as big data and

artificial intelligence (AI) in tune with the objective of health care business processes. The next section highlights digital health value propositions based on the existing literature.

Digital Health Interventions and value-added propositions

Digital Health Interventions (DHI) are the products and services developed from information and communication technologies (ICTs) to support activities in health care systems. These ICTs include electronic records, mobile, web-based applications, wearables, telehealth and in recent times advanced technologies such as AI, big data analytics (BDA), Internet of Things (IoT) (Manyazewal et al. 2021). The value-added propositions of DHI offer the promise to redress the pain points experienced by customers of health care systems, health care professionals and institutions towards realising sustainable development goal (SDG) 3 – good health and well-being. Some of the pain points include limited access to health information; longer waiting times for consultation; health care access inequalities; lack of coordinated health care systems; issues of data exchange and cyber security (Olusanya et al. 2022). These pain points lead to customer dissatisfaction, an overwhelmed workforce, a weak health care system unable to rapidly respond to disease outbreaks, leading to poor health outcomes that characterise health insecurity.

With the introduction of DHI, digitally enabled services have enabled customers to receive and seek health-related information on the internet (Acheampong & Vimarlund 2015). In this way, customers become well-informed and can make requests about their health status. Mobile health (mHealth) apps and short message services (SMS) are interventions that enable customers to schedule and get notified about follow-up appointments at hospitals or clinics. Subsequently, waiting times can become shortened. Applications on handheld devices such as WhatsApp for instant messaging and video conferencing between health care professionals in a multidisciplinary team facilitate communication to support patients' care coordination effectively (Acheampong & Vimarlund 2015). Digitalisation of patient records on hospital information systems (HIS) enables remote sharing of patients' information across institutions compared to the use of paper records (Akanbi et al. 2012). The value-add of DHI to health care services is the automation and efficiency of solutions to deliver real-time and evidence-based services effectively (Olusanya et al. 2022).

The development of DHI necessitates for innovators to understand how solutions influence the work activities of health care professionals, address the unique needs of patients, health outcomes and the overall health care system. It is the impact of these solutions that provides the appropriate performance indicators for the value-add of DHI and enables sustainability beyond the pilot phase. According to Acheampong and Vimarlund (2015), value creation relates to the unique effect a product or service offers towards the

improvement of an existing situation; the created value may not be quantified in certain instances. The unique effect of value creation can be expressed as transformation to a desired situation and empowerment. However, the unique contributions can be expressed in the form of user satisfaction, extrinsic motivation and trust for a product or service.

Despite the value propositions associated with DHI and the value-adds delivered to customers, health care professionals and health care institutions, it has been argued that several projects do not make it past the conceptual or pilot phase in SSA (Bloom et al. 2017). In this paper, the authors argue that one of the major reasons is the misalignment of DHI value propositions and health care systems' BMs in SSA. The objective of this paper builds on the previous claim as a basis for which a scoping review is necessary and conducted.

Objective

There are a host of multiple and duplicated DHI in SSA that neither fit into health care systems value chains nor the use context of health care services (Karamagi et al. 2022). The lack of fit is partly because of a lack of thorough understanding on the part of DHI innovators, service providers, health care practitioners and researchers concerning DHI value propositions within health care system BMs (Pascarelli et al. 2023; Schlieter et al. 2022). In the context of SSA, the current landscape of DHI is largely focused on data collection, record management, data mining for managing specific diseases and less at driving as well as coordinating equitable access to quality health care and well-being (Karamagi et al. 2022). While existing studies have focused on the technological and human aspects of DHI adoption, the alignment of health care system BMs and DHI value proposition for a large-scale implementation is largely ignored especially in SSA.

The alignment of health care system BMs and DHI value-added propositions is critical to addressing persistent challenges such as a lack of coordination in the implementation of DHI, access and engaging hard-to-reach populations, inadequate provision of cost-effective care services and poor return on investments (RoIs) of health information systems (Velayati et al. 2022). If there is no alignment between health care system BMs and the value propositions of DHI, then the promises associated with achieving health security and the health-related SDGs in SSA will remain stunted or not realised. Hence, the objective of this paper is to conduct a scoping review that highlights how the value-added propositions of DHI could be aligned with health care system BMs in SSA.

Research methods and design

The methodology adopted in this paper follows the Arksey and O'Malley's (2005) five-stage review framework for scoping reviews. A scoping review was the preferred choice of methodology because it enables the identification of key concepts and existing topics on a particular research area or discipline (Colquhoun et al. 2014; Tricco et al. 2016). Scoping

reviews further guide researchers on emerging areas or concepts that need further investigation and broadening, towards knowledge acquisition or application. For instance, this paper sought to explore how the value-add propositions of DHI could align with health care system BMs in SSA towards providing equitable universal access to quality service delivery. The objective of this paper influenced the choice of the scoping review framework as appropriate for its flexibility and usefulness to identify existing studies where value-added propositions of DHIs and health care system's BMs have been investigated particularly in the SSA context. Arksey and O'Malley's five-stage framework is outlined as follows: (1) identification of research questions and/or objectives; (2) identification of eligibility criteria and comprehensive search for relevant publications; (3) selection of relevant publications; (4) charting the retrieved data; (5) summarising and reporting. This article follows the outlined steps.

Identification of research questions or objectives

This article was motivated by the paucity of scholarly work on how health care systems in SSA can harmonise their DHIs' value proposition with existing or emerging BMs to improve health care access, task performance during service delivery and overall health outcomes. The review's objective was to conduct a scoping review that highlights how the value-added propositions of DHI could align with health care system BMs in SSA. The guiding research question was: How can health care systems in SSA be aligned with DHI value propositions to ensure sustainability, improved health outcomes and digitally driven health security?

Search strategy for relevant publications

The search strategy was applied to Google Scholar and Scopus to identify literature containing keywords related to 'health care system business models', 'Digital Health', 'value propositions' and 'sub-Saharan Africa'. The search strategy explored the relationship between health care system BMs and DHI's value propositions. The intersection between these two domains is where innovative DHIs can be leveraged to strengthen health care services and create value for all stakeholders. Peer-reviewed publications were reviewed using a criterion that was established based on keywords and a 10-year (2013–2023) period.

Inclusion and exclusion eligibility criteria

The inclusion criteria enabled the authors to consider only publications that fall within the scope of the paper objective. The criteria for inclusion were that publications must have been written in English language – as it is the first language of the authors; addressed health care system BMs or some components in relation to DHIs, DHI value creation or proposition; have sound scientific methods and empirical outcomes and conducted in the SSA context. Publications were excluded if they were written in other languages, non-open access, dissertations and theses or studies conducted outside the specified period as well as SSA context.

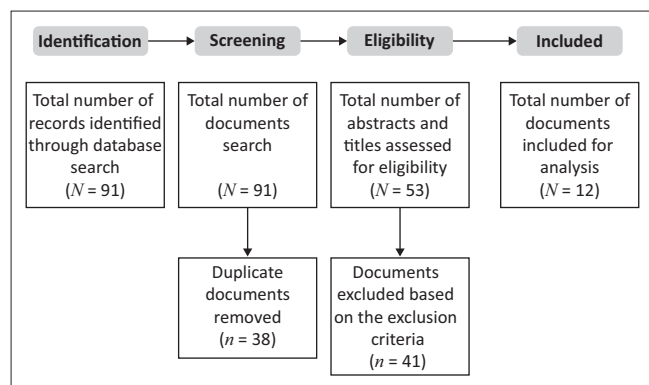


FIGURE 1: Scoping review process for identifying and selecting documents.

Selection of relevant publications

All abstracts and titles were screened against the inclusion and exclusion criteria prior to the full-text screening. Subsequently, the selection of the studies involved applying the predetermined inclusion and exclusion criteria based on the objective of this review paper.

Charting the retrieved data

At this stage, the full-text articles that met the inclusion criteria are reviewed in greater detail. This necessitated the application of analytical criteria, which involved data synthesis and interpretation. This was accomplished by sorting through the included publications based on the key objective of the topic being investigated. Examples of scrutinised literature included literature that focuses on value creation in health care systems as enabled by various DHIs. Digital health interventions' value propositions and its impact on the service delivery process, execution of work activities, job performance and positive health outcomes were identified. Additionally, during the screening process, the bibliographic characteristics of the articles, including author details, publication year and subject matter were extracted.

Summarising and reporting

This stage is divided into three steps: analysis of subject matter in included literature, reporting results and discussing the study results into context to satisfy the paper's objective. The subsequent sections present an elaborate discussion of inferences drawn from literature on how the described DHI value propositions could align with context-specific health care system BMs to optimise health care service delivery and attain Universal Health Coverage (UHC) in SSA.

Ethical considerations

The study is a scoping review that utilises existing literature that is publicly available and accessible on electronic databases online. It is for this reason that no human participants were involved; however, the review ethics committee at one of the colleges at University of South Africa was notified of the study for audit purposes and a clearance waiver was granted. Ethical clearance to conduct this study

was obtained from the University of South Africa Graduate School of Business Leadership Research Ethics Committee (No. 2024_SBL_Ac_004_FA-3161).

Results

The result of the search strategy as illustrated in Figure 1 shows that there are relatively limited studies on alignment of DHI value propositions to health care system BMs in SSA. In total, 76 publications were retrieved from the databases. After removing 38 duplications, 53 unique titles and abstracts were screened against the inclusion criteria. Of the 53 unique titles and abstracts, a total of 41 did not meet the inclusion criteria. The remaining 12 articles addressed DHIs' value creation, value delivery and value capture when implemented in SSA's health care systems. The included articles shaped the views of the authors, narration of the results and conclusions presented in this review paper.

Characteristics of the selected studies

Most ($n = 8$) of the studies analysed focused on the SSA region in general (Chitungo et al. 2021; Digital Diagnostics for Africa Network 2022; Gorski et al. 2016; Ibeneme et al. 2022; Iyawa et al. 2020; Mbunge, Muchemwa & Batani 2022; Ojo, Tolentino & Yoon 2021; Otto et al. 2015). The remaining studies ($n = 4$) were country specific. For example, Pezzuto (2019) carried out their study in Nigeria, Matiang'i et al. (2022) conducted their study in Kenya, while Hlongwane and Grobberlaar (2022) and Swartz et al. (2021) conducted their study in the South African context.

In terms of the DHI discussed, telemedicine emerged as the most discussed DHI in terms of value creation and health care system BMs (Chitungo et al. 2021; Mbunge et al. 2022; Pezzuto 2019). Other DHIs included mobile-based applications such as mobile digital ultrasound screening devices (Matiang'i et al., 2022 and Gorski et al., 2016) focusing on mHealth technologies in general. Hlongwane and Grobberlaar (2022) discussed health information systems, whereas Otto et al. (2015) and Ojo et al. (2021) discussed ICTs. Iyawa et al. (2020) and Ibeneme et al. (2022) looked at DH solutions in general.

Out of 12 articles included, three ($n = 3$) mentioned health care systems' BM components that support DHI value proposition. For instance, Pezzuto (2019) underscored the importance of defining the context of use and purpose of DHI within the health care system as facilitators for enhancing DHI value creation. Matiang'i et al. (2022) also mention purpose of use as one of the components of health care system BM that supports DHI values creation. Hlongwane and Grobberlaar (2022) in their study recognised resource availability as a crucial component of health care systems' BM that supports DHI value proposition. The studies collectively suggest that the value propositions of DHIs in SSA should focus on improving accessibility, coordination, scalability, sustainability and tailoring of health care services to the unique needs of a population.

Discussion

To address the persistent constraints that prevent the transitioning of DHI pilot projects into wide-scale implementations in the health care systems of SSA, it is critical to deal with the misalignment between the BMs and DHI value propositions. It is not explicitly clear from literature how the current health care system BMs in SSA have adapted to the integration of DHI. Hence, this section of the paper discusses enablers of value creation in SSA health care systems; inhibitors of DHI value capturing; DHI-dependent requirements for health care system BMs and benefits of DHI value propositions in SSA health care system BMs. Figure 2 provides a visual illustration of attributes that inform the requirements for health care system BMs to support DHI value propositions.

The value-add creation drivers of digital health interventions

Opportunities abound in SSA's health care systems to invest, innovate and create solutions, one of which is developing DHIs that add value to managing the prevalent burden of diseases, accessing hard-to-reach populations, supporting an overstretched health workforce. The prevalence of these issues offers opportunities for new digital businesses to co-participate within or across health care systems, enabling the cohesion of business relationships and commercialisation of DHI solutions (Al Dahdah 2022). For example, tech startups can work with frontline care workers and professionals to create evidence-based solutions that drive ease of access to health care services, automate billing plans, improve work performance and efficiencies at points-of-care (Cambaza 2023). Such evidence-based solutions can be driven by advanced Industry 4.0 technologies including machine learning, BDA, blockchain and IoT, while also ensuring capacity building aligned to digital health literacy.

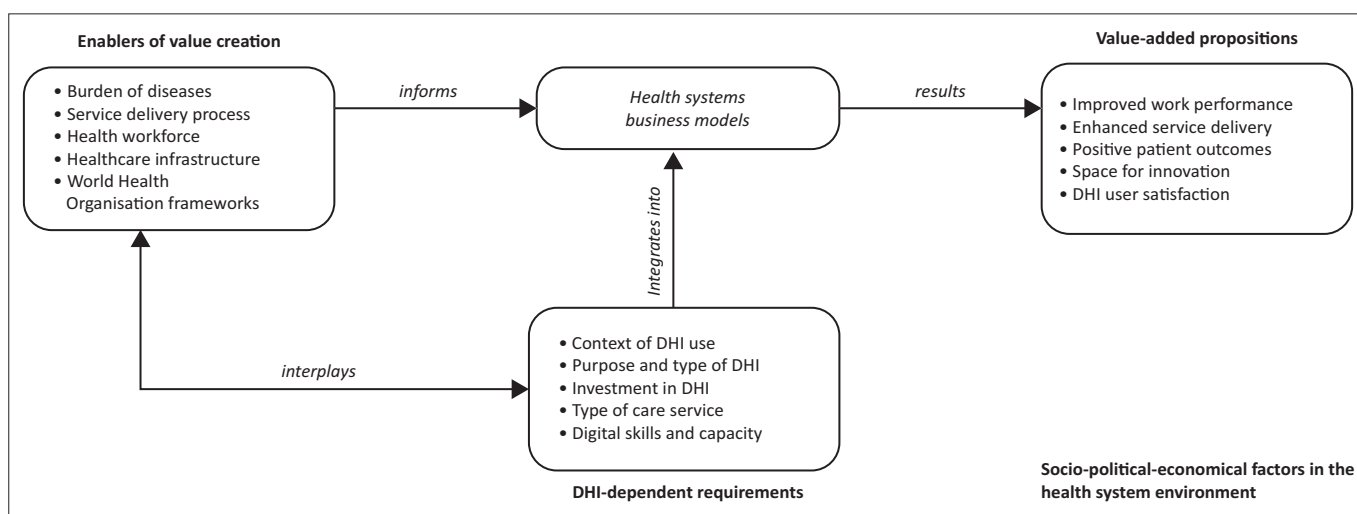
The value created by DHI in a health care system BM impacts the value chains of health care systems and how the services

are delivered (Ibeneme et al. 2022). The massive volume of data generated at points-of-care by DHIs can support person-centred care services, encourage patient involvement in self-management, rehabilitation and ultimately, reduce some of the work burden on health care professionals. The DHI value created is captured and expressed through effective management of health data and resources to respond to burden of diseases, health workers' job satisfaction and patient outcomes for sustainable well-being (Hlongwane & Grobberlaar 2022). Simultaneously, health care workers and professionals are empowered to eliminate time-consuming tasks, and to deal with more severe cases within the health care systems, as value-added capture, thereby edging towards a more resilient and strengthened health care system.

Inhibitors of digital health interventions value-added capture in health care system business models

Without a buy-in and the commitment from the political leadership structures of a health care system, it is difficult to realise the value-add by DHI on a long-term basis. The lack of buy-in can be attributed to factors such as indecisive leadership which results in a lack of adequate governance and poor vision for health care systems. Ogundaini (2023) advocates for the operationalisation of digital health leadership within the context of SSA if strengthened health care systems are to be realised. Beyond political leadership, is the importance of the technical skills required to ensure that value delivered by DHI is captured.

There are growing capacity development initiatives to ensure that the promise of advanced digital technologies across all sectors, including health care is realised (Pezzuto 2019). However, the literature in SSA highlights issues of contextualised including impractical digital health policies, limited technical skills and knowledge on digital health technologies, inadequate training, leading to suboptimal use and inefficiencies. The less than adequate capture of DHI value-add is further exacerbated by the poorly coordinated,



DHI, digital health interventions.

FIGURE 2: An illustration of the correlation between enablers of value creation, digital health interventions value-added and digital health interventions-dependent requirements in health care system business models of sub-Saharan Africa.

fragmented and centralised architecture of health information systems (Ibeneme et al. 2022). A centralised health information system in SSA is associated with several recurrent challenges as highlighted by Ogundaini and Achieng (2022). A decentralised health information system rather provides room for DHI to be integrated into a health care system BM based on immediate needs and situational realities of local contexts. In this way, the value-add of DHI is captured, bringing health care systems one step closer to ensuring a digitally driven health security.

Benefits of digital health interventions value-add integration into health care system business models

Integration of DHI into a health care system offers automation of manual processes, improved data and information management and effectiveness of making informed decisions to promote quality and safe health services (Olusanya et al. 2022). Thus, health care system BMs in SSA can significantly be improved from the integration of DHI through its value creation, delivery and capture to drive work activity performance during service provision and customer engagement. For instance, where health care professionals can efficiently diagnose and develop treatment plans or referrals using DHI, the likelihood of decision errors and frequent burnouts from overworking might be reduced (Wight et al. 2016). Also, through the collection of relevant data from multiple digital sources, health care service providers can manage and allocate the resources required to sustain and maintain the services rendered.

In an ever-evolving technological society undergoing a transition between Industry 4.0 and Industry 5.0, DHI already plays a disruptive role in how health care providers engage and bill clients; securely store patients' health records and decision support in health care systems (Garrot & Angelé-Halgand 2017). These DHI functions deliver values to the direct stakeholders in health care system BMs. The value proposition of DHI will translate to efficient service delivery, patient satisfaction and positive health outcomes especially in health care systems of SSA which are riddled with unpleasant peculiar challenges that still deter health security.

Ultimately, to capture the value-added by DHI beyond immediate gratification which oftentimes leads to pilotitis, health care system BMs in SSA need to be intentionally re-imagined to align with DHI value propositions for the transformation of health care service delivery. In this way, the value-add delivered by DHI is captured and becomes a basis for which it remains an integral part of strengthening health care systems and digitally enabled health security in SSA.

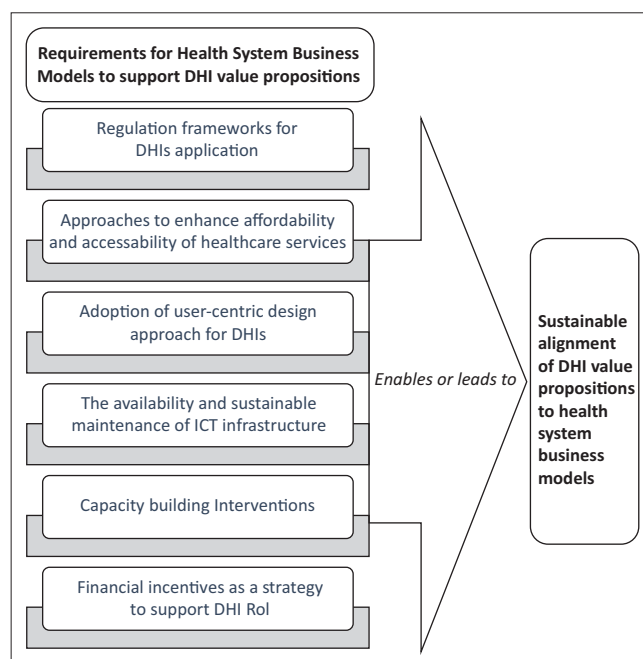
Requirements for health care system business models that support digital health interventions value propositions

The adoption of DHI by several health care systems in SSA has not resulted in the desired outcomes of a strengthened sector, yet large-scale implementation is limited to few

countries such as South Africa with MomConnect for maternal health services and mTrac to capture routine health data in Uganda. The undesired outcomes in several instances are because of a variety of challenges including misalignments between health care system BMs and DHI value propositions. This review argues that a viable health care system BM that supports DHI value should focus on improving access to quality health care, health care professionals' work performance and health care cost reduction. This could be accomplished by adopting data-driven approaches to personalised care and decision-making in the delivery of health care. Consequently, to support the attainment of DHI value propositions, health care system BMs must meet specific requirements. These requirements are critical for health care systems' BMs to succeed in delivering value to all stakeholders while ensuring sustainability and impact. The requirements are illustrated in Figure 3 and discussed in subsequent sections.

Regulatory frameworks for digital health interventions application

The establishment of comprehensive regulatory frameworks is a critical requirement for health care systems BMs to support DHI value propositions (Fernandes & Chaltikyan 2020). Frameworks play a pivotal role in delineating legal boundaries governing the implementation and application of DH technologies with an overarching goal to ensure safety, efficacy and equitable accessibility to health care services (Al Meslamani 2023; Parajuli et al. 2022). Additionally, regulatory frameworks are formulated to address multifaceted complexities, certification processes, inform strategies and governance mechanisms related to the utilisation of DH technologies (Parajuli et al. 2022). The implementation of regulatory frameworks fosters an enabling environment for



DHI, digital health interventions; ICT, information and communications technology; Rol, return on investment.

FIGURE 3: Requirements for digital health interventions value proposition alignment to health system's business models.

the development and integration of DHI in pursuit of value-based health care (Chuma & Sibiyi 2022).

Further, the regulatory frameworks ensure the judicious use of DH by defining standards and requirements for health data protection, accountability, system interoperability, compatibility and collaborative innovation among diverse stakeholders (Al Meslamani 2023; Parajuli et al. 2022). Operationalising a regulatory framework is pivotal to establishing the foundational infrastructure for the ethical utilisation of DHIs and in offering guidance on the categorisation, registration and evaluation of digital health products, including software applications and hardware designed to enhance health outcomes (Al Meslamani 2023). Subsequently, frameworks aid the identification and channelling of DHI value propositions to transform health care system issues into sustainable positive health outcomes including equitable access to health care services.

Approaches to enhance affordability and accessibility of health care services

The significance of affordability and accessibility to quality health care services across all levels of health care provision is widely acknowledged in literature (Oleribe et al. 2019). Hence, health care system BMs inclusive of DHI value propositions play a pivotal role in improving affordability and access to quality health care services through strategic approaches. One such approach is the adoption of value-based care models that are disease prevention-focused, patient-centred, risk-based and minimally invasive to ensure equitable distribution of care resources (Goff et al. 2021; Matiang'i et al. 2022). Also, the adoption of value-based care models should facilitate appropriate alignment of care services, patients, providers and the community served by the health care system to achieve better health outcomes at a lower cost (Lipson et al. 2019).

Another strategic approach is the adoption of an integrated health care service delivery across multiple care providers and settings. In SSA, health care fragmentation is a ubiquitous challenge encountered by health care systems (Chuma & Sibiyi 2022). Non-coordinated care means that it will be difficult to leverage large volumes of health data required by advanced technology applications such as BDA and AI to enhance efficiencies in making informed decisions. Health care fragmentation leads to a variety of challenges such as a lack of coordination between different levels of care and providers as well as disparities in financing (Barr et al. 2019; Chuma & Sibiyi 2022). The adoption of integrated health care services facilitated by DHI is likely to reduce redundancies, and unnecessary costs for patients. The approaches ensure that consumers receive comprehensive and coordinated care captured by health care system BMs.

Adoption of user-centric design approach for digital health interventions

User-centric consideration is a fundamental requirement to reaping the benefits associated with DHI value propositions.

Prioritising user-centric design principles in the development of DHIs enhances usability, engagement and user satisfaction (Chitungo et al. 2021). This contributes to increased adoption and adherence to the intervention, ultimately translating the achievement of the value propositions of DHI into positive health outcomes.

As a result, health care system BMs must be tailored to the development of DHIs that suits the needs, preferences and capabilities of the end users, particularly patients and health care professionals (Colloud et al. 2023). Digital health interventions developers should be encouraged to create user-friendly interfaces, considering cultural diversity, and accommodating users with varying levels of digital literacy. An intuitive user interface, clear navigation and personalised features can positively impact the user experience, fostering a sense of trust and efficacy.

User-centric designs are critical for refining, evaluating and optimising DHI's functionality and features, towards increasing its effectiveness to achieve desired health outcomes. The correlation between user-centric designs and the attainment of DHI's value proposition lies in the capabilities of well-designed digital solutions to meet user needs, positive usability measures and meeting the objectives as well as the intended goals of health care systems.

Sustainable maintenance of information and communication technology infrastructure

Health infrastructure (both soft and hard) supports health care systems to provide the population with safe, accessible, available and quality care services (Odekunle et al. 2017). Hard health care infrastructure includes medical equipment, consistent supply of water and electricity while the soft infrastructure includes human capital to health policies and regulations. Health care challenges, particularly in SSA can be linked to a lack of adequate infrastructure and mismanaged resources (Maphumulo & Bhengu 2019). For example, countries experience a disparity in access to internet connectivity and digital infrastructure, out-of-context regulatory frameworks as well as erratic electricity. As a result, DHI value proposition is rarely realised.

In several SSA health care systems, DH infrastructure is usually not adequate to support the DHI value propositions. To overcome this inadequacy, health care systems BMs must include strategies for collaboration between private and government bodies to address digital and health infrastructural shortcomings. An approach is to build a public-private partnership to promote resource sharing, competitiveness and economies of scale (Tran Ngoc et al. 2018). The partnership can contribute to the delivery of technology infrastructure, including assets, services, products and capital for innovation and development. Hellowell (2019) cautions that public-private partnership requires governments to establish regulatory frameworks and develop the capacity to mitigate against possible drawbacks that may impede the optimisation of DHI.

Capacity building

There is a case of overburdened health care systems in SSA which is compounded by a shortage of skilled health care workforces and the maldistribution of infrastructure and resources (Oleribe et al. 2019). These challenges impede health care systems' efforts to ensure quality, equitable and cost-effective health care services. As a result, capacity building interventions should be a building block in health care systems' BMs in SSA, if DHI's value proposition is to be realised. The World Health Organization (WHO) defines capacity building as 'the development of knowledge, skills, commitment, structures, systems, and leadership to enable effective health promotion'. In other words, capacity building should involve (Smith et al. 2006):

[A]ctions to improve health at three levels: [1] the advancement of knowledge and skills among practitioners; [2] expansion of support and infrastructure for health promotion in organisations; and [3] development of cohesiveness and partnerships for health in communities. (p. 341)

Capacity-building interventions in this context go beyond health care systems merely having personnel providing services towards the aim and objectives of improving health outcomes (Brownson, Fielding & Green 2018). The activities of capacity building should encompass optimisation of the ability of individuals, health care providers or organisations, systems and communities at large that evolve to create value (Bergeron et al. 2017). As a result, health care system BMs should facilitate capacity building interventions that promote sustainable efforts to support DHI adoption towards positive health outcomes. Health care system BMs should address capacity issues in three areas: individual, organisation and systemic (DeCorby-Watson et al. 2018; Finn et al. 2021).

Capacity building interventions at the individual level determines the value of DHIs' use. At the individual level, to realise the value of DHIs, capacity-building activities should aim to improve health care workforce digital skills, literacy and knowledge through reskilling and upskilling programmes (Aluny, Munene & Nabukenya 2020). Such activities would contribute to addressing the shortages of skilled health care workforce, especially in underserved areas in SSA's health care systems. At the organisational level (which includes a myriad of health care providers), capacity-building activities may focus on improving leadership and governance, supporting partnership and collaboration and strengthening infrastructure (soft and hard) (DeCorby-Watson et al. 2018).

At the systemic level, capacity-building may include regulatory framework development (including policy and strategy formulation), resource allocation and political advocacy. Capacity building intervention as a requirement for health care system BMs to support the DHI value proposition is thus an investment in the sustainable use of DH technologies to improve health outcomes while also deriving value in health care service delivery for all stakeholders. Furthermore, capacity building interventions can attract investments in ICT infrastructure and resources to implement strategies to enhance affordability and access to health care services.

Financial incentives as a strategy to support digital health interventions return on investments

Financial incentives are an essential component of health care system BMs (Velayati et al. 2022). The authors claimed that financial incentives can support the alignment of health care system BMs and DHI value propositions. For example, financial incentives are likely to motivate, attract or influence the behaviour of stakeholders within health care systems in SSA. Financial incentives could motivate health care providers to improve efficiency by linking payments to predetermined outcomes such as positive health outcomes, satisfaction or health care cost savings. From patients' perspective, financial incentives such as health insurance subsidies, care vouchers or cash transfers could attract the use of DHIs for self-care management and to access preventive as well as primary care services. Additionally, subsidies, tax credits and loans might encourage DHI developers to create user-friendly DHIs, while creating market opportunities, demand or standards for low-cost solutions through regulation can also benefit DHI RoI.

Although there are advantages to financial incentives as a strategy to support the alignment of DHI's value proposition with health care system BMs, they may create potential risks and unintended consequences such as unduly increasing the complexity and administrative costs (McIntyre et al. 2018). For example, the administration of contracts and agreements among diverse stakeholders within the health care system may pose a challenge where governance and oversight mechanisms lack transparency and adequacy. In addition, the provision of financial incentives may exacerbate existing disparities within health care systems where inequitable treatment of urban, affluent or literate populations and unintentional neglect of non-financial barriers or health determinants become widespread. This phenomenon is referred to as adverse digital incorporation (Heeks 2022).

Conclusion

Existing health care system BMs in SSA do not provide affordances for the value-add captured by the integration of DHI in health care services, thereby resulting in multiple duplications and hinders large-scale implementation. As technology advances globally and health care systems deal with re-emerging infectious diseases, it is urgent that SSA health BMs are re-imagined to address its recurring challenges and optimisation of business processes. This paper highlights how BMs of health care systems in SSA should align with the value-add propositions as well as sustainability of DHI. A critical finding was that DHIs tend to usually be developed for its intended purpose with less emphasis on the context of use in relation to the strategy of health care system BMs in SSA's peculiar context.

Beyond immediate benefits, it becomes imperative that when developing DHI, innovators and policy makers need to consider how its value proposition impacts the overall objectives of health care systems to ensure sustainability of these interventions beyond the pilot phase and to avoid

multiple duplications. Future empirical studies are required to evaluate the strategies of integrating DHI into the health care system BMs in SSA. For DHI developed in SSA to move beyond the pilot phase and be integrated into the health care system BMs, the value created as RoIs and long-term impacts should be at par with the promise of an enhanced delivery of the UHC process towards health security.

Acknowledgements

Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

O.O.O. conceptualised the paper idea while M.S.A contributed to the background section. The objective and research problem were articulated by O.O.O. while M.S.A. described both the methodology and results sections. The discussion section was drafted by O.O.O. with contributions from M.S.A. The conclusion and contribution were written by O.O.O. The visual illustrations were jointly created by O.O.O. and M.S.A.

Funding information

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Data availability

Data sharing is not applicable to this article as no new data were created or analysed in this study. The article is a review of open access articles in online journal databases.

Disclaimer

The views and opinions expressed in this article are those of the authors and the product of professional research. It does not necessarily reflect the official policy or position of any affiliated institution, funder, agency or that of the publisher. The authors are responsible for this article's results, findings and content.

References

- Abimbola, S., Keelan, S., Everett, M., Casburn, K., Mitchell, M., Burchfield, K. et al., 2019, 'The medium, the message and the measure: A theory-driven review on the value of telehealth as a patient-facing digital health innovation', *Health Economics Review* 9(1), 21. <https://doi.org/10.1186/s13561-019-0239-5>
- Acheampong, F. & Vimarlund, V., 2015, 'Business models for telemedicine services: A literature review', *Health Systems* 4(3), 189–203. <https://doi.org/10.1057/hs.2014.20>
- Achieng, M.S. & Ruhode, E., 2023, 'Context-based factors that influence healthcare information system implementation in resource-constrained public hospitals', *African Journal of Science, Technology, Innovation and Development* 15(5), 580–589. <https://doi.org/10.1080/20421338.2022.2157786>
- Al Dahdah, M., 2022, 'Digital markets and the commercialization of healthcare in Africa: the case of Kenya', *Globalizations*, 1–13. <https://doi.org/10.1080/14747731.2022.2135422>
- Al Meslamani, A.Z., 2023, 'Technical and regulatory challenges of digital health implementation in developing countries', *Journal of Medical Economics* 26(1), 1057–1060. <https://doi.org/10.1080/13696998.2023.2249757>
- Alunyu, A.E., Munene, D. & Nabukenya, J., 2020, 'Towards a digital health curriculum for health workforce for the African region: A scoping review', *Journal of Health Informatics in Africa* 7(1), 38–54.

- Akanbi, M.O., Ocheke, A.N., Agaba, P.A., Daniyam, C.A., Agaba, E.I., Okeke, E.N. et al., 2012, 'Use of electronic health records in sub-Saharan Africa: Progress and challenges', *Journal of Medicine in the Tropics* 14(1), 1.
- Arksey, H. & O'Malley, L., 2005, 'Scoping studies: Towards a methodological framework', *International Journal of Social Research Methodology* 8(1), 19–32. <https://doi.org/10.1080/1364557032000119616>
- Barr, A., Garrett, L., Marten, R. & Kadandale, S., 2019, 'Health sector fragmentation: Three examples from Sierra Leone', *Globalization and Health* 15(1), 8. <https://doi.org/10.1186/s12992-018-0447-5>
- Bergeron, K., Abdi, S., DeCorby, K., Mensah, G., Rempel, B. & Manson, H., 2017, 'Theories, models, and frameworks used in capacity building interventions relevant to public health: A systematic review', *BMC Public Health* 17(1), 1–12. <https://doi.org/10.1186/s12889-017-4919-y>
- Bloom, G., Berdou, E., Standing, H., Guo, Z. & Labrique, A., 2017, 'ICTs and the challenge of health system transition in low and middle-income countries', *Global Health* 13(1), 56. <https://doi.org/10.1186/s12992-017-0276-y>
- Brownson, R.C., Fielding, J.E. & Green, L.W., 2018, 'Building capacity for evidence-based public health: Reconciling the pulls of practice and the push of research', *Annual Review of Public Health*, 39, 27–53. <https://doi.org/10.1146/annurev-publhealth-040617-014746>
- Cambaza, E., 2023, 'The role of fintech in sustainable healthcare development in sub-Saharan Africa: a narrative review', *FinTech* 2(3), 444–460. <https://doi.org/10.3390/fintech2030025>
- Chitungo, I., Mhango, M., Dzobo, M., Denhere, K., Chimene, M., Musuka, G. et al., 2021, 'Towards virtual doctor consultations: A call for the scale-up of telemedicine in sub-Saharan Africa during COVID-19 lockdowns and beyond', *Smart Health* 21, 100207. <https://doi.org/10.1016/j.smhl.2021.100207>
- Chuma, K. & Sibiyi, P., 2022, 'Digital health ecosystem framework to address fragmentation of the health system in South Africa', *Africa Journal of Nursing and Midwifery* 24(2), 1–28. <https://doi.org/10.25159/2520-5293/11547>
- Collou, S., Metcalfe, T., Askin, S., Belachew, S., Ammann, J., Bos, E. et al., 2023, 'Evolving regulatory perspectives on digital health technologies for medicinal product development', *NPJ Digital Medicine* 6(1), 56. <https://doi.org/10.1038/s41746-023-00790-2>
- Colquhoun, H.L., Levac, D., O'Brien, K.K., Straus, S., Tricco, A.C., Perrier, L. et al., 2014, 'Scoping reviews: Time for clarity in definition, methods, and reporting', *Journal of Clinical Epidemiology* 67(12), 1291–1294. <https://doi.org/10.1016/j.jclinepi.2014.03.013>
- DeCorby-Watson, K., Mensah, G., Bergeron, K., Abdi, S., Rempel, B., & Manson, H., 2018, 'Effectiveness of capacity building interventions relevant to public health practice: A systematic review', *BMC Public Health* 18(1), 684. <https://doi.org/10.1186/s12889-018-5591-6>
- Digital Diagnostics for Africa Network, 2022, 'The potential of digital molecular diagnostics for infectious diseases in sub-Saharan Africa', *PLoS Digital Health* 1(6), e0000064. <https://doi.org/10.1371/journal.pdig.0000064>
- Fernandes, F.A. & Chaltikyan, G.V., 2020, 'Analysis of legal and regulatory frameworks in digital health: A comparison of guidelines and approaches in the European Union and United States', *Journal of the International Society for Telemedicine and eHealth* 8, e11. <https://doi.org/10.29086/JISfTeH.8.e11>
- Finn, M., Gilmore, B., Sheaf, G. & Vallières, F., 2021, 'What do we mean by individual capacity strengthening for primary health care in low-and middle-income countries? A systematic scoping review to improve conceptual clarity', *Human Resources for Health* 19(1), 1–13. <https://doi.org/10.1186/s12960-020-00547-y>
- Fredriksson, J.J., Mazzocato, P., Muhammed, R. & Savage, C., 2017, 'Business model framework applications in health care: A systematic review', *Health Services Management Research* 30(4), 219–226. <https://doi.org/10.1177/0951484817726918>
- Garrot, T. & Angelé-Halgand, N., 2017, 'Digital health business models: Reconciling individual focus and equity?', in L. Menvielle, A.F. Audrain-Pontevia & W. Menvielle (eds.), *The digitization of healthcare*, pp. 59–78, Palgrave Macmillan, London.
- Gauthier, C., Bastianutti, J. & Haggège, M., 2018, 'Managerial capabilities to address digital business models: The case of digital health', *Strategic Change* 27(2), 173–180. <https://doi.org/10.1002/jsc.2192>
- Goff, S.L., Gurewich, D., Alcusky, M., Kachoria, A.G., Nicholson, J. & Himmelstein, J., 2021, 'Barriers and facilitators to implementation of value-based care models in new Medicaid accountable care organizations in Massachusetts: A study protocol', *Frontiers in Public Health* 12(4), 183–192. <https://doi.org/10.3389/fpubh.2021.645665>
- Gorski, I., Bram, J.T., Sutermeister, S., Eckman, M. & Mehta, K., 2016, 'Value propositions of mHealth projects', *Journal of Medical Engineering & Technology* 40(7–8), 400–421. <https://doi.org/10.1080/03091902.2016.1213907>
- Heeks, R., 2022, 'Digital inequality beyond the digital divide: Conceptualizing adverse digital incorporation in the global South', *Information Technology for Development* 28(4), 688–704. <https://doi.org/10.1080/02681102.2022.2068492>
- Hellowell, M., 2019, 'Are public-private partnerships the future of healthcare delivery in sub-Saharan Africa? Lessons from Lesotho', *BMJ Global Health* 4(2), e001217. <https://doi.org/10.1136/bmjgh-2018-001217>
- Hlongwane, S. & Grobbelaar, S.S., 2022, 'A practical framework for value creation in health information systems from an ecosystem perspective: Evaluated in the South African context', *Frontiers in Psychology* 13, 637883. <https://doi.org/10.3389/fpsyg.2022.637883>
- Hwang, J. & Christensen, C.M., 2008, 'Disruptive innovation in health care delivery: A framework for business-model innovation', *Health Affairs* 27(5), 1329–1335. <https://doi.org/10.1377/hlthaff.27.5.1329>

- Ibeneme, S., Karamagi, H., Muneene, D., Goswami, K., Chisaka, N. & Okeibunor, J., 2022, 'Strengthening health systems using innovative digital health technologies in Africa', *Frontiers in Digital Health* 4, 854339. <https://doi.org/10.3389/fgth.2022.854339>
- Iyawa, G.E., Hamunyela, S., Peters, A., Akinsola, S., Shaanika, I., Akinmoyeje, B. et al., 2020, 'Digital transformation and global health in Africa', in R. Haring, I. Kickbusch, D. Ganten & M. Moeti (eds.), *Handbook of global health*, pp. 1–32, Springer, Cham.
- Karamagi, H.C., Muneene, D., Droti, B., Jepchumba, V., Okeibunor, J.C., Nabyonga, J. et al., 2022, 'eHealth or e-Chaos: The use of digital health interventions for health systems Strengthening in sub-Saharan Africa over the last 10 years: A scoping review', *Journal of Global Health* 12, 04090. <https://doi.org/10.7189/jogh.12.04090>
- Lipson, D.J., Au, M., Stringer, R. & Vogt, R., 2019, *Accelerating the adoption of value based payment in Medicaid y linking delivery system reform to managed care payment*, *Center for Medicare and Medicaid Services*, viewed 08 February 2024, from <https://www.medicare.gov/medicaid/downloads/accel-adoption-vp-pay.pdf>.
- Manyazewal, T., Woldeamanuel, Y., Blumberg, H.M., Fekadu, A. & Marconi, V.C., 2021, 'The potential use of digital health technologies in the African context: A systematic review of evidence from Ethiopia', *NPJ Digital Medicine* 4(1), 125. <https://doi.org/10.1038/s41746-021-00487-4>
- Maphumulo, W.T. & Bhengu, B.R., 2019, 'Challenges of quality improvement in the healthcare of South Africa post-apartheid: A critical review', *Curatiosis* 42(1), e1–e9. <https://doi.org/10.4102/curatiosis.v42i1.1901>
- Matiang'i, M., Ngunju, P., Koen, J., Kiilu, C., Romy, H., Aranka, H. et al., 2022, 'Viability of point of care ultrasound screening in primary health care setting: A Kenyan experience', *International Journal of Current Aspects* 6(3), 1–13. <https://doi.org/10.35942/ijcab.v6i3.273>
- Mbunge, E., Muchemwa, B. & Batani, J., 2022, 'Are we there yet? Unbundling the potential adoption and integration of telemedicine to improve virtual healthcare services in African health systems', *Sensors International* 3, 100152. <https://doi.org/10.1016/j.sintl.2021.100152>
- McIntyre, D., Obse, A.G., Barasa, E.W. & Ataguba, J.E., 2018, 'Challenges in financing universal health coverage in sub-Saharan Africa', in *Oxford research encyclopedia of economics and finance*, viewed 08 February 2024, from <https://oxfordre.com/economics/view/10.1093/acrefore/9780190625979.001.0001/acrefore-9780190625979-e-28>.
- Ndllovu, K., Scott, R.E. & Mars, M., 2021, 'Interoperability opportunities and challenges in linking MHealth applications and ERecord systems: Botswana as an exemplar', *BMC Medical Informatics and Decision Making* 21(1), 1–12. <https://doi.org/10.1186/s12911-021-01606-7>
- Odekunle, F.F., Odekunle, R.O. & Shankar, S., 2017, 'Why sub-Saharan Africa lags in electronic health record adoption and possible strategies to increase its adoption in this region', *International Journal of Health Sciences* 11(4), 59–64. <https://doi.org/10.12856/IJHIA-2018-v5-i1-147>
- Ogundaini, O. & De la Harpe, R., 2022, 'The interplay between technology performativity and health care professionals in hospital settings: Service design approach', *JMIR Formative Research* 6(1), e23236. <https://doi.org/10.2196/23236>
- Ogundaini, O.O., 2023, 'eHealth leadership in sub-Saharan Africa: A rapid review', in *2023 IST-Africa Conference (IST-Africa)*, May, pp. 1–8, IEEE.
- Ogundaini, O.O. & Achieng, M.S., 2022, 'Systematic review: Decentralised health information systems implementation in sub-Saharan Africa', *Journal for Transdisciplinary Research in Southern Africa* 18(1), 1–10. <https://doi.org/10.4102/td.v18i1.1216>
- Ojo, A., Tolentino, H. & Yoon, S.S., 2021, 'Strengthening eHealth systems to support universal health coverage in sub-Saharan Africa', *Online Journal of Public Health Informatics* 13(3), E17. <https://doi.org/10.5210/ojphi.v13i3.11550>
- Oleribe, O.O., Momoh, J., Uzochukwu, B.S.C., Mbofana, F., Adebisi, A., Barbera, T. et al., 2019, 'Identifying key challenges facing healthcare systems in Africa and potential solutions', *International Journal of General Medicine* 12, 395. <https://doi.org/10.2147/IJGM.S223882>
- Olu, O., Muneene, D., Bataringaya, J.E., Nahimana, M.R., Ba, H., Turgeon, Y. et al., 2019, 'How can digital health technologies contribute to sustainable attainment of universal health coverage in Africa? A perspective', *Frontiers in Public Health* 7, 341. <https://doi.org/10.3389/fpubh.2019.00341>
- Olusanya, O.A., White, B., Melton, C.A. & Shaban-Nejad, A., 2022, 'Examining the implementation of digital health to strengthen the COVID-19 pandemic response and recovery and scale up equitable vaccine access in African countries', *JMIR Formative Research* 6(5), e34363. <https://doi.org/10.2196/34363>
- Osterwalder, A., Pigneur, Y., Bernarda, G. & Smith, A., 2015, *Value proposition design: How to create products and services customers want*, vol. 2, John Wiley & Sons.
- Otto, K., Shekar, M., Herbst, C.H. & Mohammed, R., 2015, *Information and communication technologies for health systems strengthening: Opportunities, criteria for success, and innovation for Africa and beyond (No 94943)*.
- Parajuli, R., Bohara, D., Kc, M., Shanmuganathan, S., Mistry, S.K. & Yadav, U.N., 2022, 'Challenges and opportunities for implementing digital health interventions in Nepal: A rapid review', *Frontiers in Digital Health* 4, 861019. <https://doi.org/10.3389/fgth.2022.861019>
- Pascarelli, C., Colucci, C., Mitrano, G. & Corallo, A., 2023, 'Business models in digital health: Bibliometric analysis and systematic literature review', in *2023 IEEE Symposium on Computers and Communications (ISCC)*, July, pp. 1–4, IEEE, Gammarth, Tunisia.
- Peters, C., Blohm, I. & Leimeister, J.M., 2015, 'Anatomy of successful business models for complex services: Insights from the telemedicine field', *Journal of Management Information Systems* 32(3), 75–104. <https://doi.org/10.1080/07421222.2015.1095034>
- Pezzuto, I., 2019, 'Making healthcare systems more efficient and sustainable in emerging and developing economies through disruptive innovation: The case of Nigeria', *Journal of Management and Sustainability* 9(2), 1. <https://doi.org/10.5539/jms.v9n2p1>
- Rønn, C., Wieland, A., Lehrer, C., Márton, A., LaRoche, J., Specker, A. et al., 2023, 'Circular business model for digital health solutions: Protocol for a scoping review', *JMIR Research Protocols* 12(1), e47874. <https://doi.org/10.2196/47874>
- Schiavone, F., Mancini, D., Leone, D. & Lavorato, D., 2021, 'Digital business models and ridesharing for value co-creation in healthcare: A multi-stakeholder ecosystem analysis', *Technological Forecasting and Social Change* 166, 120647. <https://doi.org/10.1016/j.techfore.2021.120647>
- Schlieter, H., Marsch, L.A., Whitehouse, D., Otto, L., Londral, A.R., Teepe, G.W. et al., 2022, 'Scale-up of digital innovations in health care: Expert commentary on enablers and barriers', *Journal of Medical Internet Research* 24(3), e24582. <https://doi.org/10.2196/24582>
- Sibalija, J., Barrett, D., Subasri, M., Bitacola, L. & Kim, R.B., 2021, 'Understanding value in a healthcare setting: An application of the business model canvas', *Methodological Innovations* 14(3), 20597991211050477. <https://doi.org/10.1177/20597991211050477>
- Smith, B.J., Tang, K.C. & Nutbeam, D., 2006, 'WHO health promotion glossary: new terms', *Health promotion international* 21(4), 340–345. <https://doi.org/10.1093/heapro/dal033>
- Swartz, A., LeFevre, A.E., Perera, S., Kinney, M.V. & George, A.S., 2021, 'Multiple pathways to scaling up and sustainability: An exploration of digital health solutions in South Africa', *Global Health* 17(1), 77. <https://doi.org/10.1186/s12992-021-00716-1>
- Tran Ngoc, C., Bigirimana, N., Muneene, D., Bataringaya, J.E., Barango, P., Eskandar, H. et al., 2018, 'Conclusions of the digital health hub of the Transform Africa Summit (2018): Strong government leadership and public-private-partnerships are key prerequisites for sustainable scale up of digital health in Africa', *BMC Proceedings* 12(Suppl. 11), 17. <https://doi.org/10.1186/s12919-018-0156-3>
- Tricco, A.C., Lillie, E., Zarin, W., O'Brien, K., Colquhoun, H., Kastner, M. et al., 2016, 'A scoping review on the conduct and reporting of scoping reviews', *BMC Medical Research Methodology* 16, 1–10. <https://doi.org/10.1186/s12874-016-0116-4>
- Velayati, F., Ayatollahi, H., Hemmat, M. & Dehghan, R., 2022, 'Telehealth business models and their components: Systematic review', *Journal of Medical Internet Research* 24(3), e33128. <https://doi.org/10.2196/33128>
- Wight, D., Wimbush, E., Jepson, R. & Doi, L., 2016, 'Six steps in quality intervention development (6SQuID)', *Journal of Epidemiology and Community Health* 70(5), 520–525. <https://doi.org/10.1136/jech-2015-205952>