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Disruptive digital innovations in healthcare: Knowing the past and anticipating the future

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ABSTRACT

The twin focus on healthcare and digital transformation during the past two decades, which was intensified by the COVID-19 pandemic to an unanticipated level, has resulted in the mushrooming of literature in the area. While this has enriched the available insights, it has also created a certain amount of confusion, and there is now a need to make sense of what has been achieved before undertaking research that contributes more meaningfully to theory and practice in the area. Motivated by this need, we systematically analyze and evaluate the existing empirical research on the topic of disruptive digital innovations in healthcare. We followed a five-step approach to identify and analyze 42 congruent studies spread across domains, publishers, and geographies to achieve our objective. The outcome of our review is a conceptual framework that could serve to motivate and support future research. First, we presented a bibliographic sketch of the literature to clarify the milieu and descriptives. Next, we performed content analysis to organize the existing evidence into meaningful streams. Towards this end, we followed a structured approach to the review by defining the scope through a matrix–form conceptual framework to guide thematic analysis. Accordingly, we reported on the findings from three perspectives—theoretical, enabler, and barrier—anchoring them in four innovation implementations/outcomes: products, services, processes, and business models. Our analysis suggests that existing scholarship has drawn upon various interdisciplinary theories to map the enablers as well as the barriers that may inhibit the adoption and usage of these disruptive innovations. Based on the findings of our structured approach, we offer useful recommendations to advance research and practice in this field.

1. Introduction

With the progression of the digital era, advancements in digital technology have catalyzed the exponential growth of disruptive digital innovations (DDIs). DDIs have become all-pervasive, impacting almost every product, service, and day-to-day organizational routine (Jahanmir and Cavadas, 2018). The growth of these innovations has been largely fueled by an intense demand for transforming traditional business models into more agile entities driven by digital technologies (Kohli and Melville, 2019).

Since DDIs enable novel outcomes (i.e., products, services, processes, and business models) and help firms in achieving higher performance through cost-effectiveness, the scope of their use or impact is not limited to a particular field or domain (Valmohammadi, 2017). Almost all industries leverage the benefits of digital innovations (Cohen et al., 2017), and the healthcare sector is no different (Looman et al., 2021). With sustainable development goals (SDGs; United Nations, n.d.) giving top priority to people and prosperity, and the COVID-19 pandemic presenting unforeseen public health challenges, timely healthcare and continued well-being have emerged as essential areas of focus, now more than ever before. DDIs, with their sweeping transformations, provide a ready platform to make healthcare more inclusive, accessible, and effective.

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To better understand the nature of the present-day healthcare challenge, the issues and impediments within existing systems need to be thoroughly diagnosed. The scholarly literature has paid close attention to some of these issues, enumerating high medical cost, asymmetric access to healthcare, and expensive healthcare infrastructure as some of the reasons that are limiting the efficiency of the healthcare system (e.g., Paterick et al., 2009). At the same time, academic research suggests that the integration and adoption of DDIs and related technologies is one of the most convenient and cost-effective ways to address the various bottlenecks and obstacles in the healthcare system, ensuring healthy lives and well-being for citizens (Abdel-Basset et al., 2021; Ienca and Vayena, 2020; Konstantinidis et al., 2021). Indeed, several DDIs have been adopted to counter the challenges faced by the healthcare sector, such as online consultations with patients, 3D printing facilities, online care delivery, automated insulin delivery, remote consultation, flexible operation theatres, home medical ventilation, and e-health records, to name a few (Alves et al., 2020; Jung and Padman, 2015). Past studies have determined that these initiatives have reduced the cost of healthcare to an appreciable extent, promoted and supported healthcare infrastructure, and reduced the disparities in access to healthcare facilities (Jung and Padman, 2015).

These findings and observations have been supported by an appreciable volume of extant literature, with scholars noting the benefits of adopting DDIs in the healthcare sector in terms of improvements in access and delivery of healthcare services to patients (e.g., Agarwal et al., 2010), consultative methods (Gupte et al., 2016), patient-centered care (Donaldson, 2008), patient safety (Jue et al., 2020), patient wellbeing (Di Giacomo et al., 2021), preventive treatments (Paterick et al., 2009), home-based/remote advisory and treatments (Ramaswamy et al., 2020), collaborations, including inter-organizational collaborations, (i.e., with hospitals, universities, and other agencies; Secundo et al., 2019), telemedicine (Drago et al., 2021), and so on. Recent studies have specifically noted that some key digital innovations that have been instrumental in increasing efficiency in the healthcare value chain are those based on disruptive technologies such as blockchain, artificial intelligence (AI), machine learning, and robotics. (Sousa et al., 2019).

In sum, existing scholarship agrees that the adoption of digital innovations, particularly DDIs in healthcare, has increased the overall efficacy and resilience of the sector, making it more resilient (Cobianchi et al., 2020). The role of DDIs in the sector has become not only visible but also more critical during the recent global health crisis caused by the COVID-19 pandemic as the traditional healthcare system was forced to adapt and evolve (Cobianchi et al., 2020). For example, health surveillance apps are DDIs that significantly helped governments to better manage the challenge of the COVID-19 pandemic around the world by providing the public health authorities with relevant details about COVID-19 infected patients, their quarantine period, and their location (Susanto et al., 2020; Zhang et al., 2020). All in all, there is sufficient evidence to support the claim that DDIs can be deployed effectively to help the healthcare sector overcome the ongoing and upcoming global health management challenges.

The preceding discussion confirms that academic research has accorded due attention to the diffusion of DDIs in the healthcare sector, both at the administrative and medical service delivery levels. However, scholars have also been quick to admit that the diffusion of DDIs in healthcare as a research area is not fully developed since it lacks an independent body of literature, with the existing work remaining loosely connected (Florian and Hess, 2020; Kohli and Melville, 2019). The literature also seems to be skewed, with most of it focused on the benefits derived from DDI adoption, while critical issues, such as resistance to technology acceptance, risks, patient-doctor relationships, and so on, seem to be underdeveloped and deficient. These aspects may or may not be serious in this context, but they need to be explored since resistance to innovations, in particular, is a phenomenon well-acknowledged in other digital contexts (e.g., Sharma et al., 2021; Talwar et al., 2020; Talwar et al., 2020). To summarize, there are gaps in the literature in terms of the contexts and variables examined and the research findings available, which severely constrain both theory and practice in the area (Florian and Hess, 2020). On a positive note, these concerns can be easily remedied through motivating research that expands the scope of investigations in the area.

One impediment that can hinder the recommendation of future research activity in the area is the lack of a systematic presentation, which is evident in the DDI literature, in general, and is also observed in the case of healthcare research (Ma et al., 2020). To explain the issues further, we observe that the scope of research on DDIs in healthcare is spread across multiple verticals such as products, processes, services, and business models, including drug development (Afolabi, 2013), occupational therapy (Imms et al., 2017), and the training and learning of advance practice nursing (Campbell et al., 2021). Findings related to such diverse issues need structured mapping and consolidation before they can serve as a robust platform to support further research, which is possible through rigorous review studies. Appreciating this need, scholars have undertaken reviews in the past to synthesize the literature, but the scope of these reviews is limited to certain niches, such as patient-centered digital health applications (Ludewig et al., 2021), digital innovation for diet monitoring (Mortazavi and Gutierrez-Osuna, 2021), and preventive psychiatry (Reilly et al., 2019). There is no existing review that provides an all-inclusive and comprehensive evaluation of research spanning the application of DDIs in products, services, processes, and business models in the healthcare sector by following a structured and systematic approach. This is a visible gap that needs to be addressed to energize and expedite future research endeavors. We aim to fill this gap in the research by systematically reviewing the extant literature on DDI implementation in the healthcare sector using the popular approach of a systematic literature review (SLR). SLRs are a popular approach used by many recent review studies (e.g., Dhir et al., 2020; Talwar et al., 2020). We particularly propose to address the following research questions (RQs): **RQ1**. How has the research on the implementation of DDIs in the healthcare sector evolved over the years? and **RQ2**. What are the key themes in the congruent scholarly literature on the implementation of DDIs in the healthcare sector that can guide future research and practice?

To address these questions, we have further funneled them into specific research objectives that are guided by the scope of review and presented with a description of SLR methodology in the relevant part of the study.

Our study adds to the current understanding of research on DDI implementation in the healthcare sector in the following ways: First, to our knowledge, this is the maiden SLR synthesizing the research on DDI implementation in the healthcare sector from the broad perspective of products, services, processes, and business models. As a result, the findings offered are relevant to a larger group of researchers and practitioners. Second, the study provides visibility to the existing research in the area by contextualizing it, thereby granting it theoretical and conceptual legitimacy. Third, our SLR provides a balanced view of the literature by classifying two distinct thematic areas—enabling factors that have increased the diffusion and effectiveness of DDIs in healthcare in various implementation/outcome categories and inhibiting factors or barriers and challenges that have obstructed/slowed the seamless implementation and diffusion of DDI in the sector. Such a systematically organized view can serve to guide future researchers to plan their conceptualizations better. Finally, our present research suggests future areas of investigation by identifying certain unanswered research questions in this domain. Knowing specific gaps will encourage focused and effective research capable of enhancing the maturity of knowledge in this field.

2. Conceptual boundary and scope of the review

Healthcare activities such as patient consultation and diagnosis, diagnostic procedures, sample collection, lab testing, maintaining records, drug development and testing, medical treatment procedures, surgeries, patient data management, tracking patient history, collaborations, and knowledge sharing offer a huge scope for implementing digital innovations (Cobianchi et al., 2020; Neumaier, 2019). Due to the anticipated gains, the healthcare sector has observed an unprecedented and organic adoption of digital technologies (Ienca and Vayena, 2020; Keesara et al., 2020). Most of such digital innovations in the sector have the potential to drastically transform the traditional way of doing things, so they are often called DDIs to truly reflect their impact. The planned implementation of these DDIs has the potential to develop an effective, sustainable, and robust healthcare ecosystem comprising multiple actors such as healthcare practitioners and professionals, hospitals, pharmacies, drug companies, R&D labs and universities, and government bodies and departments (Cobianchi et al., 2020; Cohen et al., 2017; Nambisan, 2017; Rippa and Secundo, 2019; Secundo et al., 2019).

Such a dynamically evolving ecosystem needs extensive and continuous research inputs for it to expand and overcome its challenges. Our study is an attempt in this direction. To better understand the context of our study, it is essential to first have a more detailed discussion on DDIs. To present a clear picture, we begin by focusing first on digital innovations and thereafter moving on to the disruptive aspect. The term *digital innovation* has a broad context, and it can be defined as "the creation of (and consequent change in) market offerings (product and services), business processes, and business models that result from the use of digital technology" (Nambisan, 2017, p. 224). In comparison, DDIs have a more specific connotation, referring to innovations such as AI, blockchain, virtual/augmented reality, 3D printing, and the Internet of things (IoT), which are quite drastic in their impact and bring about highly visible changes in the way things are done at work as well as play (Harrington, 2023). In other words, DDIs are innovations that involve using digital technologies in innovative and novel ways (Kohli and Melville, 2019; Nambisan, 2017), and their value comes from their inherent architecture (Kohli and Melville, 2019; Nambisan, 2017). To elaborate, DDIs enable major business improvements and transformations across various commercial functions and industries (Khin & Ho, 2019). Importantly, DDIs create value for organizations and their stakeholders by supporting the creation of novel products, services, processes, and business models (Ciriello et al., 2018; Hinings et al., 2018; Ramaswamy and Ozcan, 2018). Other benefits that can accrue from adopting DDIs include a higher degree of customer involvement (Shi et al., 2022), enhanced firm performance through rapid innovation and operational efficiency (Liu et al., 2022), entrepreneurship transformation (Elia et al., 2020; Kitsios and Kamariotou, 2022), digital boosts/transformations (Schneckenberg et al., 2021), and value creation (Bosler et al., 2021; Ramaswamy and Ozcan, 2018), user-wellbeing (Majchrzak and Shepherd, 2021).

The motivation for our study comes from the fact that while the existing insights are exciting, they are lacking from two prominent perspectives—first, the accumulated literature research has yet to catch up with the practice, and second, there are too many ongoing parallel conversations, making the existing literature fragmented and difficult to absorb. For the literature in the area to be more incisive and attractive from a practice perspective, the findings need to be augmented in both depth and width, which mandates generating noticeable momentum to conduct research in the area. However, to encourage future research endeavors, there is a need to structure the current diverse and loosely coupled body of literature to present a more coherent and cohesive narrative. We address this need by systematically reviewing the literature using the SLR approach.

Taking the discussion forward, the prior literature on DDIs largely agrees on two characteristics or features: convergence and generativity (Nambisan, 2017). Convergence means that information technology architecture and artifacts enable information and knowledge sharing among various actors of an ecosystem (Tilson et al., 2012). In comparison, generativity refers to those features that enable existing information technology architecture and artifacts to generate new offerings (i.e., products, services, and processes; Liu et al., 2022; Tilson et al., 2012). Since our objective is to examine the literature around disruptive digital innovations in the healthcare sector, our review subscribes to this popular and uncontended conceptualization of DDIs and focuses on the four implementation/outcome categories of DDIs in healthcare—products, services, processes, and business models (Nambisan, 2017; Tilson et al., 2012; Florian and Hess, 2020; Kohli and Melville, 2019).

Towards this end, we propose a framework for guiding our review in a structured manner. This framework, in the form of a matrix presented in Fig. 1, provides the basis for a thematic analysis of the congruent literature. On the one hand, it accommodates the conventional implementation/outcome categories of DDIs in healthcare, and on the other hand, it incorporates diffusion-related aspects (theoretical perspectives, enablers, and barriers). The idea behind such a conceptualization is to bring together the concerns of theory and practice.

3. Methods

Our study aims to critically examine the past research in the area to set the agenda for future research on the implementation of DDIs in the

healthcare

Thematic foci of research on disruptive digital innovations in the healthcare sector	Disruptive Digital Innovation Implementations/Outcomes				
	Themes /Digital Innovations Outcomes	**Products**	**Services**	**Processes**	**Business Models**
	Theoretical Perspectives	Conceptual underpinnings of the extant investigations grounded in theoretical frameworks			
	Enablers	Factors that capture the positivist agenda of the facilitators of successful DDI implementation and effective outcomes			
	Barriers	Factors that capture the resistant perspective of barriers and challenges that impede the successful adoption and use of DDIs in the sector			

Fig. 1. Framework for thematical analysis of research on disruptive digital innovations in healthcare.

healthcare sector. To achieve the proposed outcomes of our study, we considered the available literature holistically, reviewing it systematically and comprehensively using the SLR approach. SLR is a suitable approach for our study due to two main advantages: (i) it provides a reproducible and systematic consolidation of the literature (Kaur et al., 2021; Kushwah et al., 2019); (ii) it is considered an appropriate method for reviews with clear guiding research questions (Talwar et al., 2020; TM et al., 2021). Following recent studies (e.g., Madanaguli et al., 2021; Seth et al., 2020), we used a five-step process for executing the SLR: (a) defining clear research objectives, (b) identifying relevant keywords for a literature search (c) setting distinct inclusion and exclusion criteria, (d) sorting and filtering the literature to select congruent studies, and (e) conducting content analysis to critically review the selected literature. This process is exhibited in Fig. 2.

3.1. Research objectives

In alignment with our proposed research questions and the conceptual framework present in Fig. 1, we sought to achieve three research objectives (ROs).

RO.1: What are the various theoretical perspectives used in different implementation categories/outcomes of DDIs in healthcare?
RO.2: What are the enabling factors that support the implementation of DDIs and positive outcomes in different healthcare verticals and contexts?
RO.3: What are the barriers and challenges that hinder the implementation of DDIs and positive outcomes in different healthcare verticals and contexts?

3.2. Relevant keywords

To achieve the objectives of the SLR, we needed to select the relevant studies to be reviewed. The first step in this selection process was the identification of keywords to help search the relevant articles. Towards this end, we followed the popular practice (e.g., Chaudhary et al., 2022) of generating an exhaustive list of keywords: "healthcare*" or "health care*" or "health service*" or "public health*" or "healthcare*" and "disruptive technolog*" or "digital innovation*" or "disruptive innovation*." Thereafter, in concurrence with recent studies (e.g., Kaur et al., 2022), we searched these words on two prominent digital databases—Scopus and Web of Science (WoS). Herein, we searched these keywords in an *all fields* query in WoS and in a *Title-ABS-Key* query in Scopus. Further, to make sure that all potentially relevant studies were identified, we did not limit the search to a specific timeframe of shorter duration.

3.3. Inclusion and exclusion criteria

Our keyword search across multiple databases resulted in the generation of a large list of studies that were potentially incongruent with the scope of the review. Hence, these needed to be filtered and refined. To execute such filtration effectively, we laid down distinct inclusion and exclusion criteria consistent with recent reviews (e.g., TM et al., 2021); these are presented in Table 1.

3.4. Selection of congruent studies

After an all-inclusive initial keyword search, which was rerun in August 2022, we found 1542 articles, of which 887 were from Scopus and 655 from WoS. Next, we applied the first three exclusion criteria, which yielded 783 relevant articles of which 401 were from Scopus and 382 from WoS.

Thereafter, we merged the Scopus and WoS lists and applied the fourth exclusion criterion, whereby we removed the duplicate articles. This step resulted in a joint pool of 580 potentially relevant studies. Moving on to a closer evaluation, the author team read the titles and abstracts of these articles to confirm their congruence with the topic at

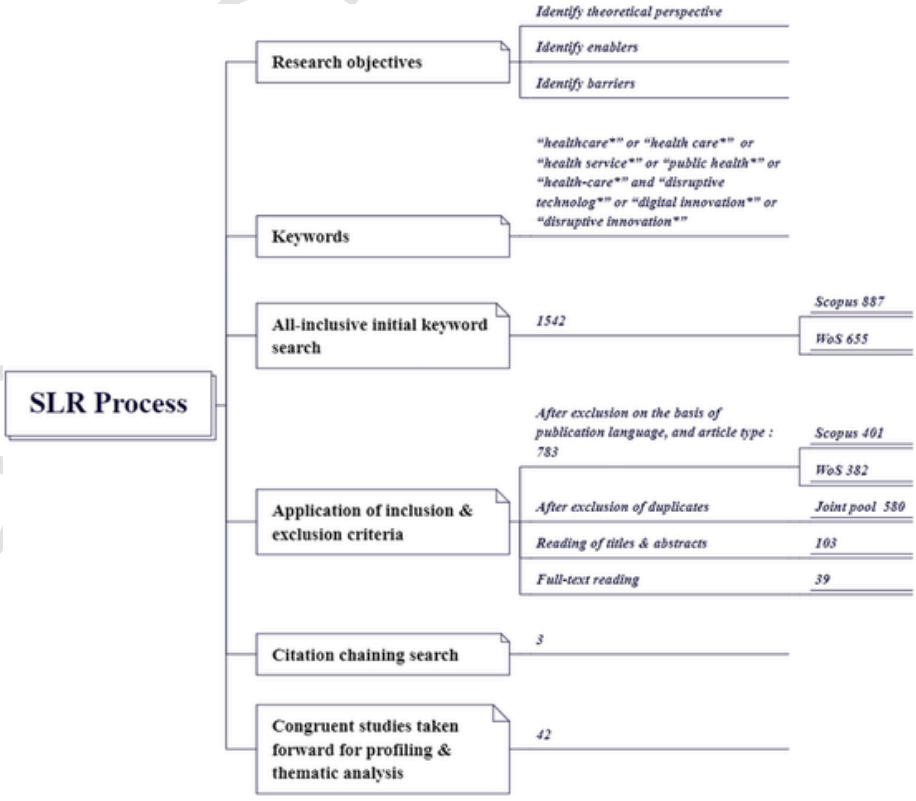

Fig. 2. The SLR process.

Table 1
Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
(i) only empirical articles (ii) only articles published in peer-reviewed journals	(i) articles published in other than English language (ii) research notes, lecture notes, editorials, conference papers, proceedings, expert opinions, and theses (iii) review and conceptual articles (iv) duplicate articles based on titles/DOIs

hand. This step helped us identify 103 studies to take forward for full-text reading. As a result of full-text reading, undertaken independently by each author, we excluded 64 articles that were not relevant to our specific context of DDIs in healthcare and shortlisted a data set of 39 empirical articles to be included in the SLR. We also undertook a citation-chaining search of these 39 articles to find three more relevant studies, which were also included in the survey. The final data set taken forward for systematic review comprised 42 journal articles published in English.

3.5. Analysis of the literature

To synthesize and present the findings and relevant details for making sense of the fragmented literature field, which at times appears in completely undiscernible silos, we analyzed the shortlisted set of 42 studies from two perspectives: (a) an analysis of bibliographical details to understand the research profile of the extant literature, and (b) a detailed qualitative content analysis. The bibliographic profile of the studies is important to motivate future research since it helps in understanding research trends, potential publication targets, geography-related scope, and method-related gaps. Similarly, qualitative content analysis of the shortlisted congruent literature is important not only to synthesize the scattered evidence and present a meaningful narrative but also to assess it critically to develop a conceptual framework to guide future research on DDIs transforming the face of healthcare.

4. Results and discussion

The results and discussion section is arranged into two sub-sections. First, we present the research profile details of the eligible data set in terms of publication trends and publishers, geographical context, method and research design, sample, and DDI implementation/outcome categories. We also discuss the potential implications of the findings for future research. In the second sub-section, the findings are discussed as per the themes presented in the conceptual framework in Fig. 1.

4.1. Research profile

We examined the 42 studies to extract descriptive details related to operational and methodological choices. The yearly trend of publications, as presented in Fig. 3, reveals that the research on implementational aspects of DDIs in healthcare has still not gained the desired momentum and continues to grow at a tepid pace. However, the existing studies have been published by noteworthy publishers, including Blackwell Publishing, Cambridge University Press, Elsevier, Emerald Publishing, SAGE Publications Ltd., and Springer.

Fig. 4 illustrates the geographical scope of the accumulated research. The data indicates a noticeable skew of insights from developed countries, with more than 50 percent of the insights coming from the United States and European nations.

Coming to methodological choices, the existing scholarship has shown an inclination to favor qualitative methods, with nearly 74 percent of the studies using methods such as case studies, observations, interviews, focus group discussions, and Delphi studies (e.g., Khatter and Relan, 2022; Kraus et al., 2022). The remaining 26 percent are based on quantitative approaches, with data collected through cross-sectional surveys, experiments, secondary data sources, and work-flow analysis (Samonte et al., 2022; Subirats et al., 2015). In addition, most studies were conducted at a single point in time, with data collected in a single wave, and very few chose to collect data longitudinally (e.g., Shimada et al., 2013).

To their credit, the reviewed studies have examined diverse target groups ranging from single organizations (e.g., Khatter and Relan, 2022) to entrepreneurs (Beaulieu and Lehoux, 2019; Garbuio and Lin, 2019; Janssen and Moors, 2013), advanced practice nurse faculty and participants (Campbell et al., 2021), medical and healthcare professionals (Bagot et al., 2015; Shah et al., 2019; Zaman et al., 2021), pharmacy owners and assistants (White, 2009), various cohorts at healthcare facilities (Shimada et al., 2013), patients (Hans et al., 2018; Jung and Padman, 2014; Kario, 2020; Kraus et al., 2022; Subirats et al., 2015; Wong et al., 2017), projects (Evans et al., 2009; Herrmann et al., 2018; Keijser et al., 2016), IoT users (Ben Arfi et al., 2021), and service providers (Veld et al., 2011).

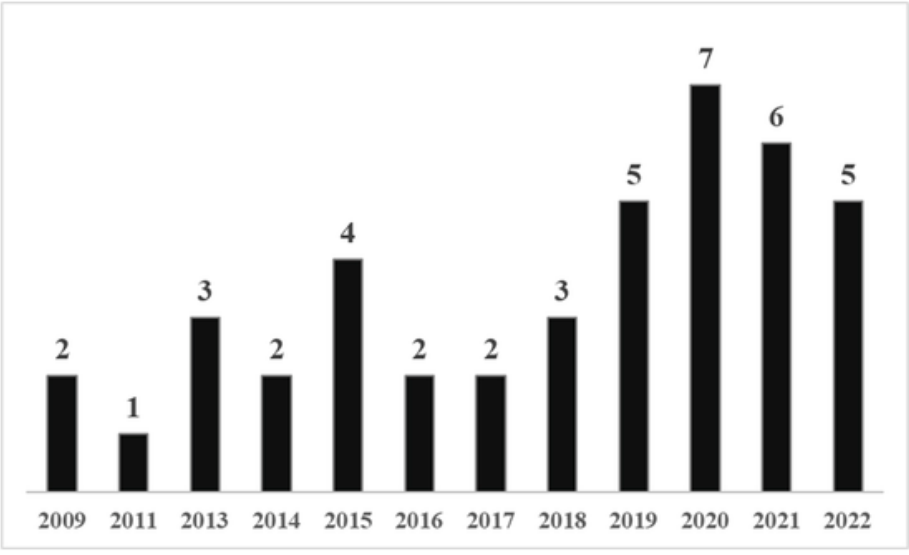

Fig. 3. Yearly publication trend.

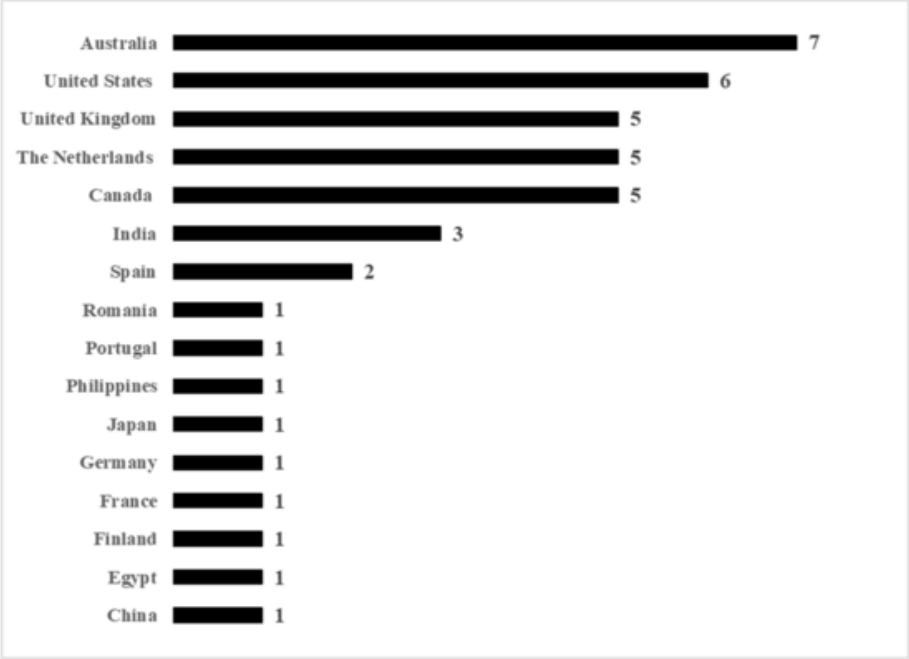

Fig. 4. Geographical scope.

The final profile-based information that we extracted from the shortlisted studies concerned the context/categories. Herein, in terms of DDI implementation/outcome categories, maximum inquiries (based solely on one implementation/outcome category) were about processes (29 percent), and 21 percent of the inquiries considered two or more implementation/outcome categories (e.g., services, processes, and business models). The details are presented in Table 2.

4.2. Thematic analysis and discussion

This section presents a thematic evaluation of the shortlisted studies. With the conceptual framework proposed to guide the scope of our analysis as a point of reference, we evaluated and synthesized the full text of each study and consolidated the findings into three streams—theoretical perspectives, enablers, and barriers, aligning them at the same time with the four implementation/outcome categories.

Table 2
DDI implementation/outcome categories.

Implementation/ outcome categories	Studies
Business models (8)	Beaulieu and Lehoux (2019); Garbuio and Lin (2019); Herrmann et al. (2018); Janssen and Moors (2013); Khatter and Relan (2022); Sterling and LeRouge (2019); van Meeuwen et al. (2015); Veld et al. (2011)
Processes (12)	Afolabi (2013); Bagot et al. (2015); Campbell et al. (2021); Garrety et al. (2014); Keijser et al. (2016); Kraus et al. (2022); Li et al. (2022); Samonte et al. (2022); Sangal et al. (2022); Shah et al. (2019); Sharp et al. (2020); Wong et al. (2017)
Products (5)	Evans et al. (2009); Kario (2020); Nguyen et al. (2015); Rushforth and Greenhalgh (2020); Subirats et al. (2015)
Services (8)	Ben Arfi et al. (2021); Gilbert Hunt (2017); Jung and Padman (2014); Looman et al. (2021); Menon et al. (2019); Shimada et al. (2013); Steele Gray et al. (2018); White (2009)
Processes and services (4)	Abdel-Basset et al. (2021); Hans et al. (2018); Mukherjee (2021); Sahu et al. (2020)
Products, processes, and services (3)	Castro e Melo & Araújo (2020); McBee and Wilcox (2020); Zaman et al. (2021)
Services, processes, and business models (2)	Sust et al. (2020); Virtanen et al. (2016)

4.2.1. Theoretical perspectives on disruptive digital innovations in healthcare

The research on DDIs in healthcare is in a nascent state, with scholars still exploring various aspects and outcomes to develop a preliminary understanding. Despite the exploratory nature of the inquiries, these initial efforts have appreciable theoretical grounding. Our content analysis confirmed that diverse theoretical frameworks have been utilized to ground the conceptualization. Some exemplars include the disruptive innovation framework (Afolabi, 2013), top management team (Garbuio and Lin, 2019), and simulative learning (Campbell et al., 2021). The fine-grained aspects of the application of these theories in the underlying literature become even more clear when seen in the context of the four implementation/outcome categories. Consequently, we have divided the discussion into four sub-themes—business models, processes, products, and services.

4.2.1.1. Theoretical perspectives and business models. Insights: The business model outcome of DDI implementation in healthcare has received due attention with discussions focused on AI technology development strategy, business models for mobile telehealth services, customer needs, the development and dissemination of health technologies, the implementation of e-health innovations, models for the supply chain, etc. Specifically, Garbuio and Lin (2019) used the theoretical lens of the top management team paradigm to discuss AI-based business models for healthcare start-ups, and Veld et al. (2011) used the service, technology, organization, and financing (STOF) framework to discuss transformations in telemonitoring and teletreatment models. In other studies focused on business models, Virtanen et al. (2016) utilized the theoretical propositions of service dominant logic for conceptualizing and explicating customer needs and developing business intelligence, Beaulieu and Lehoux (2019) employed neo-institutional theory to investigate the dynamics of how entrepreneurs managed the challenges of market and healthcare systems and interacted with other actors, and van Meeuwen et al. (2015) used the design approach and actor perspectives to create a business model toolkit for online pre-care services.

4.2.1.2. Theoretical perspectives and processes. Process outcomes of DDIs that have been examined using a suitable theoretical lens include drug development, training of advanced practice nursing, health innovation systems, the adoption of mobile technologies, and participation in telemedicine. More specifically, Afolabi (2013) used a disruptive innovation framework for conceptualizing varied nuances of indigenous medicine research, and Li et al. (2022) employed complex system theory to discuss 5G-enabled COVID-19 prevention and control. Resonating with the disruptive nature of the innovations being examined, Bagot et al. (2015) and Garrety et al. (2014) utilized disruptive innovation theory to examine the use of telemedicine in acute health settings and healthcare. Existing scholarship has drawn upon some novel theoretical lenses to examine the process outcomes of DDIs. For instance, Mukherjee (2021) used a health technology assessment framework to examine the process outcomes of integrating technology to manage the COVID-19 pandemic, and Sangal et al. (2022) employed swift trust and organization information theory to investigate blockchain adoption in the omnichannel healthcare sector. Interestingly, acknowledging that DDIs brought various coping challenges, Shah et al. (2019) invoked the change management perspective for explicating the process-related aspects of transitioning to a mobile-first culture of work.

4.2.1.3. Theoretical perspectives and products. In comparison to business models and processes, fewer product-related outcomes of DDIs have been examined using a theoretical lens. In fact, only three such contexts—personalized medicine, an antiaging drug, and electronic nursing documents—were examined through theoretical frameworks. Admittedly, scholars have used uniquely befitting theoretical frameworks in this regard. In the case of personalized medicine, Rushforth and Greenhalgh (2020) utilized the strong structuration theory to examine the issues related to the failure of personalized medicine in the UK. To contribute meaningful insights on the development of an antiaging drug, Evans et al. (2009) used the programmed and error theory of aging, and Nguyen et al. (2015) used the actor-network approach to examine the transition of patient records in Australia from paper versions to electronic form.

4.2.1.4. Theoretical perspectives and services. As in the case of product-related outcomes, where the theoretical perspectives were quite narrow, past studies have examined only a limited variety of service-related outcomes of DDIs, such as e-healthcare, management of COVID-19, and community-based primary healthcare. Specifically, Ben Arfi et al. (2021) used a common-yet-popular technology adoption theory, the unified theory of acceptance and use of technology, to examine the factors driving the acceptance of e-healthcare services, and Abdel-Basset et al. (2021) utilized neutrosophic theory to propose a framework based on disruptive technologies for COVID-19 analysis. In another study, Steele Gray et al. (2018) used service-dominant logic to examine the role of ubiquitous revolutions in clinical care, remote monitoring, etc. and the diffusion of innovation and normalization process theory for examining integrated community-based primary healthcare.

4.2.2. Enablers of disruptive digital innovations in healthcare

Diffusion and sustained use of any innovation in any setting, particularly in the digital domain, is driven or impeded by certain enablers of adoption. It is no different for the healthcare sector. Content analysis of the short-listed studies confirmed that the existing scholarship had indeed noted various enablers that support the diffusion of DDIs. The reviewed studies discussed a number of enablers, ranging from organizational factors to resource availability. The majority of studies included in the review have discussed various enablers; however, the narratives are confusing. To make sense of the enablers discussed in the literature, we have not only divided the discussion into four sub-themes—business models, processes, products, and services—but also coded them and clubbed them under five aggregate dimensions representing broad types of enablers—institutional, actor-related (users, providers, other stakeholders), infrastructure/resource-related, products/services-related, and partnership-related as presented in Table 3.

4.2.2.1. Enablers and business models. DDIs bring with them multiple changes for business models, and enablers play the role of motivating stakeholders to make the changes required to adjust to the new reality. In this regard, the reviewed studies identified several enablers that support business model outcomes. These include customer value propositions, customer needs, and customer acquisitions (Herrmann et al., 2018; Sterling and LeRouge, 2019), key resources such as technology and venture capital providers (Garrety et al., 2014; Herrmann et al., 2018; Sterling and LeRouge, 2019), the brand extension and profit formula (Herrmann et al., 2018; Sterling and LeRouge, 2019), opportunity identification (Beaulieu and Lehoux, 2019), and the involvement of experts from health sectors, strategic collaborations, and service-dedicated experts (van Meeuwen et al., 2015). These enablers can further be contextualized by classifying them under the broad types: institutional (brand extension, profit formulas, and opportunity identification); actor-related (customer value propositions, customer needs, and customer acquisitions); infrastructure/resource-related

Table 3
Enablers of disruptive digital innovation outcomes in healthcare.

Type of enabler	Enablers	Business models	Processes	Products	Services
Institutional	Leadership	Y	Y	–	Y
	Organizational culture	–	Y	Y	Y
	Information and knowledge sharing	Y	Y	–	Y
	Reorganization of work process	–	–	–	Y
	Strategic orientation	Y	Y	–	Y
Actor-related (users, providers, other stakeholders)	Training, trainers' ability	–	Y	Y	Y
	Employee involvement	Y	Y		Y
	End-user engagement	Y	Y	–	Y
	Stakeholder engagement	–	–	Y	–
	End users' expectations	Y	Y	–	Y
	Skills and competencies of service providers (individual and relational capabilities)	–	Y	–	Y
	Customer retention and customer value proposition	Y	–	–	–
Infrastructure/ resource-related	Technological infrastructure such as IoMT, drones, and robots	–	Y	–	Y
	Financial provisions	Y	–	–	Y
	Technology development	Y	Y	Y	Y
	Information availability	–		–	Y
Products/services-related	Features such as accuracy, flexibility	–	–	Y	–
Partnership-related	Partnership	–	–	–	Y
	Vendor support		–	–	Y
	Institutional collaboration	Y	Y	–	Y
	Collaborative governance	–	–	–	Y

(technology and venture capital providers); products/services-related (service dedicated experts); and partnership-related (involving experts from health sectors and strategic collaborations).

4.2.2.2. Enablers and processes. Next, we synthesized and classified the enablers of the process outcomes (such as drug development, COVID-19 management, e-learning in APN, cost management processes, policy formulation, the adoption of mobile technologies, clinical information systems rollout, remote patient monitoring, medical imaging record management, and knowledge transformation and learning). The key enablers in this regard include collaboration and knowledge sharing (Afolabi, 2013; Virtanen et al., 2016), trainers' ability and leadership support (Campbell et al., 2021; Shah et al., 2019; Wong et al., 2017), organizational culture (Shah et al., 2019), user engagement and user-centric service production (Shah et al., 2019; Virtanen et al., 2016), staff training and engagement (Hans et al., 2018; Wong et al., 2017), individual and relational capabilities (Sharp et al., 2020), change management and disruptive business models (Keijser et al., 2016), and technological development and adoption (Abdel-Basset et al., 2021). These process outcome enablers can be classified under the five broad types as follows: institutional (leadership support, organizational culture, change management, and knowledge sharing); actor-related (trainers' ability, staff training and engagement, individual and relational capabilities, and user engagement); infrastructure/resource-related (disruptive business models and technological development and adoption); products/services-related (user-centric service production); and partnership-related (collaboration).

4.2.2.3. Enablers and products. Analysis of the short-listed studies suggests that factors such as stakeholder engagement (Evans et al., 2009; Rushforth and Greenhalgh, 2020), and employee training (Nguyen et al., 2015), and features such as reliability, accuracy, and flexibility (Kario, 2020) promote product-related outcomes of DDI implementation.

Within the broad categories, the types of enablers include the following: institutional (organizational culture), actor-related (employee training and stakeholder engagement), products/services-related (features such as reliability, accuracy, and flexibility), and infrastructure/resource-related (system integration).

4.2.2.4. Enablers and services. Offering the deepest insights among the four outcome categories, the enablers of service-related outcomes of DDIs identified by the reviewed studies include partnerships (Gilbert Hunt, 2017), infrastructure and policy (Menon et al., 2019), leadership (Shimada et al., 2013), employee involvement, technology adoption, training, reorganization of the work process, and vendor support (White, 2009), knowledge management and user-centered production (Virtanen et al., 2016), staff competencies (Shimada et al., 2013), service providers' training and the availability of and access to relevant information (Hans et al., 2018), resources such as technological infrastructure (Abdel-Basset et al., 2021), finance, multidisciplinary teams, feedback, and governance mechanisms (Looman et al., 20201), expected outcomes such as performance and efforts (Ben Arfi et al., 2021), and demographic features of the users (van Meeuwen et al., 2015).

These enablers can be further classified under four of the five broad types: institutional (leadership, multi-disciplinary team, feedback, governance mechanism, knowledge management, and reorganization of work process); actor-related (expected outcomes, employee involvement, service providers' training, user-centered production, staff competencies, and training); infrastructure/resource-related (technology adoption, finance, technological infrastructure, availability and access to relevant information, and ecosystem integration); and partnership-related (partnership, vendor support, policy, and ecosystem integration).

4.2.3. Barriers impeding disruptive digital innovations in healthcare

Coming to the final theme, content analysis of the retrieved studies helped us in consolidating insights related to various barriers identified by the existing scholarship. As in the case of enablers, the discussion on barriers is also fragmented and siloed in past studies. To make the content more useful and discernible, we have not only divided the barriers into four sub-themes—business models, processes, products, and services—but also coded them to club them under seven aggregate dimensions representing broad types of barriers: data-related, user-related, organizational, ecosystem-related, policies and regulations-related, strategic orientation-related, and resource/infrastructure constraints-related, as presented in Table 4.

4.2.3.1. Barriers and business models. We analyzed the content of the retrieved studies to understand the barriers that the existing scholarship had observed as impediments to business model outcomes of DDI implementation in the healthcare sector. The main barriers and challenges enumerated in the literature were related to the identification of suitable disruptive technology, data security, and trust (Garbuio and Lin, 2019), lack of process standardization (Sterling and LeRouge, 2019), misalignment and asymmetry of resources and technologies (Beaulieu and Lehoux, 2019), scalability (Khatter and Relan, 2022), data quality and patient privacy (Garrety et al., 2014), and issues in the implementation of e-health innovations (van Meeuwen et al., 2015). These barriers can be further classified under five of the seven broad types: data-related (data security and trust, data quality); user-related (patient privacy); ecosystem-related (lack of process standardization); strategic orientation-related (identification of suitable disruptive technology, misalignment, scalability, and issues in the implementation of e-health innovations); and resource/infrastructure constraints-related (asymmetry of resources and technologies).

4.2.3.2. Barriers and processes. The process outcome-related barriers and challenges are well considered in the past literature on DDI implementation in the healthcare sector, with scholars identifying the following impediments: poor linkage among various stakeholders (Afolabi, 2013), lack of users' acceptance and anxiety (Afolabi, 2013; Sharp et al., 2020), technical, operational, and legal issues (Sangal et al., 2022), perceived cost in terms of time and effort, poor fit with existing work schedule, and care givers' resistance (Hans et al., 2018), role clarity among teams and accountability (Sharp et al., 2020), training of trainer, lack of administrative support, and lack of approval from accreditors (Campbell et al., 2021), data quality, privacy, and governance (Garrety et al., 2014), lack of in-person contact (Castro e Melo & Araújo, 2020), and lack of regulations on various aspects such as drug testing (Afolabi, 2013). Factors such as poor change management, clinical factors, expertise of staff, and staff-to-patient ratio (Wong et al., 2017), political, economic, and institutional context (Mukherjee, 2021), social and cultural factors (Castro e Melo & Araújo, 2020; Mukherjee, 2021), complexity and dynamics of service space (Virtanen et al., 2016), cost-effectiveness and patient convenience (Kraus et al., 2022), technological constraints and sample biasness (Sahu et al., 2020), governance models (Keijser et al., 2016), unknown patient outcomes and lack of follow up communication (Bagot et al., 2015), and handling real-time big data and diverse devices (Li et al., 2022) also impede the success of DDI process outcomes.

In terms of the seven broad types, these barriers may be categorized as follows: data-related (data quality, privacy, handling real-time big data); user-related (perceived cost in terms of time and effort, sample biasness, lack of users' acceptance and anxiety, patient convenience, not knowing the patient outcome, caregivers' resistance); organiza-

Table 4
Barriers impeding disruptive digital innovations in healthcare.

Type of barrier	Barriers	Business model	Process	Product	Service
Data-related	Data security and privacy	Y	Y	Y	Y
	Data quality	Y	Y	–	–
	Information access barriers	–	–	–	Y
	Data governance and accountability	–	Y	–	
	Data breach and data safety regulation	–	Y	–	Y
User-related	User acceptance	–	Y	–	–
	Uncertainty about patient outcomes	–	Y	–	–
	Perceived cost and risk	–	Y	–	Y
	Care-giver resistance				Y
	Patient anxiety	–	Y	–	–
	Patient privacy	Y	Y	–	–
	Patient profile	–	–	–	Y
	Product efficacy (drug)	–	Y	–	–
	Sample biasness	–	Y	–	Y
Organizational	Lack of leadership support	–	Y	–	–
	Organizational and provider inertia	–	–	–	Y
	Poor change and project management	–	Y	Y	Y
	Traditional work model	–		Y	Y
	Communication	–	Y	–	–
	Lack of customization				Y
	Training of trainer	–	Y	–	–
	Lack of shared commitment				Y
	Clearly defined roles		Y		
Ecosystem-related	Macro-business factors	–	Y	Y	Y
	Lack of in-person contact	–	Y	Y	Y
	Stakeholder resistance (professional bodies)	–	–	Y	–
	Resistance from service provider	–	Y	–	
	Lack of standardization	Y	–	–	–
Policies and regulations-related	Judicial aspects concerning system failures	–	Y	–	
	Lack of regulations		Y		
	Approval from accreditors	–	Y	–	–
Strategic orientation-related	Technology development strategy	Y		–	–
	Complexity and dynamics of service space	Y	Y	Y	Y
	Governance model	–	Y	–	–
	Boundary misalignment	Y	–	–	–
	Innovation implementation	Y	Y	–	–
Resource/ infrastructure constraints-related	Poor resource asymmetry	Y	–	–	–
	Technological constraints	–	Y	–	Y
	Skilled staff	–	Y	Y	–
	Limited functionality of technology	–	–	–	Y
	Inter-operability	–	Y	–	
	Lack of funding	–	–	–	–

tional (training of trainer, poor fit with existing work schedule, role clarity among team and accountability, lack of follow up communication, lack of administrative support, cost-effectiveness, poor change management); ecosystem-related (clinical factors, lack of in-person contact, poor linkage among various stakeholders, political, economic, institutional, social and cultural factors); policies and regulations-related (legal issues, lack of regulations on various aspects such as drug testing, lack of approval from accreditors); strategic orientation-related (governance model, complexity and dynamics of service space); and resource/infrastructure constraints-related (technological constraints, diverse devices, operational issues, expertise of staff and staff-to-patient ratio).

4.2.3.3. Barriers and products. Our analysis revealed several barriers and challenges that the existing scholarship identified as the key impediments to product-related outcomes of DDI implementation in healthcare. Specifically, the reviewed studies identified the following barriers: the complexity of service space, privacy, speed, and security (McBee and Wilcox, 2020), overdiagnosis and poor tailoring of treatment and pushback from primary care professional bodies (Rushforth and Greenhalgh, 2020), poor change management (Nguyen et al., 2015), and lack of in-person contact and socio-cultural factors (Castro e Melo & Araújo, 2020).

These barriers can be placed under five of the seven aggregate dimensions as follows: data-related (privacy, speed, and security); organizational (poor change management); ecosystem-related (pushback from primary care professional bodies, lack of in-person contact, socio-cultural factors); strategic orientation-related (complexity of service space); and resource/infrastructure constraints-related (overdiagnosis and poor tailoring of treatment).

4.2.3.4. Barriers and services. Moving further, we evaluated the studies to synthesize the barriers that past studies had identified in the context of service-related outcomes of DDI implementation in the healthcare space. The key barriers observed to exist were time, effort, and lack of shared commitment (Gilbert Hunt, 2017; Hans et al., 2018), political, economic, institutional, and socio-cultural factors (Castro e Melo & Araújo, 2020; Mukherjee, 2021), lack of in-person contact (Castro e Melo & Araújo, 2020), information access barriers, limited functionality of technology, and organizational and provider inertia (Steele Gray et al., 2018), poor change and project management and a lack of customization in services (White, 2009), complexity and dynamics of the service space (McBee and Wilcox, 2020; Virtanen et al., 2016), privacy, security and speed (McBee and Wilcox, 2020; Garrety et al., 2014), patient profiles (Jung and Padman, 2014), perceived financial cost and risk (Arfi et al., 2021), poor fit with existing work schedule and care givers' resistance (Hans et al., 2018), and technological constraints and sample biasness (Sahu et al., 2020).

From the perspective of the seven broad types of barriers, the identified challenges can be thus classified: data-related (information access barriers, privacy, security, and speed); user-related (sample biasness, time, effort, patient profile, perceived financial cost and risk, and care givers' resistance); organizational (poor fit with existing work schedule, lack of shared commitment, lack of customization in services, organizational and provider inertia, and poor change and project management); ecosystem-related (political, economic, institutional, socio-cultural factors, and lack of in-person contact); policy and regulations/strategic orientation-related (complexity and dynamics of service space); and re-

source/infrastructure constraints-related (limited functionality of technology, technological constraints).

5. Gaps and the path ahead

We undertook research profiling and thematic analysis of the identified studies as guided by the research objectives, research questions, and the conceptual framework defining the scope-related boundaries of our study. Such close analysis not only allowed us systematically to synthesize the state-of-the-art in the area, but also helped us form a critical view of its limitations and how, going forward, the visible gaps in the amassed knowledge can be addressed to make the literature robust and useful. We discuss here the said gaps and suggest potential paths to address them. The recommendations are in no way exhaustive, but they are sufficiently comprehensive to motivate and support research in the area. Since there are visible gaps in the research from both profile and thematic perspectives, we have bifurcated the discussion accordingly: (a) research gaps and the path ahead from the profile perspective and (b) research gaps and the path ahead from the thematic perspective.

5.1. Research gaps and the path ahead from the methodological perspective

From the perspective of profiles, as evidenced by the limited number of studies shortlisted for review, research on implementational aspects of DDIs in the healthcare sector is scarce and narrow, supporting our contention that the area needs additional impetus to accelerate academic research, not only to keep it apace with practice but also to support it with novel inputs for future expansion. A look at the list of publishers reveals that congruent studies included in the review have been published in journals from leading houses as well as standalone bodies/associations. Such expression of interest by prominent publishers confirms the relevance of the topic, encouraging future research in the area. The diversity of geographies covered is also a cause for concern, with most of the studies remaining focused on developed countries, resulting in an unequal representation of economies. One of the reasons for the inclination of scholars to examine developed countries could be that these are the countries that would have taken the pioneering initiative to implement DDIs in healthcare. Nonetheless, there are many other countries where DDIs are being implemented at an appreciable pace, such as India, and there is an exigent need for scholars to examine such developing geographies with their unique challenges, opportunities, and cultural moorings.

It is also obvious from the research profile details that the area is still in a state of methodological nascency as it is largely focused on exploratory investigations. Thus, there is a need to stimulate methodological maturity of research in the area, such that robust and deeper insights are made available. For example, researchers can use mixed-method approaches to collect longitudinal data for analysis to better explicate the changes in perception about enablers and/or barriers.

To its credit, the existing scholarship has sampled an appreciable variety of units of analysis, which can serve to guide future researchers quite meaningfully as they conceptualize their study and research designs. However, a closer look reveals that the sample size in most cases, particularly in the studies that employed a qualitative approach, is quite small, raising concerns about the universality and robustness of the findings. There is, therefore, a specific need for future inquiries to draw larger, more representative samples to offer robust findings that can make the literature in the area more useful for theory and practice.

The last aspect that we examined as a part of our research profiling was the spread of the reviewed studies across the four DDI implementation/outcome categories. Our analysis revealed that, while the authors have attempted to examine all four categories, most of them have focused on only one, whereas business complexity can be better captured by looking at all four or at least two categories (e.g., services and business models) in tandem. This has resulted in linear insights that can make limited contributions to practice. A summary of research profile-based gaps is presented in Fig. 5.

5.2. Research gaps and the path ahead from the thematic perspective

The findings of our thematic analysis confirm that the reviewed literature has reasonable coverage in terms of the four DDI implementation/outcome categories—business models, processes, products, and services. However, from the perspective of all three thematic dimensions—theories, enablers, and barriers—the insights are limited, offering testimony of an under-explored area and exploratory beginnings.

First, from the theoretical perspective, while it is evident that several theories have been utilized to explain and describe the four DDI implementation/outcome categories in healthcare, the theorization is very fragmented, lacking generalization, robustness, and contextual continuity. One of the key issues is that none of the studies in the area have tried to build upon prior findings or extend the insights generated using a particular theory. The resultant evidence is, thus, a disconnected set of findings, which does little to guide further research or practice.

The gaps exist in the extent of theorization within the four categories as well, which warrants a deeper discussion of each of the categories separately. To begin with, in the case of business model-related outcomes, at a glance, the available insights appear to be rich and spread across varied contexts. However, when juxtaposed with the size of the sector and the variety of healthcare verticals, not to mention the pace of digital transformation observed in recent times in the healthcare sector (e.g., Iyanna et al., 2022), the lens used and the contexts covered can be easily called limited and rather narrow. Several visible gaps persist in this regard. For instance, certain business model aspects that have remained unaddressed by a sound grounding in theory are the medical supply chain, health solutions for health policy, digital transformation, and emerging business models for early adopters.

Similar gaps are observable in the case of the other three categories, where insights were quite limited to begin with. In the case of process-related outcomes, our analysis suggests outcomes such as care delivery, cost minimization, clinical system information rollout, collaboration and knowledge transfer, information sharing, and e-health record keeping in particular have remained unaddressed so far from a theoretical perspective. In a similar vein, product-related outcomes such as drugs for different specialties, patient-care products for critical care, imaging, and wearable devices to name a few pertinent ones have also not been considered. Finally, a lack of theorization is apparent in service-related outcomes as well. To identify some crucial ones, there is a lack of theory-driven research on service outcomes such as occupational therapy, outpatient diabetes care, automated drug dispensing system, tracking of medical devices, nutrition care, and patient data sharing.

Coming to the second theme, a similar narrowness is observed, as is evident from Table 3. To begin with, the enablers of business model-related outcomes identified and the types they can be categorized into are limited, with the literature ignoring a large set of enablers. We sug-

Fig. 5. Research profile-based gaps.

gest that future studies should take into consideration the role of institutional enablers such as leadership and organizational culture, infrastructure-related enablers, and product/service-related enablers that can directly impact business model outcomes. Moving on to the enablers of process-related outcomes, while the reviewed studies have identified one or more enablers under each of the five broad types—institutions, actors, infrastructure/resources, products/services, and partnerships—the enablers attributed to each type are very small in number and do not provide much input for practice. Further studies are required, with an intense focus on one of the five categories such that more fine-grained insights are generated. The gaps are even more noticeable in the case of product-related outcomes, where enablers coming under the partnership category have not been examined at all, and others, such as those under the infrastructure/resource category, are examined in a very narrow manner. In a similar vein, the enablers of service-related outcomes under all five categories remain under-examined, with the product/service-related enablers remaining completely ignored. Furthermore, since human behavior is a key aspect of enablers, more behavioral studies examining how various stakeholders perceive and respond to the changes in the business models, processes, products, and services brought about by DDI implementation in the healthcare sector can be useful for managers to increase the diffusion of these innovations.

The third and last theme/perspective was related to the barriers impeding the implementation of DDIs in the healthcare sector. As in the case of the preceding two themes, we examined the conceptualizations and insights by dividing them across the four outcomes and further classified the barriers under seven broad categories. Some key observations in this regard are that the business model outcomes-related challenges are the second least examined challenges after product outcome-related barriers, as is evident from the entries in Table 4. Going into further detail, it is evident that barriers to business model outcomes coming under the organizational, and policies and regulations-related categories have not been examined at all, revealing a visible gap in the literature. Next, we critically evaluated the barriers inhibiting process-related outcomes and observed that the majority of barriers coming under the identified seven categories have been examined to an appreciable extent. However, the existing scholarship has left the barriers inhibiting product-related outcomes noticeably underexplored, with barriers under the two categories, user-related and policy and regulation-related, remaining completely ignored, and those under three categories—organizational, strategic orientation-related, and resource/infrastructure constraints-related—considered only superficially. Similarly, the barriers obstructing service-related outcomes have been examined in a very limited manner, with policy and regulation-related barriers remaining totally unexplored.

Conclusively, research on the implementation of DDIs in the healthcare sector is still in its early phase, and impetus is required to spur its growth organically by highlighting the visible gaps.

6. Conclusion

Using a structured and systematic approach to review congruent literature on the diffusion of DDIs in the healthcare sector, our SLR is among the pioneering efforts to synthesize, consolidate, and critically evaluate the available studies. The primary objective of our study was to review the congruent research base in the area to provide a sound platform for potential future extension of insights. To present our findings systematically and reproducibly, we sought to address two specific research questions, one related to the evolution of research from an operational perspective, and the second related to the conceptual orientation of the underlying literature. We employed the SLR approach to address these research questions. Before applying the approach, we set the scope and conceptual boundary of our study by proposing a conceptual framework comprising four outcomes—business models, processes, products, and services—and three themes: theoretical perspectives, enablers, and barriers. We executed our SLR by following five distinct steps, including the definition of research objectives, identification of keywords for literature search, specification of inclusion and exclusion criteria, short-listing of congruent studies, and their content analysis, to address the research questions. Our analysis yielded many interesting findings that can help accelerate the pace of research in the area. Particularly, the critical analysis of the findings helped identify visible gaps in the amassed evidence and set future research agendas. The study offers many interesting theoretical and practical implications, which are discussed below.

6.1. Theoretical implications

The first contribution of our analysis is the consolidation of theorization of the DDIs in healthcare (i.e., tracing and locating the theoretical frameworks relevant to this field of research). For example, our analysis has determined that many theories—strong structuration, the programmed and error theory of aging, the actor-network approach, the unified theory of acceptance and use of technology, neutrosophic theory, the technology adoption model, service-dominant logic, the diffusion of innovation and normalization process theory, the disruptive innovation framework, simulation learning, the health technology assessment framework, change management theory, top management team theory, the STOF framework, neo-institutional theory, and the design perspective—have been used while studying DDIs in healthcare. These findings indicate the existence of theoretical diversity in the field as is evident from the fact that the different innovation outcomes have used different theories; for example, service outcomes used the technology acceptance model, the products category used the actor-network approach, and business models used the top management teams theory. This conclusion from our study will help future researchers in selecting the relevant theories for studying various outcomes of digital innovations. Also, it is interesting to note that service-dominant logic and the technology acceptance model were used repetitively in one innovation outcome—services. This suggests that, at least in the service outcomes of digital innovations, some degree of generalization exists, which provides an avenue for theoretical generalizations in other innovation outcomes, too.

Second, our review identified the enablers of DDIs in healthcare and also structured the identified enablers in a typology: institutions, actors (users, providers, other stakeholders), infrastructure/resources, products and services, and partnerships/collaborations. This finding may help future researchers to design their research inquiries in a more focused and clearer way. Our analysis specifically linked the typology of enablers with the innovation outcomes; for example, institutional category enablers are found to be linked strongly with process outcomes. This clustering consolidates the key enablers and their roles in various outcomes of DDIs in healthcare and provides a guiding structure for further inquiries.

Third, our study also clustered various barriers and challenges of disruptive digital innovations in healthcare. These categories of barriers and challenges are data-related, user-related, organizational-related, ecosystem-related, policy and regulation-related, strategic orientation-related, and resource/infrastructure constraints-related. This know-how may be helpful for scholars in selecting the category of barriers and challenges with a particular digital innovation's outcome. For example, the policy and regulations-related category of barriers is linked strongly with processes, and there is a need to test these with product outcomes, too.

6.2. Practical implications

The findings of our systematic review also offer implications for the potential for practice. First, the study findings are of great importance

for practitioners who are interested in digital innovations in healthcare and medicine. As an example, our study has listed the possible enablers and barriers of DDIs in healthcare. Our study listed several institutional, actor-related, infrastructure-related, product and service-related, and partnership-related enablers of DDI outcomes. For example, leadership, information and knowledge sharing, strategic orientation, involvement of service providers and users, and institutional collaboration are found to promote almost all types of digital innovation outcomes, such as products, processes, services, and business models. Organizations, practitioners, and policymakers may utilize this understanding in promoting the outcomes of digital innovations in healthcare.

Next, our analysis also presents the barriers and challenges of DDIs in healthcare in a structured manner. The identified barriers and challenges are categorized as data-related, user-related, organizational, ecosystem-related, policy and regulation-related, strategic orientation-related, and resource/infrastructure constraint-related. Knowing about the barriers and challenges of a DDI in healthcare may help interested stakeholders in developing strategies and interventions in overcoming those barriers and mitigating the challenges. For example, data-related challenges such as data security, data privacy, and data governance in digital healthcare have become much more important than ever; thus, concerned stakeholders may use this information appropriately. Consequently, practitioners should comprehend the topic of data governance and invest in developing related educational and training programs. Similarly, knowing a user's related barriers and challenges may help practitioners in resolving those challenges by taking appropriate actions such as enhancing users' awareness, reducing sample biasness, and so on. In addition to this, the findings of this study can help organizational leaders in the healthcare sector in designing strategies for promoting disruptive innovations. For example, our findings suggest leadership support is an important enabler of DDIs. Conclusively, our findings may be utilized for enabling the digitalization of healthcare.

6.3. Limitations

Although this paper contributes in several ways, it is not free from the conventional limitations of reviews. First, this paper follows a predecided protocol for the selection and retrieval of the data set and the process has its own advantages; however, sometimes this may dilute the focus of analysis. Second, the present analysis is largely structured around the DDI outcomes framework, and more research could be undertaken using other analysis criteria.

Data availability

Data will be made available on request.

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