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**TOPICAL REVIEW**

The Impact of Digital Platforms and Ecosystems in Healthcare on Value Creation—A Integrative Review and Research Agenda

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ABSTRACT Enabled by technological innovations and the pressure to modernize healthcare systems, the digital transformation is fundamentally changing the healthcare sector. It facilitates strategic alignments that drive significant changes to the creation of value of organizations, as well as to their stakeholders in the sector. One manifestation of this development is the advancement of digital platforms and ecosystems into the sector, impacting established practices. Because of the sector's low level of platformization, discussions in healthcare have yet to profoundly engage with the impact of these digital architectures. This study provides insights on the ways digital platforms and ecosystems are changing the nature of value creation in healthcare. Based on a literature review, four distinctive changes to the value creation of the sector are identified. Based on the results, lessons from other domains, and the specific dynamics of technical advancements at the intersection of information science and healthcare, an agenda for future research is proposed. This agenda takes social and ethical discussions into consideration and is intended to guide academic discussions to further leverage digital formats to foster collaboration, cooperation and cooptation.

INDEX TERMS Digital ecosystem, digital health, digital platform, digital transformation, healthcare 4.0, value creation.

I. INTRODUCTION

The healthcare sector is one of the most critical economic and social parts of societies [1]. It is subject to constant pressure from political, economic and social forces, which historically led to incremental improvements of internal processes, yet at a slow rate and diffusion [2]. The increasingly uncertain and complex landscape, e.g., fueled by climate change caused pollution, migration, and deteriorating environmental conditions facilitating the transmission of diseases, is forcing the healthcare sector to adapt at an unprecedented rate [3], [4].

The digital transformation is one of the main drivers of innovation in the healthcare sector [5]. It is defined as “a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity

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technologies” [6], it continues to change entire industries, and facilitates new business models while challenging old ones [7]. In healthcare, the digital transformation is promised to drive clinical outcomes, cost saving initiatives, and the transformation of the provision of services [8], [9], [10]. Yet, scholars highlight that the results on the sector still haven't materialized [11]. The inherent disruptive nature of technological advancements, like telemedicine and digital health oversold and underdelivered for the past two decades [12].

In this regard, recent studies criticize the strict focus of the sector on the technological aspects of new solutions, while neglecting a holistic view on the impacts of digital transformation on the organizations themselves and the ecosystems they are operating in [13], [14]. Consequently, scholars have argued that the healthcare sector lacks a profound engagement with its technologies, which leads to scarce research on their impact on processes, organizations, and ecosystems [15], [16]. A mind-shift of the stakeholders involved in the

healthcare sector is required to address the ongoing redefinition of the meaning of health [17].

Similar to technology-driven transformation processes in manufacturing, commonly referred to as Industry 4.0, the healthcare sector is increasingly adopting digital platform- and ecosystem-based technologies and business models [18]. Here, digital platforms and ecosystems are seen as necessary means to orchestrate the exchange of data inside the healthcare system as a non-platformized sector [18], [19], [20]. However, because of the multi-dimensional nature of digital platforms and ecosystems, the expansion of these kinds of entities into the healthcare sector poses new challenges. Due to the sensitive nature of health data, the centralistic hyperscaler effect of platform business models is increasingly viewed with a critical eye [21]. As the sector continues to move towards complex interacting multi-sided markets, discussions on appropriate measures to avoid monopolistic and profit-maximizing tendencies are intensifying [22]. In this regard, concepts such as data spaces, federated data ecosystems, and platforms in healthcare are at the forefront of discussions on the common good perspective on healthcare data, privacy, and trust [23], [24].

This study aims to re-connect academic discussions on healthcare technologies with the complexities of the healthcare sector. Its contribution is two-fold. For one, this study answers the research question: How are digital platforms and ecosystems redefining the value creation in the healthcare sector? On the other hand, based on the results, a research agenda is proposed that outlines research directions that should be addressed to further facilitate the digital transformation of the healthcare sector with regard to digital platforms and ecosystems.

II. BACKGROUND

A. DIGITAL TRANSFORMATION IN HEALTHCARE

The digital transformation is initiating significant changes to a target entity through the strategic leverage of digital technologies and other key resources and capabilities [6], [25]. This highlights the wide-ranging impact of digital transformation and the imperative need to consider whole value networks instead of single organizations [26]. Enabled by ecosystem alignments, the co-creation of value among various stakeholders, e.g., by resource exploitation, coopetition, and the use of (digital) platforms [27], fundamentally changes the provision of services and goods.

When referring to the digital transformation in the healthcare sector, scholars often use the term Healthcare 4.0. It is characterized by the utilization of modern technologies like artificial intelligence, Internet of Things (IoT), and cyberphysical systems to enable real-time customization of healthcare for patients [28]. At its core, Healthcare 4.0 is based on a predictive medicine approach, that derives decisions from the analysis of large amounts of data and the collaborative efforts of various actors [29].

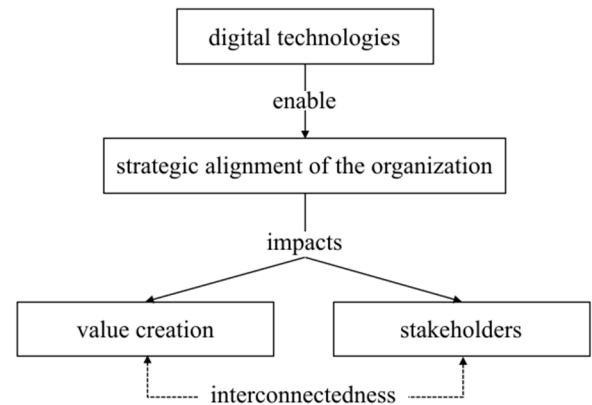


FIGURE 1. Conceptualization of the interdependencies of digital transformation, own representation.

Drawing on these conclusions, the outcome of digital transformation can be described as the strategic alignment that drives significant changes to the creation of value of an organization, as well as to its stakeholders. Because of the interconnectedness of these two, complementarities and interdependencies allow for unique forms of value creation. The interdependencies of the characteristics of digital transformation are shown in Figure 1.

Based on a different analysis [30] and focusing on the most essential stakeholders in the healthcare system, the effects of digital transformation on value creation in healthcare can be described as follows. Patients are experiencing a technology-enabled growth of influence in the sector. Healthcare providers are increasingly relying on intermediary actors for their value proposition and to facilitate patient interaction. These intermediaries introduce capabilities in managing and distributing relevant data toward different entities into the system [31], interconnect various stakeholders, and drive new ways of value creation. Payers are expected to pursue increased influence over these intermediaries in order to leverage vast amounts of data, even as emerging technologies pose challenges to their existing business models. Governing institutions regulating the healthcare sector are increasingly facing challenges from new entrants in the sector and have to adopt new metrics that are able to assess the overall effectiveness of the healthcare sector.

More detailed insights on the effects of digital transformation on the value creation and relationships among stakeholders in the healthcare sector are reported elsewhere [30].

B. DIGITAL PLATFORMS AND ECOSYSTEMS IN HEALTHCARE

The healthcare sector comprises a wide variety of heterogeneous actors involved in the complex creation of value and the reimbursement procedures [32]. In addition, its highly regulated nature [33] and entry barriers have led to marginally successful introductions of platform-based business models [34]. However, current discussions on necessary improvements

of healthcare systems and corresponding political measures have led to an increasingly favorable environment for the introduction of digital platform- or ecosystem-based solutions [35].

Accordingly, scholars are calling for a digital infrastructure across national borders to integrate research data with real-world datasets [36]. In this context, digital platforms and ecosystems are seen as appropriate means to facilitate cooperation and collaboration [15]. Based on experiences from other domains, they are expected to address two major problems in the provision of healthcare: the fragmentation of healthcare services and the lack of innovation [37].

While data spaces, federated data ecosystems, and platforms are leading discussions on decentralized structures in healthcare, the platformization of healthcare is still in its infancy [38]. Consequently, the conceptualization of ‘open’ platforms is limited by the relatively low maturity of such solutions within the sector [39]. To further advance the digital transformation and the adoption of digital platforms and ecosystems, it is imperative to comprehend the mechanisms through which these constructs generate value within the healthcare sector. This study aims to contribute to the research at the intersection of digital platforms and ecosystems and healthcare by examining the mechanisms of value creation in the sector. Subsequently, future research endeavors should be guided by these insights.

III. METHODS

To answer the research question, an integrative review methodology, commonly used to synthesize the literature on emerging topics and to conceptualize them initially or preliminarily [40], [41], was chosen. The following sections are structured along the stages of the integrative review process of Whittemore and Knafl [42].

A. LITERATURE SEARCH

An initial pilot search to assess the feasibility of the literature search revealed that potentially relevant articles referred to the phenomenon of digital transformation in healthcare as “Health Care 4.0”, “Healthcare 4.0”, or “Health 4.0”. The search term had to combine the domains of healthcare and digital transformation via the terms “Health Care 4.0”, “Healthcare 4.0”, and “Health 4.0”, complemented by the terms “health*” and “digital transformation”. Furthermore, terms like platform or ecosystem were avoided as the results of the pilot search indicated that these units of analysis of this study are sometimes referred to in a more abstract fashion. Accordingly, the search term (*health* AND digital transformation*) OR “Health Care 4.0” OR “Healthcare 4.0” OR “Health 4.0” was used and adjusted for the syntax requirements of the respective databases.

B. DATABASES

The bibliographic databases Web of Science (WoS), PubMed, and Dimensions.ai were used during the literature search.

WoS was chosen because of its large coverage of academic literature and its ability to serve as a principal resource in literature search, PubMed also qualifies as a principal resource and supplements WoS with an additional coverage of medical related resources [43], [44]. Lastly, Dimensions.ai adds a larger dataset [45] straddling additional conferences and outlets on information science.

C. INCLUSION AND EXCLUSION CRITERIA

First, practical criteria were defined. Articles must be written in German or English language, but no limitations regarding the date of the publication were defined. Despite the surge of high-quality publications on digital transformation after 2010 [5], the pilot search revealed that only a limited amount of search results published before 2010 could be expected which allowed for the inclusion these results with reasonable effort.

Further inclusion and exclusion criteria were derived from the research question. Eligible results must refer to the digital transformation in the context of the healthcare sector. These results must describe strategic changes of an entity in the healthcare sector to the value creation with its stakeholders and be initiated by digital platforms or ecosystems.

D. DATA EVALUATION

Despite the literature search methodology of Whittemore and Knafl [42] recommending a data evaluation stage, no quality appraisal methods, like quality checklists, were used. Hence, no evaluation was performed. The preliminary pilot search indicated that information of interest for this article (insights on how digital platforms and ecosystems are redefining the value creation in the healthcare sector) are expected to not be the main element of studies of interest, but rather a byproduct. That is why the relevance (thematic fit of the study) and rigor were used to judge the fitness of the results [46]. The reasoning behind this approach was to incorporate inputs straddling different research streams and encompass a heterogeneous array of study designs, rather than exclusively focusing on studies that adhere to specific methodological standards [47], [48].

E. DATA ANALYSIS

The results were analyzed with an inductive driven grounded theory-based methodology [49]. With the help of the data analysis software MAXQDA, relevant identified text segments were first open coded in vivo, followed by an axial coding stage. This led to an aggregation of the text-segments into higher-order categories. Lastly, selective coding systematically ensured proper relationships between the findings and a sound conceptualization of the topic. All while abiding concepts like theoretical sampling and inductive reasoning [50].

F. DESCRIPTIVE RESULTS

2505 records were identified through the database search. After removing duplicates, the titles and abstracts of

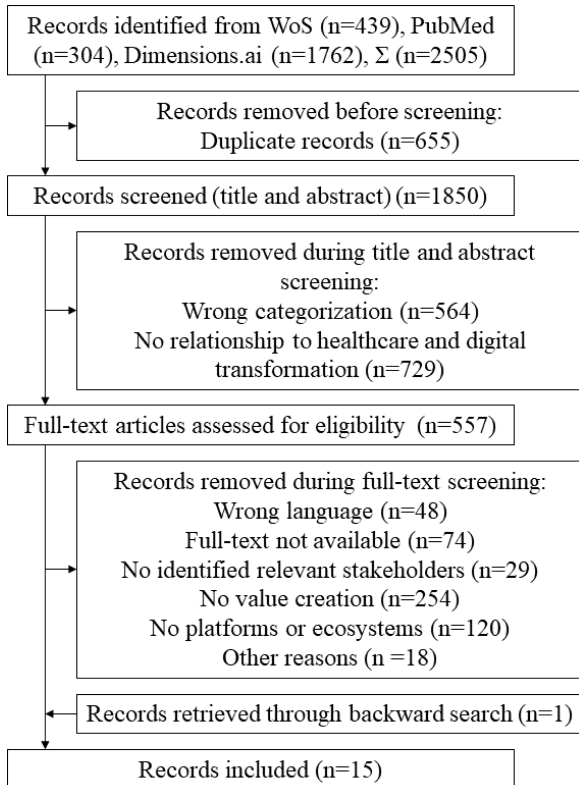


FIGURE 2. Literature search process.

1850 records were screened and 1293 records were removed. 557 records were assessed full-text. The final sample consisted of 15 titles, including one title that has been identified through backward search. Figure 2 summarizes the literature search process according to the PRISMA statement [51].

IV. RESULTS

During the assessment of full-text records, it became evident that the vast majority of publications on digital platforms and ecosystems in healthcare do not view these architectures as means to alter the value creation inside the system. The focus lies predominantly on the digitalization of existing interventions or procedures, rather than fundamental improvements of the provision of healthcare. Only few scholars recognize the effect on value creation inside the healthcare system, which are subsumed under the following four distinctive areas of change.

A. PLATFORM-ENABLED EMPOWERMENT OF PATIENTS

The effect of the continuing advancement of platforms, enabled by the digital transformation, is expressed in the increased engagement of patients in the medical care process. Via established mobile and wearable technologies, patients are able to collect large quantities of healthcare-related data [52]. With digital platforms as a central resource with advanced data collection capacities, formerly highly fragmented data can now be aggregated. Processing and analysis capabilities of platforms allow patients to monitor their health

journey in real-time [53]. For the first time, patients are provided the necessary means to engage actively in care processes.

The empowerment of patients is also characterized by the ability to evaluate health-related data. Traditionally, physicians' authority partially rests on an asymmetry of knowledge [54]. They possess a special body of knowledge that is not readily accessible to patients [55]. Via the provision of pre-processed and easily understandable data, knowledge inequalities in the physician-patient relationship can be mitigated [56]. For one, expert systems are able to detect anomalies and direct patients to proper professional care. On the other hand, patients are able to make informed decisions whether they want to engage in care processes. They evolve from purely consumers of medical treatments into prosumers [22]. With the control and availability of large quantities of data as a strategic advantage, patients are able to choose from a plethora of services and channels [18]. Enabled by digital technologies and intermediaries, such as digital platforms, they co-create value for the healthcare system in cooperation with healthcare providers [22].

These changes alter the nature of value creation inside the healthcare system. The balance of power is shifting towards empowered consumers. This forces other actors to adapt their business models to offer solutions catering to well-informed patients willing to divide parts of the treatment process between physical and digital actors.

B. PATIENT SELF-TREATMENT

As a logical implication of the increased empowerment, patients begin to carry out more and more profound aspects of the treatment process themselves. Illustrating an ophthalmology setting, Kim et al. [57] highlight tools for assessment and treatment of conditions, such as glaucoma where patients are able to perform tasks related to the measure of visual acuity.

The enablement of patients via platform capabilities even goes beyond the actual treatment itself. With IoT devices tracking bio samples, vital signs, rehab progress, and medication intake, observatory tasks of the treatment process are allocated to the patient's sphere of responsibility. Prospectively, related information streamed to family members or tele-carers could trigger further actions. [58]

The body of literature of the included records suggests that patients, as the focal actors in the treatment process, are increasingly performing adjunct tasks related to tele-consultations or long-term treatment processes with periodic monitoring of health conditions. This fundamentally changes the nature of value creation inside the healthcare system. Not only are parts of the value creation provided by patients themselves, other parts of the treatment process are divided across a multitude of entities.

C. STRATEGIC USE OF KNOWLEDGE AND DATA BY PROVIDERS

Healthcare providers have already recognized the potentials of digital platforms for their businesses. They are

thus evaluating ways to realize the strategic and commercial value of their knowledge and data [59]. Yet current responses of providers to the growing possibilities of digital transformation in healthcare are mainly centered around the improvement of existing procedures of treatment processes.

In the literature, limited perspectives are given for strategic changes to providers of medical treatments, enabled by digital platforms. Articles that do, however, highlight the interconnection of medical devices and other sources of medical data, like patient-generated and participatory data, via distributed digital platforms [60]. With the integration of multiple sources, the assessment of patients, can be performed in a dynamic and near real-time fashion [3]. The value creation of providers is increasingly becoming proactive in nature. This integration of data allows for the monitoring of patients in formerly uneconomical ways. Automated solutions based on digital platforms can predict critical conditions in patients and alert medical staff [61]. As this kind of close monitoring previously would have preoccupied large quantities of the workforce, providers are able to broaden their offering of medical services in this area.

This way, platforms are not only simplifying existing tasks, but also boost efficiency and allow providers to offer additional services. All by reducing time and costs for providers [62].

Prospectively, some providers could see their positions in the medical value chain reduced to a diagnostics and therapy initiating center [31]. With an increase in patient empowerment, providers unwilling to adapt to new technological advancements like digital platforms might lose essential parts of their value creation to other actors.

D. PLATFORM-FACILITATED ECOSYSTEM VALUE

By the provision of technological building blocks to develop new products and services, digital platforms are transforming the healthcare sector into platform-mediated ecosystems [22]. These building blocks are used by complementors to develop new products and services [63]. The value creation is also altered by the decoupling of data, applications, and business processes from legacy systems [64]. Via a closely linked system of suppliers of products and services [65], the value creation inside the ecosystem is co-created on these platforms providing a comprehensive case management [66].

V. DISCUSSION

This study provides insights on how digital platforms and ecosystems facilitate the digital transformation by redefining the value creation in the healthcare sector. Based on a literature review, four key areas of changes in value creation were identified. Three of those are located on the patients' and providers' sides, as these two are the focal actors in the healthcare sector, one is referring to changes in the whole ecosystem.

The results, however, indicate that the healthcare sector still only shows a low level of maturity regarding the

implementation of digital platforms and ecosystems in value creation processes. Despite the wide adoption of digital platforms and ecosystems in other domains, where firms exploit these architectures to efficiently develop, configure, and deliver advanced services [67], literature in the healthcare sector does not yet engage in these kinds of discussions on a broader scale. Nielsen and Sahay [15] argue that digital interventions and medical technologies differ regarding their flexibility and their rate in which they are changing. Digital platforms are therefore to be seen as constructs that require recurrent reevaluations and revisions to keep up with real-world dynamics. Yet, healthcare-related digital platforms have so far been unable to create the necessary capabilities to facilitate extensive improvements to the provision of healthcare.

One reason for these shortcomings might be the lack of connection of digitally-enabled interventions with outcome-focused measures [68]. Existing concepts like the quadruple aims of healthcare (improved population health, enhanced patient experience, cost reduction, and improved provider experience) [69] are yet to be integrated into investigations on the benefit of digital measures. This void of tools and frameworks to assess the impact of digital solutions in general, and more abstract concepts like digital platforms and ecosystems specifically, might disincentivize actors to further adopt innovative technical solutions based on digital platforms. As described by Leone et al. [66], digital platforms and other co-created assets are unlikely to add to the value generation of actors in the healthcare sector if the mechanisms of digital platforms and ecosystems are insufficiently connected with appropriate measures.

As the healthcare sector's entrance barriers are among the highest of all sectors, factors beyond the capabilities of the individual platform's capabilities must also be considered. The centralized nature of most platform architectures introduces vulnerabilities into the value chain. As for the operational and technical side, centralized digital platforms are subject to a single point of failure [70]. Even with efficient operating models, the general lack of a connected digital health infrastructure across borders [36] still limits digital platforms in their abilities. In addition, the architecture design of such platforms incentivizes platform owners to design governance rules according to their own best economic interests, as soon as they gain a dominating position in the market. The economic effect of "winner takes all" [21] does not facilitate improvements inside the healthcare system to the best of all actors in the system.

Recent discussions in healthcare are therefore considering different architectures as appropriate means to advance the digital transformation of the sector. Data spaces and federated data ecosystems provide architectural conceptualizations that are able to mitigate known risks in digital platforms.

For one, the issue of data ownership and privacy in digital platforms is apparent. Under most regulatory stipulations, it is currently impossible to integrate electronic medical records of major medical institutions [71]. Data spaces and federated

data ecosystems provide frameworks that require the definition of standards that allow for the integration of data from a multitude of sources. They also actively promote that data remains stored at their sources. Conclusively, a freedom of choice in technology is promoted, that reduces the negative influences of strong dependencies from proprietary, black-boxed technologies.

This study is subject to certain limitations. The literature search yielded only a small number of results that actually connect digital platforms and ecosystems in healthcare with a changing value creation. While platforms are an established construct in the sector, many results focus on incremental improvements of existing procedures or mere descriptions of technological characteristics, rather than fundamental changes in value creation. Also, by choice of search terms, the search results had to be classified as digital transformation- or Healthcare 4.0-related.

To mitigate the aforementioned limitations and to provide an alternative perspective on the subject matter, further investigations could analyze existing or piloted digital platforms and ecosystems. Based on a multiple case study-approach, archetypes of such constructs could be used to empirically derive novel mechanisms of value creation in healthcare.

VI. RESEARCH AGENDA

Contrary to expectations, the healthcare sector was so far unable to adopt more disruptive methods of value creation, as seen in other domains. Research shows that such changes require holistic modifications of existing social, economic and governance models [72]. The dynamics of technical advancements at the intersection of information science and healthcare pose a challenge to social and ethical discussions. Research on information science and healthcare can benefit from cross-discipline efforts on digital enabled formats that foster collaboration, cooperation and competition. Following this line of argument and the results from this study, the following avenues of further research are proposed.

A. RESEARCH DIRECTION #1: PRIVACY AND DATA OWNERSHIP

As the healthcare sector is already changing into multi-sided markets constructs [22], the inter-sector division of labor between physicians, caregivers, therapists etc. challenges existing ways of privacy and data protection. Growing complexities necessitate regulatory models that account for these new realities. Research shows that privacy concerns are an important barrier to the adoption of new technologies by patients and are influenced by the perceived data sensitivity, trust in data protection, and the individual disposition to value privacy [73]. However, the use and re-use of data is essential for regulatory and medical research. This trade-off between legitimate but conflicting interests between the societal perspective for the common good and the individuals' perspective of privacy and fair compensation for the provision of data [74] has not yet been addressed properly. So far, the right of patients to control their own health data is not yet

implemented sufficiently. As the results from the literature search suggest, patients could leverage the strategic advantage of the portability of their own health data to stimulate competition between healthcare solutions and providers. This new perspective on health data ownership and handling could improve the access to and quality of care delivery. Future research should target appropriate legislative, operational, and technical models that ensure the portability of health data, even across borders.

B. RESEARCH DIRECTION #2: TRUST-GENERATING MEASURES IN HEALTHCARE DATA HANDLING

To allow patients to put trust in digital platforms, the architectures of these constructs need to be designed accordingly. Digital platforms are not only passive intermediaries for sensitive data, but active parties in the definition of privacy [75]. As demonstrated by Handler et al. [76], insufficiently designed healthcare monitoring systems can raise serious security and privacy issues. The healthcare sector is subject to ongoing discussions on the application of information and communication technology, namely patient privacy, confidentiality and anonymity, data security, and informed consent [77]. The current state of research suggests that platform architecture principles from other domains are unable to address the needs of the healthcare sector. Conceptualized as contextual integrity by Nissenbaum [78], privacy expectations of patients depend upon complex contextual and situational norms. Next to sufficient answers to privacy and data ownership, trust generating measures in the very design of digital platforms are needed to further advance their adoption. This also includes questions regarding the ownership and governance of the platform. While the concepts of data spaces and federated data ecosystems provide conditions facilitating trust in digital data exchange, research on specific design principles is still in its infancy. Future research should investigate trust building privacy by design principles in digital platforms and ecosystems in healthcare. Here, the intertwining of structural and legislative composition of such platforms is of particular interest.

C. RESEARCH DIRECTION #3: BUSINESS MODELS FOR DATA-BASED VALUE CREATION

With the vanishing relevance of linear value chains, actors in healthcare are forced to re-evaluate their position in the value network. Research indicates that actors are generally struggling to recognize a redefinition of the value proposition and relationships of and between the main actors in the healthcare system, and the reconfiguration of the organizational, structural, and technological elements in line with the long-term business objectives [79]. Ecosystem- and platform-enabled opportunities allow for novel ways of data-based value creation in healthcare. Yet, this view on the interrelations of ecosystems and business models of focal firms seems to be unexplored in academic discussions in healthcare [80], despite its relevance demonstrated in other settings and

domains [81]. Future research should focus on the domain-specific technical, legal, and organizational conditions in healthcare and how the growing availability of data can be leveraged into ecosystem-enabled business models for focal firms. New entrants, and small and medium-sized enterprises (SMEs) in particular, are provided with a variety of opportunities to establish themselves in the value network, previously hampered by linear value chains.

VII. CONCLUSION

Digital platforms and ecosystems are expected to play a major role in the digital transformation of healthcare systems, yet solutions exhibit a low level of maturity. Current discussions are neglecting the widespread potentials of these constructs. Disadvantageous effects on entities in the sector like strong dependencies from black-boxed technologies might explain the reluctance to embrace digital platforms. By answering the research question “how are digital platforms and ecosystems redefining the value creation in the healthcare sector?”, this study aimed at exploring the areas of change in value creation of these digital constructs in the healthcare sector and to propose a research agenda.

Four distinctive changes of value creation could be identified. First, a platform-enabled empowerment of patients is manifested in the ability to self-reliantly assess their health data and status. Second, patient self-treatment leads to patients increasingly performing adjunct tasks related to teleconsultations or long-term treatment processes with periodic monitoring of health conditions. Third, the strategic use of knowledge and data by providers is expected to unlock efficiencies, but also alter the position of some providers within the medical value chain. Fourth, platform-facilitated ecosystem value via the development of new products and services, decoupling data, applications, and business processes from legacy systems.

To advance the introduction of digital platforms and ecosystems into the healthcare sector, further cross-discipline research at the intersection of information science and healthcare is needed. The research agenda proposes three directions, namely privacy and data ownership, trust generating measures in healthcare data handling, and business models for data-based value generation.

The aforementioned four distinctive changes fuel the shift in power dynamics within the system. Not only in bilateral relationships among actors, but also within the entire value creation network. The research agenda indicates a way ahead for data-based value creation in healthcare. Researchers are advised to further engage in these avenues. Practitioners offering value propositions in the sector are urged to devise solutions in these areas to seize opportunities in light of current dynamics and to favor their own business endeavors. Ultimately, the specific requirements of the sector might even lead to the leapfrogging of traditional platform concepts in favor of data space- and data ecosystem-like federated constructs.

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