Fundamental Research 4 (2024) 961–971

Contents lists available at ScienceDirect

Fundamental Research

journal homepage: http://www.keaipublishing.com/en/journals/fundamental-research/

Review

Intelligent health in the IS area: A literature review and research agenda

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ARTICLE INFO

Article history:
Received 18 October 2022
Received in revised form 15 April 2023
Accepted 25 April 2023
Available online 11 May 2023

Keywords:
Intelligent health
IT impacts
Service innovation
Research agenda
e-Health
Online health communities
Mobile health

ABSTRACT

As the global demand for healthcare services continues to grow, improving the efficiency and effectiveness of the healthcare ecosystem has become a pressing concern. Information systems are transforming the healthcare delivery process, shifting the focus of healthcare services from passive disease treatment to proactive health prevention and the healthcare management model from hospital-centric to patient-centric. This study focuses on reviewing research in IS journals on the topic of e-health and is dedicated to constructing a theoretical model of intelligent health to provide a research basis for future discussions in this field. In addition, as the innovation of intelligent healthcare services has led to changes in its elements (e.g., an increase in the number of stakeholders), there is an urgent need to sort out and analyze the existing research.

1. Introduction

The digitalization of healthcare has become a hot topic in information system (IS) research in recent years, leading to a number of studies on the subject [1]. Researchers believe that increasing the integration of information, technology, people, and connectivity will increase the efficiency of healthcare professionals and improve patient health [2]. The COVID-19 pandemic has also helped to usher in widespread acceptance of digital health products, which has fundamentally transformed the healthcare industry [3]. For instance, according to a report from McKinsey & Company, "Telemedicine consultations in Germany increased significantly with the onset of the COVID-19 pandemic, from fewer than 3,000 in 2019 to 2.7 million in 2020"[1]. In China, in the first six months after Baidu launched its "Ask a Doctor" service, more than 300,000 consultations were conducted daily, and 4.2 million consultations were conducted cumulatively[2]. Thus, the pandemic may amplify healthcare digitalization in the long term, which provides interesting avenues for future research.

A number of review papers have been published in the IS domain regarding the digitalization of healthcare, examining how information systems can impact healthcare delivery [1,4-6]. For instance, Agarwal et al. [4] surveyed studies of health information systems (HISs) such as electronic health records and proposed that prior studies mainly focused on exploring the factors influencing HIS adoption and how investment in HIS affects medical performance (e.g., financial cost, quality of care). Furthermore, healthcare services are undergoing significant transformation due to the emergence of external players, particularly technology companies that provide services such as fitness trackers and patient monitoring software in hospitals. Thus, Ostern et al. [1] extend healthcare contexts to include mobile health (mHealth), health information exchanges, online healthcare communities (OHCs), and services that alter customer expectations and may result in significant interventions. These authors also present a corresponding research agenda by reviewing IS publications relevant to their focal topics.

From these review papers, it appears that HIS is continuously updating our understanding of how healthcare is delivered and gradually driv-

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[1] https://www.mckinsey.com/industries/life-sciences/our-insights/germanys-ehealth-transformation-makes-good-but-uneven-progress#0.
[2] https://www.cn-healthcare.com/articlewm/20200211/content-1087401.html?appfrom=jkj.

https://doi.org/10.1016/j.fmre.2023.04.008

ing this process. For example, online platforms have enabled a shift from a physician-centric to a patient-centric healthcare delivery scenario [7]. In recent years, advanced technologies (e.g., Internet of Things, sensors, artificial intelligence) have also been gradually integrated into HIS, driving dynamic data collection, management, and analysis, and supporting the transfer of information across stakeholders in the healthcare delivery process. This change will further expand our understanding of the impacts of information technology on healthcare delivery. It is imperative that we develop a solid foundation for future e-health research by updating our understanding of intelligent health and how intelligent technologies will transform the healthcare domain. It is thus essential to have a comprehensive understanding of prior research on e-health and of the technology evolution in the healthcare field.

This study presents a literature review of papers on healthcare related topics in the IS and medical informatics field. By analyzing the existing literature, this study presents a concept of intelligent health that covers most applications of e-health technology. It also sorts out the development of information systems applications in healthcare and presents a research agenda focused on intelligent health. Specifically, intelligent health is a dynamic and iterative health management process that uses diverse information technologies to support information exchange among stakeholders in the healthcare service process and significantly influence the learning, compliance, and feedback behaviors of stakeholders to achieve the goals of the management process. In addition, this study constructs an information-service-management research model that can be used to map the progress of intelligent health research in the IS field. This study will provide a theoretical foundation and, more importantly, a practical research framework for future research.

This study provides insights for IS researchers into both the development of the healthcare field and the impacts of information systems on it, as well as providing a research foundation for further exploration in this area. This study systematically examines the IS field's exploration of healthcare topics and the exploration of e-health topics in medical informatics. This study also combines the current state of intelligent technology development with the state of the healthcare industry to suggest feasible future research directions, offer viable guidance for future research and practice, and provide a solid research foundation for the development of healthcare ecosystems.

2. Medical care and intelligent health

An analysis of the literature on e-health shows that the concept of e-health is changing with the development of technology and is changing from "electronic health" to "intelligent health". To understand intelligent health, we propose two dimensions involved in this concept: stakeholders and IT affordances. Stakeholders refer to the people in the healthcare delivery process, including physicians, patients, families, communities, government, and technical assistants. IT affordances refer to the possibilities and opportunities for action arising from the involvement of actors in a focused technology [8]. Affordability theory proposes that each environment contains specific affordances or possibilities that trigger specific actions, which may vary depending on the characteristics of the environment and the actors [9]. Therefore, when we discuss intelligent health's relationship to IS, we define it as the ability, mediated through the interaction of a technological object with the user, to guide the user to take a target action [10,11].

Based on a systematic analysis of the literature related to HIS and the research framework of Barrett et al. [12], we identified three IT affordances in healthcare: *connecting, social,* and *sensing and collecting*. Specifically, as IS applications in healthcare began to develop, HIS and telemedicine bridged the *connections among physicians and patients inside and outside hospitals* to meet patients' needs for efficient healthcare services and access to quality healthcare resources in an infinite amount of time and space [13]. As Internet technologies have developed, social has been added to connectivity by *creating social networks between users*

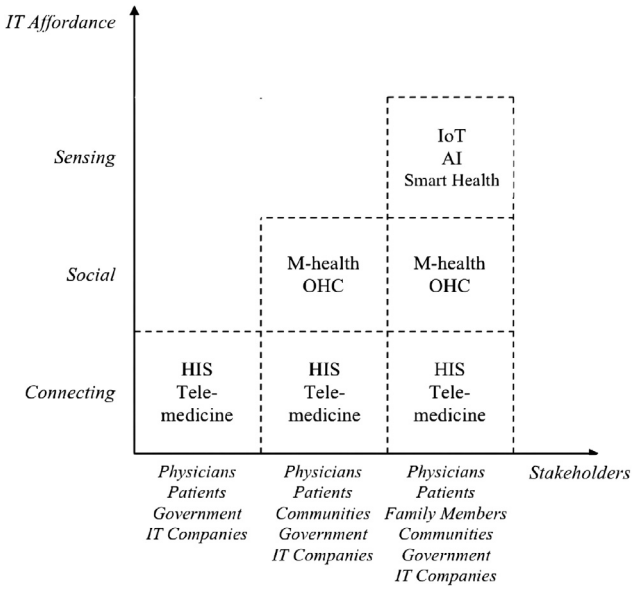

Fig. 1. The development process of intelligent health.

(*physicians and patients*) so that through mHealth and OHCs, patients can access health information and socialize with other users [14,15]. This affordance has also enabled HIS to engage more stakeholders, such as family members, community members, and government and IS employees, in the healthcare delivery process [16]. Then, as patient demand for personalized healthcare has increased, *sensing and collecting* are being added to e-health services to enable intelligent capabilities in healthcare delivery by providing users with services like intelligent diagnosis and personalized recommendations [17].

Fig. 1 depicts the evolution of HIS. With the evolution of stakeholders and IT affordances in healthcare services, we classified the development of HIS into three stages: Stage 1: emphasis on healthcare data connection and exchange, Stage 2: emphasis on stakeholder communication and exchange, and Stage 3: emphasis on intelligent services. Throughout this development process, the empowerment of healthcare services via the advanced technologies has resulted in the maturing of the idea of intelligent health, and we can observe in the third stage that the scenarios in intelligent health have gotten more diverse as the variety of IT affordances and stakeholders grows. Technologies, such as telemedicine, the digital hospital, and e-health, will serve as the foundations and key components of intelligent health. However, intelligent health is a more complex concept that goes beyond the integration of intelligent technologies into healthcare systems and services. Thus, based on above, the intelligent health in this study refers to the HIS applications in the third stage.

It is important to note that the concept of intelligent health in a narrow sense is limited to studies related to the application of intelligent technologies (e.g., machine learning) in the healthcare, while the concept of intelligent health in a broad sense is used in this study, which covers the application of diverse information technologies in the healthcare and emphasizes more on the affordances achieved by HISs, e.g., data analysis through a large amount of EMR data to predict variables related to quality of care; discussing the impact of personalized medical services provided by mHealth, etc. Therefore, we based on the two dimensions mentioned above define intelligent health as *a dynamic interaction iterative process of health management using diverse information technologies that collect, manage and analyze health data to support information delivery among stakeholders in the health service process, significantly influencing stakeholders' learning, adherence and feedback behavior in order to achieve health management goals.* Compared with traditional medical treatment, intelligent health has some distinct characteristics including integrated healthcare systems with rich connections among multiple

stakeholders, personalized healthcare services based on health big data, and intellectualization among the whole standard process of subdivided medical treatments. Despite the importance of intelligent health, there are several issues that still need to be addressed to develop it, resulting in several challenges for its development and application.

3. Methods

A scoping review of literature is conducted in this study in order to identify knowledge gaps in intelligent health, scope a body of literature, clarify concepts of intelligent health, and investigate research methods [18]. To conduct this study, we used a method involving interrelated stages of searching, screening, and analyzing the content [1]. In the search stage, the scope of the literature review is described, in the content screening stage, the papers are selected, and finally, in the content analysis stage, we can extract the most relevant topics from the papers. Below, we provide a more detailed description of these three stages.

3.1. Searching

In this study, the search method used by Ostern et al. [1], the hermeneutic approach, was adopted to more comprehensively, systematically, and effectively identify intelligent health-related papers in the literature. This method improves the quality and criticism of scholarship and research by emphasizing the importance of reading and the dialogical interaction between literature and readers. We first searched the web of science using the keywords “digital health” and “electronic health” and filtered the search results based on title, abstract, and keywords to initially identify a set of 30 papers as the initial dataset. We then expanded and refined our keywords by reading these papers. During the subsequent reading of the papers, we repeated the process of comparing the keywords in the papers with the latest keyword sets and adding them if they were relevant to our research question (intelligent health in IS research). All authors of this study discussed the set of keywords obtained using this method until a consensus was reached.

We finally obtained two keyword sets for searching in the IS and medical informatics literature, respectively. Since IS research is cross-disciplinary research focused on information systems [19], we searched by medical health keywords to obtain a more comprehensive view of e-health research in IS, with the keyword set of “healthcare/health, hospital, online health community, m-health, telemedicine, doctor/physician, patient, and chronic disease”. Since medical informatics itself focuses on the intersection of IT and health/medical topics, this study used keywords related to different HIT applications to obtain more comprehensive search results, like “electronic health, ehealth, mobile health, health apps, techhealth, healthcare services, healthcare informatics, medical informatics, health data”. Accordingly, this study could obtain the development history of e-health research through the analysis of e-health related papers in IS literature, to understand how e-health developed into intelligent health.

Given our initial research questions and the scope of the review, we began by searching for papers in Web of Science over a period of 20 years (2003 to 2022). We used the above keywords to search for papers in the dataset. To provide insights for future research in the IS domain about e-health topic, we reviewed studies published in a basket of eight IS journals (i.e., *EJIS, ISR, ISJ, JAIS, JIT, JMIS, JSIS, MISQ*)[3], well-regarded journals following analysis of ref. [1] (e.g., DSS, I&M[4]) and journals from health informatics area (e.g., JAMIA, Lancet Digital Health, BMC Medical Research Methodology[5]). Following the creation of a dataset and the removal of duplicates, 5,042 publications were left to be evaluated in the searching stage.

3.2. Content screening

We first excluded any papers that did not meet our criteria, such as papers that were abstract-only papers, research-in-progress papers, panel formats, or workshop formats, research notes, editorial material, letters, as well as papers without direct thematic reference to our research objective. We also excluded the papers unrelated to the information systems, like the research question of career options for healthcare professionals in the context of new technologies. We believe that such issues do not interact directly with the information systems and, therefore, are not included in this literature review. After screening, we obtained 1,483 papers and proceeded to review the full text of each one. It is important to note that this study use the broader concept of intelligent health. It describes a dynamic interaction iterative process of health management using diverse information technologies that collect, manage and analyze health data to support information delivery among stakeholders in the health service process. Thus, we exclude the papers only discussed the HISs with simple information storage or exchange functions, such as primary hospital information systems or health information exchange systems. But the studies related to hospital information systems with advanced functions (e.g., data analysis, visualization or predictions) are included in our review. Afterward, content screening resulted in the reduction of the number of papers to 402. We then read these papers to determine the context and technology used in the studies. Appendix A provides a detailed description of the paper selection process. Appendix B shows the number distributions of publications in the journals reviewed in this study.

3.3. Content analysis

The review papers in the previous literature provided a general understanding of the literature, which enabled us to analyze and interpret the data. Accordingly, we classified the 402 included papers using meta-synthesis integrated content coding and analyzed their specific content according to the method described in Ostern et al. ’s study [1]. Specifically, two authors labeled papers based on research focus, observation level, model, and method. After reviewing the results of the research focus, three main research aspects were identified and synthesized: design and method development, patient and physician attitudes and behaviors, and HIT evaluation and impact. As an example, in design and method development, we include ‘software design for electronic health records’, ‘predictive models for adverse drug reactions’, ‘screening for depression symptoms’, and ‘detection models for automated adverse event and medical error detection’. Furthermore, we reviewed the papers in each category and identified themes, main topics, types of HIT, and significant findings, as shown in the following section.

4. Intelligent health: information-service-management model

Based on the review findings and on our definition of intelligent health, we identified three focuses of studies in prior literature, namely, intelligent information systems, medical services, and health management. Fig. 2 illustrates how these three components combine to form the intelligent health literature. We then propose a conceptual framework including three management elements, namely, information system management, service management and societal impacts, to further understand the main research focus of e-health domain and construct the foundation for future research.

- Information system management focuses on the health data analytics, healthcare system design and management issues related to health data, information and systems. By building connections among systems, data, and people, this research stream aims to increase information value, IT efficiency, and accuracy when applying

[3] The basket of eight IS journals includes *MIS Quarterly* (MIS), *Information Systems Research* (ISR), *Journal of Management Information Systems* (JMIS), *Journal of the Association for Information Systems* (JAIS), *Journal of Strategic Information Systems* (JSIS), *Journal of Information Technology* (JIT), *European Journal of Information Systems* (EJIS), and *Information Systems Journal* (ISJ).

[4] DSS: Decision Support Systems; I&M: Information & Management.

[5] JAMIA*: Journal of the American Medical Informatics Association.

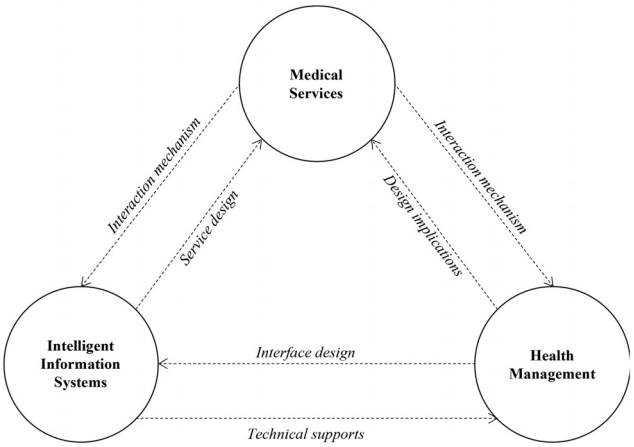

Fig. 2. Dynamic system of intelligent health.

IT artifacts to medical and healthcare practices, which could build the technical foundation for future studies.

- The service management stream focuses on how stakeholders gain benefits during the interaction process of intelligent health services. The implementation of information technology leads to a shift from physician-centered to patient-centered medical services, which increases the power of social connections and stakeholder interaction in influencing attitudes and behaviors, resulting in potential social, economic, and medical value in healthcare systems. Thus, the objective of this research stream is to explore paradoxes that occur during the service process in an intelligent healthcare environment, paying more attention to the antecedents and consequences of physician-patient interaction behaviors.
- Societal impacts research examines how HIT affects societal problems related to healthcare management (e.g., tense relationships between physicians and patients). A growing number of stakeholders are interacting with new medical and healthcare services, leading to studies that focus on the social impact of these services, bringing a more holistic approach to understanding the impact of intelligent health. Therefore, in comparison with studies in the service management stream, which look at interactions between stakeholders, this stream focuses on research topics relating to changes in HIS at the organizational and community levels.

Consequently, the relationships between intelligent information systems, medical services, and health management are dynamic systems in the sense that intelligent information systems provide technical support for medical services and health management, medical services provide interaction mechanisms, and health management provides guidelines for IT design and service provision for the other two elements. As shown in Fig. 2, these three elements are dynamically interconnected.

4.1. Information and system management in intelligent health

Prior studies in this stream mainly discussed clinical and healthcare intelligent design, health information exchange, privacy concern and information security.

4.1.1. Clinical and healthcare intelligent design

It is important to note that in the early stages of HIT implementation, there are numerous issues relating to the design of the IS, which lead to discussions regarding how to improve the effectiveness of an HIS and its efficiency of implementation. Prior studies have aimed to provide HIS designs that can aid with a particular disease, such as personalized treatment plans for breast cancer [20] and smart asthma management [17]. Further, considerable discussion has focused on ways to utilize emerging technologies for health management, such as how to create virtual communities for patients, mobile health services for self-management, and in-home diabetes management systems using IoT and sensor-based technologies [21–24]. Also, the concept of information infrastructure indicates a shift in focus from discrete information systems to expanding assemblages of closely related systems [25]. As a result, studies can provide valuable insights into how to design information infrastructures.

In addition, accumulated health data and intelligent technologies provide opportunities for healthcare innovation that can support clinical decision making for personalized and preventive care by identifying risks in healthcare delivery or self-management processes. For instance, Lin et al. [26] developed a Bayesian multitask learning model that enables healthcare providers to achieve multifaceted risk analysis, and the model can reduce the risk of future adverse health events in patients. Similarly, clinical intelligence systems can predict medical performance in hospital or other stakeholder activities. For instance, Bardhan et al. [27] developed the beta geometric Erlang-2 (BG/EG) hurdle model, a novel predictive analytics model that predicts the propensity, frequency, and timing of readmissions of patients diagnosed with congestive heart failure. Intelligent technologies have also been used to address the fraud, waste, and abuse that are significant issues in healthcare industries, particularly when it comes to third-party payers such as Medicare. For instance, Bouayad et al. [28] proposed a generalized linear mixed model with multitask learning and stochastic time series processes to identify fraudulent activities and thereby reduce excess healthcare costs.

4.1.2. Health information exchange

There has been significant interest in health information exchanges in both academic and industrial areas of healthcare, primarily due to their potential impact on cost reduction and quality enhancement for healthcare services [29]. Patient health records are fragmented, and they cannot be exchanged between healthcare systems [30]. This has resulted in a significant increase in healthcare costs and reduced quality of care. Research on this topic has indicated the importance of establishing health information exchange (HIE) platforms and sustainable HIE networks [31–33]. Researchers have also empirically examined the relationship between HIE and healthcare cost reduction [29]. Furthermore, while the importance of implementing an HIE within healthcare systems has been widely acknowledged, effective integration of HIE with internal systems is essential to obtaining the expected performance benefits [34].

4.1.3. Privacy concern and information security

Within the emerging context of healthcare digitalization, electronic health records (EHRs) constitute a significant technological advance in the way medical information is stored, communicated, and processed by the multiple parties involved in healthcare delivery [35]. Despite the expected value potential of this technology, there is widespread worry that consumer privacy concerns may hinder its popularity [36]. Studies have also highlighted the potential negative impact of privacy issues on health information systems; for example, individuals' privacy concerns can affect the information framework of health information systems and thus patients' attitudes or behaviors in using health systems [36]. Therefore, although health information technology has increased the accessibility of healthcare data and benefited medical research and healthcare management, patient privacy issues remain a concern and issue to be addressed when sharing healthcare data.

Thus, healthcare privacy and information security are currently intensively studied in e-health research in the IS field. Specific topics include the drivers of disclosing personal health information [37–39], how to strengthen information security through health information ex-

change design [40–42], and information security policy views [43,44]. For instance, Anderson and Agarwal [39] proposed that the relationship between privacy concern and people's willingness to provide access to their personal health information is influenced by the information type, intended purpose, and requesting stakeholders, as well as their emotional status. To protect patient health information, Li and Qin [41] proposed a new systematic approach to extract, cluster, and anonymize medical text records by including a recursive partitioning method to cluster medical text records based on the similarity of the health and medical information and a value-enumeration method to anonymize potentially identifying information in the text data rather than simply detecting and removing patient identifiers from it. Further, studies have discussed the determinants of patient information breaches, including IT strategies or IT investment (e.g., meaningful use attestation, the adoption of HIT) and individual characteristics (e.g., professional subcultures) [40,42]. Finally, several studies have explored the effectiveness of the consequences of organizational privacy efforts, providing policy insights for effective security programs in complex healthcare environments.

4.2. Service management in intelligent health

Intelligent health service aims to improve service quality and satisfaction and increase the organization's competitiveness in healthcare markets. Mobile health applications, for example, may collect users' health data (e.g., exercise, sleep data) through wearable devices for personalized health interventions. OHC allows for personalized doctor recommendations based on patient needs. The directions of prior studies include the adoption of intelligent health services, the interaction process, and value creation among stakeholders.

4.2.1. Health services adoption

Studies in this stream have discussed stakeholders' behavior in adopting healthcare services, such as physicians' adoption or resistance behavior regarding OHC and m-health services [45–48], as well as patients' adoption behavior regarding OHC, and m-health services [49,50]. Studies initially discussed the determinants of physicians' intentions or adoption behaviors regarding HISs, like EMR and COPE, through the mechanisms of cognitive factors (e.g., usefulness) [48], affective factors (e.g., IT anxiety) [45], and social influence [46]. With the emergence of advanced Internet capabilities, studies then investigated the determinants of HIT adoption (e.g., telemedicine, online health community, mobile health) from more diverse perspectives, such as multi-users (e.g., service providers to patients), multi-channels (e.g., online to offline), and diverse IT artifacts (e.g., gamification).

4.2.2. Service process management

Empowered by advanced Internet capabilities, online health platforms (e.g., online health community, m-health, social media in healthcare) enable professionals to share high-quality health information [51] and offer healthcare consultation services; they allow patients to share their experiences [15] and this communication can decrease tensions between physicians and patients [14]. However, online platforms can also lead to inequities in the healthcare delivery process, which in turn can affect the quality of the physician-patient relationship. Liu et al. [14] empirically examined the causal relationship between physician-patient behavior in online healthcare communities and the benefits of this collaborative relationship in terms of improving interpersonal relationships between patients and physicians. Physician-patient interactions in online healthcare communities are not limited to medical services or medical decisions, but they may also have spillover effects on their non-transactional behaviors, such as effects on physicians' knowledge-sharing [52] and patients' online reviews [53]. As technology has developed, new issues have emerged in the healthcare delivery process; for example, AI has the potential to become a healthcare provider, but it is unclear how the addition of AI will affect healthcare delivery. Accordingly, recent studies have mostly discussed issues related to dynamic doctor-patient interactions from the dual perspectives of physicians and patients, including the antecedents and consequences of doctor-patient interactions and the dynamic interaction process.

4.2.3. Stakeholders and value co-creation

Online health platforms have the potential to become a channel for value exchanges among stakeholders in the healthcare delivery process. These exchanges could affect patients' cognitive status (e.g., health knowledge, health awareness) [54], improve their emotional state or perceptions (e.g., patient satisfaction), generate economic value for providers (e.g., financial performance, financial rewards) [55], reshape providers' reputations (e.g., gifting, online ratings) [56], and improve patient health status (e.g., well-being) [14], thereby benefiting stakeholders in the healthcare delivery process. It has been shown that exchange behavior among healthcare stakeholders in online healthcare communities can be a potential resource for solving problems in medical practice.

4.3. Societal impact in intelligent health

Research in this direction discusses the social impacts of adopting intelligent health technologies from three perspectives: hospital management, self-management, and public health. First, intelligent health technologies can improve hospital management problems by optimizing the process of healthcare delivery. Second, intelligent health technologies can provide technical supports for people self-management. Finally, intelligent health technologies can optimize the allocation of healthcare resources and provide technical support during public emergencies (e.g., COVID-19).

4.3.1. Medical process optimization

Patients face practical problems in accessing medical care, such as complex diagnostic and treatment processes, high treatment costs, and inefficient services. These also lead to inefficiencies in hospital management, such as high operating costs and low quality of care. Therefore, studies in this stream focus on the question of how intelligent IT could improve the effectiveness and efficiency of medical services. By collecting data related to hospital operations and quality of care, studies have posited that applying intelligent technologies in hospitals could reduce financial cost [31], medical errors [57], and readmission, and it could also increase hospital operational efficiency (e.g., bed turnover, responsiveness) through the information transfer in the healthcare system [58–62]. Intelligent technologies could also help hospitals improve their reputation or gain a digital advantage [63,64].

4.3.2. Personal self-management and patient outcomes

The synergistic characteristics of intelligent health can help eliminate physician-patient communication barriers and improve physician-patient relationships, but its mechanism of action is still unclear. Focusing on the question of how intelligent IT can alleviate tension between physicians and patients and improve patients' health status, studies have provided evidence that intelligent technologies are great potentials for improving patients' health outcomes because they are not limited by the hospital context [65]. Intelligent health services can also satisfy the individualized health management needs of patients with chronic diseases, but there is still a lack of empirical evidence for its medical and economic value, and the corresponding mechanism of action remains to be explored [14]. Therefore, studies have posited that intelligent technologies could support patients' self-management, and their positive behavior (e.g., adherence, use, connecting network) could then influence their health outcomes [14,66,67].

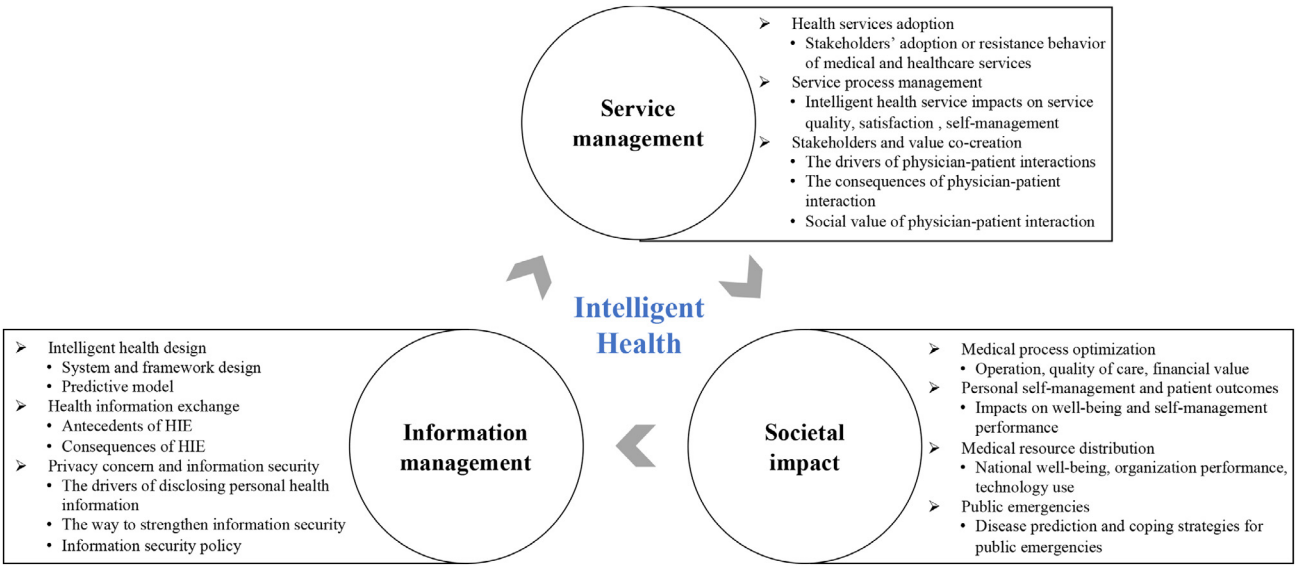

Fig. 3. Review findings on intelligent health.

4.3.3. Medical resource distribution

Regarding the redistribution of medical resources, the uneven distribution of medical resources between regions is a long-term social problem facing China and the world. Focusing on the question of how intelligent IT improves the imbalance of medical resources, studies have posited that intelligent technologies enable the flow of medical resources across various channels through providing medical services (e.g., making an appointment, online consultations) [67–70]. For instance, Goh et al. [71] showed that technology-mediated online health communities are able to alleviate rural-urban health disparities through the social exchange among users. However, there are dark sides to the impacts of intelligent technologies when they are not applied in an appropriate way. For instance, Greenwood et al. [72] found that when technologies are disruptive and force professionals to alter their routines, there is a pronounced exodus from the organization.

4.3.4. Public emergencies

In recent years, COVID-19 has posed significant challenges to public health, resulting in heated discussions about solutions to mitigate the damage caused by disease to national well-being [73]. Many journals have published special issues related to COVID-19 topics, such as the special issue on digital resilience published by *MISQ*[6], which in 2020 featured prospective research on digital resilience in response to major exogenous shocks (e.g., COVID-19). Most of the intelligent health papers in this direction focus on the role of information technology in eliminating the effects of COVID-19 [3], particularly as it relates to people's mental health [74]. Research from the medical informatics literature suggests several methods for tracking, monitoring, and early detection of COVID-19 infection through the mining of multi-source data (e.g., electronic medical record, social media) [75,76]. COVID-19 has also driven the discussion of the impact of online platforms, which have been a dominant channel for people to exchange health information. This research stream implies potential benefits of the use of IT to shape new health behaviors, but these discussions are limited. Fig. 3 is a summary of our review findings.

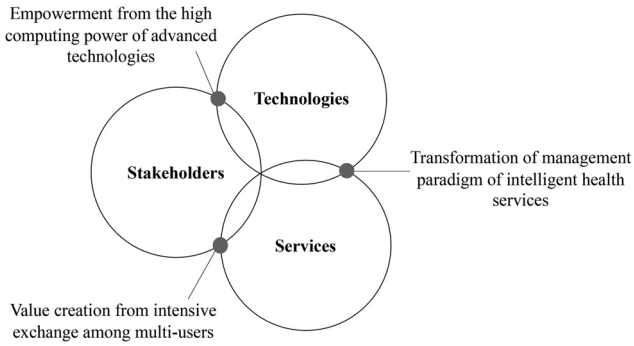

Fig. 4. Relationships among factors in health systems.

5. Lessons and opportunities from the literature review on intelligent health

New context with emerging technologies brings new phenomena and opportunities for e-health research. Specifically, driven by their high computing power, advanced technologies and methods (e.g., machine learning, deep learning) enable researchers to conduct diverse analyses with high analytic performance [77]. Then, as more IT implementation has occurred in the healthcare domain, more stakeholders have been considered in studies. Lastly, the center of health management is shifting from disease treatment to preventive care (health promotion and disease prevention). Therefore, by reviewing published intelligent health studies, we summarize the lessons and opportunities for future studies. These include *empowerment from the high computing power of the advanced technologies, value creation from intensive exchange among multi-users in medical services,* and *transformation of the management paradigm of intelligent health services,* as shown in Fig. 4.

By reviewing papers in the IS and medical informatics literature, we can identify research status on the topic of intelligent health in both fields and thus provide informative insights into each other's future research. In this section, we identified the strength and weakness of medical informatics literature to bring insights for IS studies.

[6] URL: https://misq.umn.edu/skin/frontend/default/misq/pdf/CurrentCalls/DigitalResilience.pdf.

5.1. Empowerment from the high computing power of the advanced technologies

Emerging technologies could power the healthcare domain in two ways: analytic models with high computing power [78] and new practical context with demand differentiation. The popularity of advanced methods enables studies to focus more on quality rather than quantity by using a high volume of objective data, leading to more diverse discussions and accurate explorations [79]. The use of machine learning or deep learning methods to solve problems in healthcare domain has generated substantial discussion in recent years, as introducing such advanced methods into the healthcare domain has enabled researchers use big data to explore healthcare topics in interesting ways, such as analyzing the semantics in health text.

Also in recent years, AI has drawn great attention from researchers, with top tier IS journals including *MISQ* and *ISR* publishing special issues on AI topics [77,79]. Some studies have already discussed the potential benefits of AI in medical detection [80], AI adoption and IT collaboration [77]. In addition to AI, other emerging technologies (e.g., IoT, virtual technologies) have great potential to improve medical performance but have received limited attention in research discussion [22]. Therefore, potential research directions for future development include exploring how such advanced technologies could support chronic disease management or member collaboration in intelligent health management and exploring how virtual technologies can empower gamification design in health management.

Researchers in the field of medical informatics have primarily focused on predicting the risk of disease [75,76] or other variables associated with quality of care [81] by mining data from multiple sources and improving models and algorithms [75,76,82]. Consequently, these studies tend to focus exclusively on the methods and techniques themselves, while neglecting to consider the impacts on human beings. Particularly in the context of AI, the human in the loop is an important research topic. Nevertheless, the medical field differs significantly from other fields in that individual involvement and heterogeneity are even more important. Accordingly, future research should consider user studies both in the field of medical informatics and in the field of information systems.

Medical informatics literature, due to its own medical characteristics, is more specific when it comes to the types of research context than IS literature. The characteristics of the context are often overlooked by scholars in IS research, especially in the e-health direction, where scholars face the dilemma of how to distinguish the medical health field from other context. Medical informatics literature provides an insight into the unique challenges of researching medical context. It acknowledges the complexity of these context and the need to consider the specific medical characteristics of the research context. This insight can be extremely beneficial for IS researchers, as it helps them to better understand the differences between medical and non-medical context. Therefore, the medical informatics literature can serve as a source of information for IS e-health research.

5.2. Value creation from intensive exchange among multi-users in medical services

The benefits of increasing use of HIT have been widely identified in previous studies and proven in various cultures to enhance efficiency, reduce errors, improve patient safety, and generally augment quality of care [4,5]. Motivated by this, many countries have boosted their investments in advanced health technologies, mostly by focusing on the expansion of HIS and online platforms (e.g., online health communities, health apps). With the introduction of these platforms into a complex, pluralistic sector like healthcare, the practices, roles, interdependencies, and communication mechanisms of stakeholders across a range of sectors are being transformed [83]. Hansen and Baroody [83] proposed four roles for stakeholders in clinical environments including *medical professionalism, private sector managerialism, regulatory oversight,* and *technical design*. Based on their explorations and prior studies in the intelligent health literature, we add two roles relying on the whole health management process, *demand side* and *healthcare supporters*. Specifically, in the traditional medical service process, patients passively receive help from caregivers; however, in intelligent health, patients are enabled to actively participate in their health management process through activities such as information seeking and exchange in online environments or self-management behaviors (e.g., diet, exercise). More importantly, online platforms have established relationships among peer patients and other roles, and such social relationships offer a channel for experience and emotional communication that promotes positive health outcomes using a psychological approach. Accordingly, future studies could involve more stakeholders in such exploration, which could establish the foundation for a more holistic understanding of value creation within the healthcare ecosystem [84]. Table 1 summarizes the stakeholders investigated in previous literature.

5.3. Transformation of management paradigm of intelligent health services

Intelligent health management is facing a transformation from disease treatment to preventive care, which is especially important given the worldwide rise in prevalence of chronic diseases and public emergencies and in deaths from them [22]. Based on a WHO report[7], preventive care encompasses two concepts, disease prevention and health promotion. The former refers to action and early detection steps to prevent the onset of a disease and maximize health outcomes. The latter is about empowering people to increase control of their health and its determinants through health literacy initiatives and multisectoral policies to promote healthy behavior.

Based on this definition, we identify the key question as how to predict the risk factors related to diseases or health problems (e.g., tobacco use, obesity, diet and physical inactivity, mental health, injury prevention, drug abuse control, alcohol control, health behavior related to HIV, and sexual health). Therefore, in comparison with the treatment services that have been the focus of most previous studies, the study of preventive care requires long-term, continuous and fine-grained data for predicting risk factors, such as monitoring data on people's regular and frequent activities of daily living [90].

Through this literature review, we find that researchers are gradually transferring their focus from investigating the value of intelligent technologies in medical service processes (e.g., hospitals, telemedicine) [60,61,85] to intelligent health management (e.g., online health consultations, intelligent self-management) [52] and preventive care using intelligent technologies (e.g., risk prediction) [26]. This trend also proves that intelligent technology has the power to improve health outcomes by identifying the risk factors that precede diseases, by promoting positive behaviors for routine health management (e.g., exercise for obesity, diet, and physical inactivity) and by facilitating chronic disease management (e.g., exercise to mitigate complications of diabetes). Similar trends could also be found in medical informatics literature that studies focused more on predicting the health risk rather than disease risk [75]. For instance, Aral and Nicolaides [91] tested the social influence of exercise behavior within a social network, proving the casual impact of social relationships in motivating people to maintain healthy routine behaviors. Another research trend is risk prediction through big data and advanced methods. For instance, Zhu et al. [90] proposed a novel deep transfer learning framework for identifying performed activities of daily life using object motion sensors, and employing sensor-based home monitoring systems within this framework could provide affordable, predictive, preventive, and personalized care to ensure a healthy life for senior citizens [22]. Therefore, future research can consider this shift in the intelligent health management paradigm by focusing on how

[7] http://www.emro.who.int/about-who/public-health-functions/health-promotion-disease-prevention.html.

Table 1
Stakeholders in a healthcare system.

Stakeholders		Research topics or influencing mechanism	Ref.
Medical professionalism	Health service providers	❖ HIT adoption; HIT impacts on medical performance and patient outcomes; providing professional support (e.g., knowledge sharing, suggestions)	[45-48,85-87]
Private sector managerialism/ Regulatory oversight	Insurance providers	❖ The impact of IT on Malpractice Insurance Premium	[88]
	Hospital administrators	❖ HIT investment, deployment strategies	[58–62]
	Private practitioners	❖ HIT adoption; HIT impacts on medical performance and patient outcomes	[89]
	Regulators	❖ Information security; information infrastructure; policy intervention	[16,35]
	Auditors	❖ The impacts of auditing policies	[28]
Technical designers	HIT managers	❖ HIT can improve medical care	
	Vendors	❖ Information integration improves health outcomes	
Demand side	Patients	❖ HIT adoption; how HIT (e.g., use or design) improves self-management (e.g., health literacy, health consciousness, health awareness)	[49,50]
Healthcare supporters	Individuals in social network (e.g., family, friends, peer patients)	❖ Providing emotional support or health experience for patients to increase their psychological status or health outcomes	[15,53,54]

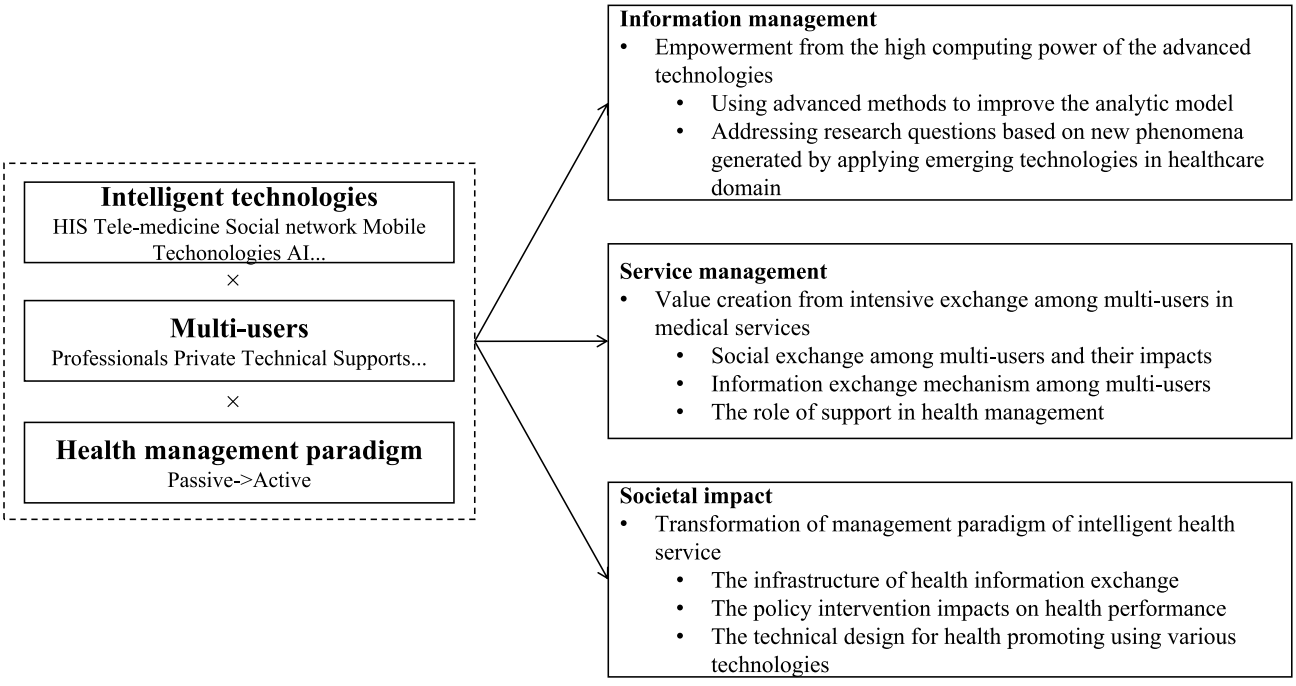

Fig. 5. Review results and future research suggestions.

disease prevention and health promotion can be achieved through intelligent health technologies.

Future directions have been shown in Fig. 5.

5.4. Implications for practice

The proposed intelligent health-based ternary interaction model can prompt healthcare innovation and provide various practical implications for coping with public health management issues worldwide.

Regarding healthcare innovation, the intelligent health services that are emerging from intelligent health technologies could help build a sustainable framework of public health management methods serving people in multiple scenarios (i.e., family, community and hospitals) and throughout their lives. As Fig. 6 presents, in this framework, practitioners can achieve healthcare model innovation, develop personalized health management, and create precise strategies to prevent and control epidemics (e.g., COVID-19). In this process, IT companies and suppliers can provide technical support, and the government serves as a regula-

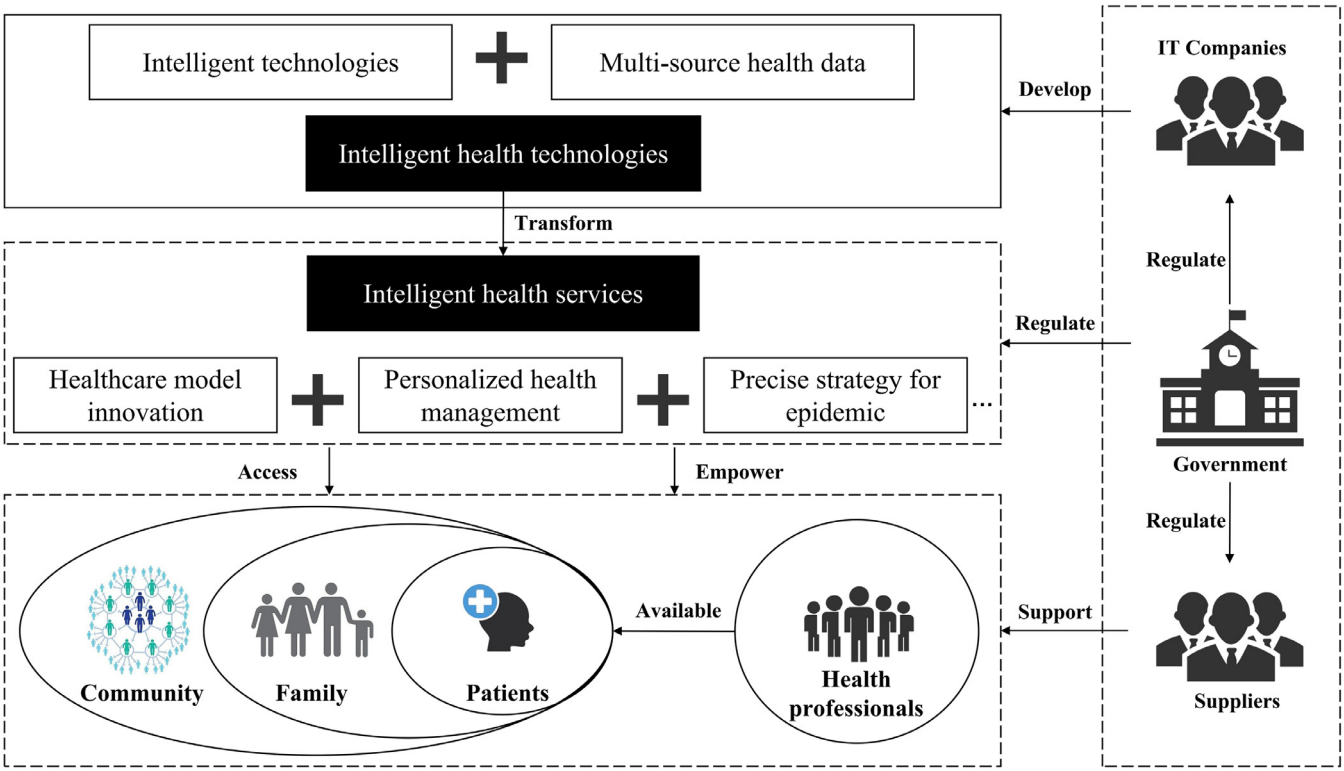

Fig. 6. Intelligent health services in practice.

tor, ensuring the technologies and services meet certain standards and facilitating fair transactions among all participants.

People could then access innovative services that improve their well-being, and these emerging services would also empower the healthcare system. Therefore, practically, our theoretical model for intelligent health services has great potential to address many public health management issues and can provide rich implications for healthcare policymaking.

5.4.1. Health management with multi-party active engagement

Intelligent health services can facilitate multiple parties (e.g., physicians and patients) engaging in health management as well as the establishment of a continuous health management service model covering multiple scenarios in families, communities, and medical institutions. For instance, by establishing an "Intelligent Health + Group Intervention" model, which would facilitate the chronic disease management through online and offline group interventions, group activities, and group incentives, healthcare providers could reduce their costs and improve healthcare productivity. More importantly, this model could increase the popularity of health management as well as improve chronic disease patients' compliance.

5.4.2. Advanced health service with high performance

Intelligent health services can be, compared to traditional healthcare, more personalized and make deeper use of multi-source health big data; thus, the utilization rate of intelligent health services as well as their performance can be greatly increased. As intelligent health technologies can be precise, anthropomorphic and proactive, healthcare providers (e.g., platforms) can develop and design emerging services that are more useful for elderly and chronic disease patients by harnessing these advantages to analyze health big data. For example, platforms can provide people with precise exercise and diet recommendations by using health big data algorithms and models, which can be more persuasive; public health administrations can provide people with chronic disease screening drawing on more accurate algorithms and models; and the medical system can optimize the allocation of nursing resources and provide chronic disease patients with personalized home care.

5.4.3. Robust health monitoring networks for public emergencies

Intelligent health technologies/services can help public health systems better prevent and control public emergencies (e.g., COVID-19) by establishing a robust health monitoring network. Using intelligent health technologies, medical systems can develop comprehensive electronic health record databases that incorporate residents' physiological data, pathological data, medical data, healthcare data, examination data, and genome data, and by combining the database and the trajectory information for a susceptible population, a public health system can achieve normalized and precise epidemic prevention and control. For instance, China has effectively prevented the spread of disease during outbreaks of COVID-19 by examining a resident's health code and itinerary code, providing a successful example for countries worldwide struggling with COVID-19.

5.4.4. Implications for health policymaking

To further increase the sharing, inclusiveness and equity of intelligent health services, governments and health authorities should take initiative to implement policies that can support and regulate the development of the intelligent health industry. For instance, to promote health data sharing, a nation's government and health authority can improve the construction of intelligent health infrastructure and implement policies that encourage the interconnection of information systems. To further ensure the quality of intelligent health, the health authority and related institutions should advance the standardization and precision of intelligent health technologies/services, especially in the fields of primary care, chronic disease management, and health big data, which are particularly important for ensuring patients' safety and the sustainable development of intelligent health. Moreover, given that intelligent health is a promising industry, policies can be made to reallocate social resources for promoting it. Specifically, to facilitate the platformization,

generalization and industrialization of intelligent health, governments can make more policies to introduce or train talent in the intelligent health industry, encourage investment in it, and implement policies like government procurement, tax reduction and exemption.

6. Conclusion

This study presents the development process of intelligent health technology through a review analysis of e-health research in the IS field. It assesses the main lines of existing literature and proposes possible directions for future e-health research in the IS field in conjunction with the development of intelligent technology. This study will help researchers to quickly understand the status of research in the e-health field while allowing for more in-depth consideration of future research.

Declaration of competing interest

The authors declare that they have no conflicts of interest in this work.

Acknowledgments

This study was partially funded by the National Natural Science Foundation of China (72125001, 72293584, 72071054, 72201076, 72201289).

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.fmre.2023.04.008.

References

[1] N. Ostern, G. Perscheid, C. Reelitz, et al.,Keeping pace with the healthcare transformation: A literature review and research agenda for a new decade of health information systems research, Electron. Markets 31 (2021) 901–921.
[2] F.C. Payton, G. Paré, C. LeRouge, et al., Health care IT: Process, people, patients and interdisciplinary considerations, J. Assoc. Inf. Syst. 12 (2011) i–xii Special Issue.
[3] G. Fagherazzi, C. Goetzinger, M.A. Rashid, et al., Digital health strategies to fight covid-19 worldwide: Challenges, recommendations, and a call for papers, J. Med. Internet Res. 22 (6) (2020) e19284.
[4] R. Agarwal, G.G. Gao, C. DesRoches, et al., The digital transformation of healthcare: Current status and the road ahead, Inf. Syst. Res. 21 (2010) 796–809.
[5] R.G. Fichman, R. Kohli, R. Krishnan, The role of information systems in healthcare: Current research and future trends, Inf. Syst. Res. 22 (2011) 419–428.
[6] C. LeRouge, V. Mantzana, E.V. Wilson, Healthcare information systems research, revelations and visions, Eur. J. Inf. Syst. 16 (2007) 669–671.
[7] S. Hamine, E. Gerth-Guyette, D. Faulx, et al., Impact of mhealth chronic disease management on treatment adherence and patient outcomes: A systematic review, J. Med. Internet Res. 17 (3) (2015) e52.
[8] S. Faraj, B. Azad, The materiality of technology : An affordance perspective, Mater. Organ.: Soc. Interact. Technol. World (2012) 237–258.
[9] J.J. Gibson, The Theory of Affordances, Hilldale, USA, 1977.
[10] M.L. Markus, M.S. Silver, A foundation for the study of IT effects: A new look at DeSanctis and Poole's concepts of structural features and spirit, J. Assoc. Inf. Syst. 9 (10) (2008) 609–632.
[11] O. Volkoff, D.M. Strong, Critical realism and affordances: Theorizing IT-associated organizational change processes, MIS Q. 37 (3) (2013) 819–834.
[12] M. Barrett, E. Oborn, W. Orlikowski, Creating value in online communities: The sociomaterial configuring of strategy, platform, and stakeholder engagement, Inf. Syst. Res. 27 (4) (2016) 704–723.
[13] I. Bardhan, H. Chen, E. Karahanna, Connecting systems, data, and people: A multidisciplinary research roadmap for chronic disease management, MIS Q. 44 (1) (2020) 185–200.
[14] Q.B. Liu, X. Liu, X Guo, The effects of participating in a physician-driven online health community in managing chronic disease: Evidence from two natural experiments, MIS Q. 44 (1) (2021) 391–419.
[15] L. Yan, Y. Tan, Feeling blue? Go online: An empirical study of social support among patients, Inf. Syst. Res. 25 (4) (2014) 690–709.
[16] D. Gefen, O. Ben-Assuli, M. Stehr, et al., Governmental intervention in hospital information exchange (HIE) diffusion: A quasi-experimental arima interrupted time series analysis of monthly HIE patient penetration rates, Eur. J. Inf. Syst. 28 (6) (2019) 627–645.
[17] J. Son, P.F. Brennan, S. Zhou, A data analytics framework for smart asthma management based on remote health information systems with bluetooth-enabled personal inhalers, MIS Q. 44 (1) (2021) 285–303.
[18] Z. Munn, M.D. Peters, C. Stern, et al., Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach, BMC Med. Res. Method. 18 (2018) 1–7.
[19] I. Benbasat, R.W. Zmud, The identity crisis within the IS discipline: Defining and communicating the discipline's core properties, MIS Q. 27 (2) (2003) 183–194.
[20] W. Chen, Y. Lu, L. Qiu, et al., Designing personalized treatment plans for breast cancer, Inf. Syst. Res. 32 (3) (2021) 932–949.
[21] J.M. Leimeister, W. Ebner, H. Krcmar, Design, implementation, and evaluation of trust-supporting components in virtual communities for patients, J. Manage. Inf. Syst. 21 (4) (2005) 101–135.
[22] S. Chatterjee, J. Byun, K. Dutta, et al., Designing an internet-of-things (IoT) and sensor-based in-home monitoring system for assisting diabetes patients: Iterative learning from two case studies, Eur. J. Inf. Syst. 27 (6) (2018) 670–685.
[23] K. Spohrer, M. Fallon, H. Hoehle, et al., Designing effective mobile health apps: Does combining behavior change techniques really create synergies? J. Manage. Inf. Syst. 38 (2) (2021) 517–545.
[24] J. Sjöström, P. Ågerfalk, A. Hevner, The design of a system for online psychosocial care: balancing privacy and accountability in sensitive online healthcare environments, J. Assoc. Inf. Syst. 23 (1) (2022) 237–263.
[25] J. Ure, M. Hartswood, J. Wardlaw, et al., The development of data infrastructures for ehealth: A socio-technical perspective, J. Assoc. Inf. Syst. 10 (5) (2009) 415–429.
[26] Y.-K. Lin, H. Chen, R.A. Brown, et al., Healthcare predictive analytics for risk profiling in chronic care: A Bayesian multitask learning approach, MIS Q 41 (2) (2017) 473–495.
[27] I. Bardhan, J.H. Oh, Z.Q. Zheng, et al., Predictive analytics for readmission of patients with congestive heart failure, Inf. Syst. Res. 26 (1) (2015) 19–39.
[28] L. Bouayad, B. Padmanabhan, K. Chari, Audit policies under the sentinel effect: Deterrence-driven algorithms, Inf. Syst. Res. 30 (2) (2019) 466–485.
[29] I. Adjerid, J. Adler-Milstein, C. Angst, Reducing medicare spending through electronic health information exchange: The role of incentives and exchange maturity, Inf. Syst. Res. 29 (2) (2018) 341–361.
[30] J.R. Vest, L.D. Gamm, Health information exchange: Persistent challenges and new strategies, J. Am. Med. Inform. Assoc. 17 (3) (2010) 288–294.
[31] Z. Ozdemir, J. Barron, S. Bandyopadhyay, An analysis of the adoption of digital health records under switching costs, Inf. Syst. Res. 22 (3) (2011) 491–503.
[32] N. Yaraghi, A.Y. Du, R. Sharman, et al., Health information exchange as a multisided platform: Adoption, usage, and practice involvement in service co-production, Inf. Syst. Res. 26 (1) (2015) 1–18.
[33] E.M. Demirezen, S. Kumar, A. Sen, Sustainability of healthcare information exchanges: A game-theoretic approach, Inf. Syst. Res. 27 (2) (2016) 240–258.
[34] G.E. Truman, Integration in electronic exchange environments, J. Manage. Inf. Syst. 17 (1) (2000) 209–244.
[35] Y.K. Lin, M. Lin, H. Chen, Do electronic health records affect quality of care? Evidence from the hitech act, Inf. Syst. Res. 30 (1) (2019) 306–318.
[36] C.M. Angst, R. Agarwal, Adoption of electronic health records in the presence of privacy concerns: The elaboration likelihood model and individual persuasion, MIS Q. 33 (2) (2009) 339–370.
[37] S.H. Kim, J. Kwon, How do EHRs and a meaningful use initiative affect breaches of patient information? Inf. Syst. Res. 30 (4) (2019) 1184–1202.
[38] K. Juhee, E. Johnson, Meaningful healthcare security: Does meaningful-use attestation improve information security performance? MIS Q. 42 (4) (2018) 1043–1068.
[39] C.L. Anderson, R. Agarwal, The digitization of healthcare: Boundary risks, emotion, and consumer willingness to disclose personal health information, Inf. Syst. Res. 22 (3) (2011) 469–490.
[40] H. Li, S. Yoo, W.J. Kettinger, The roles of IT strategies and security investments in reducing organizational security breaches, J. Manage. Inf. Syst. 38 (1) (2021) 222–245.
[41] X.B. Li, J. Qin, Anonymizing and sharing medical text records, Inf. Syst. Res. 28 (2) (2017) 332–352.
[42] J. Kwon, M.E Johnson, Health-care security strategies for data protection and regulatory compliance, J. Manage. Inf. Syst. 30 (2) (2013) 41–65.
[43] S. Sarkar, A. Vance, B. Ramesh, et al., The influence of professional subculture on information security policy violations: A field study in a healthcare context, Inf. Syst. Res. 31 (4) (2020) 1240–1259.
[44] R. Parks, H. Xu, C.H. Chu, et al., Examining the intended and unintended consequences of organisational privacy safeguards, Eur. J. Inf. Syst. 26 (1) (2017) 37–65.
[45] G.C. Kane, G. Labianca, Is avoidance in health-care groups: A multilevel investigation, Inf. Syst. Res. 22 (3) (2011) 504–522.
[46] H.J. Hao, R. Padman, B.H. Sun, et al., Quantifying the impact of social influence on the information technology implementation process by physicians: A hierarchical Bayesian learning approach, Inf. Syst. Res. 29 (1) (2018) 25–41.
[47] V. Venkatesh, X. Zhang, T.A. Sykes, "Doctors do too little technology": A longitudinal field study of an electronic healthcare system implementation, Inf. Syst. Res. 22 (3) (2011) 523–546.
[48] Y. Tong, C.H. Tan, H.H. Teo, Direct and indirect information system use: A multimethod exploration of social power antecedents in healthcare, Inf. Syst. Res. 28 (4) (2017) 690–710.
[49] Z. Xiaofei, X.T. Guo, S.Y. Ho, et al., Effects of emotional attachment on mobile health-monitoring service usage: an affect transfer perspective, Inf. Manage. 58 (2) (2021) 103312.
[50] S. Khurana, L.F. Qiu, S. Kumar, When a doctor knows, it shows: An empirical analysis of doctors' responses in a Q&A forum of an online healthcare portal, Inf. Syst. Res. 30 (3) (2019) 872–891.

[51] X. Zhang, S. Liu, Z. Deng, et al., Knowledge sharing motivations in online health communities: A comparative study of health professionals and normal users, Comput. Hum. Behav. 75 (2017) 797–810.
[52] L.A. Wang, L. Yan, T.X. Zhou, et al., Understanding physicians' online-offline behavior dynamics: An empirical study, Inf. Syst. Res. 31 (2) (2020) 537–555.
[53] K.Y. Huang, I. Chengalur-Smith, A. Pinsonneault, Sharing is caring: Social support provision and companionship activities in healthcare virtual support communities, MIS Q. 43 (2) (2019) 395–423.
[54] L.T. Chen, A. Baird, D Straub, Fostering participant health knowledge and attitudes: An econometric study of a chronic disease-focused online health community, J. Manage. Inf. Syst. 36 (1) (2019) 194–229.
[55] S.S. Guo, X.T. Guo, Y.L. Fang, et al., How doctors gain social and economic returns in online health-care communities: A professional capital perspective, J. Manage. Inf. Syst. 34 (2) (2017) 487–519.
[56] A. Ivanov, R. Sharman, Impact of user-generated internet content on hospital reputational dynamics, J. Manage. Inf. Syst. 35 (4) (2018) 1277–1300.
[57] R. Aron, S. Dutta, R. Janakiraman, et al., The impact of automation of systems on medical errors: evidence from field research, Inf. Syst. Res. 22 (3) (2011) 429–446.
[58] D. Saifee, Z. Zheng, I. Bardhan, et al., Are online reviews of physicians reliable indicators of clinical outcomes? A focus on chronic disease management, Inf. Syst. Res. 31 (4) (2020) 1282–1300.
[59] G. Peng, D. Dey, A. Lahiri, Healthcare it adoption: An analysis of knowledge transfer in socioeconomic networks, J. Manage. Inf. Syst. 31 (3) (2014) 7–34.
[60] N.M. Menon, U. Yaylacicegi, A. Cezar, Differential effects of the two types of information systems: A hospital-based study, J. Manage. Inf. Syst. 26 (1) (2009) 297–316.
[61] B. Rajan, A. Seidman, E.R. Dorsey, The competitive business impact of using telemedicine for the treatment of patients with chronic conditions, J. Manage. Inf. Syst. 30 (2) (2013) 127–157.
[62] A.N. Mishra, C. Anderson, C.M. Angst, et al., Electronic health records assimilation and physician identity evolution: An identity theory perspective, Inf. Syst. Res. 23 (3) (2012) 738–760.
[63] E. Karahanna, A. Chen, Q.Q.B. Liu, et al., Capitalizing on health information technology to enable digital advantage in US hospitals, MIS Q 43 (1) (2019) 113.
[64] J. Braa, O. Hanseth, A. Heywood, et al., Developing health information systems in developing countries: The flexible standards strategy, MIS Q 31 (2) (2007) 381–402.
[65] A. Ghose, X. Guo, B. Li, Y. Dang, Empowering patients using smart mobile health platforms: Evidence from a randomized field experiment, MIS Q 46 (1) (2022) 151–191.
[66] V. Venkatesh, T. Sykes, X. Zhang, ICT for development in rural India: A longitudinal study of women's health outcomes, MIS Q. 44 (2) (2020) 605–629.
[67] K. Ganju, P. Pavlou, R. Banker, Does information and communication technology lead to the well-being of nations? A country-level empirical investigation, MIS Q. 40 (2) (2016) 417–430.
[68] M. Ayal, A. Seidmann, An empirical investigation of the value of integrating enterprise information systems: The case of medical imaging informatics, J. Manage. Inf. Syst. 26 (2) (2009) 43–68.
[69] Y. Gao, W. Duan, H. Rui, Does social media accelerate product recalls? Evidence from the pharmaceutical industry, Inf. Syst. Res. 33 (3) (2022) 765–1118.
[70] G. Miscione, Telemedicine in the upper amazon: Interplay with local health care practices, MIS Q. 31 (2) (2007) 403–425.
[71] J.M. Goh, G. Gao, R. Agarwal, The creation of social value: Can an online health community reduce rural–urban health disparities? MIS Q. 40 (1) (2016) 247–263.
[72] B. Greenwood, K. Ganju, C Angst, How does the implementation of enterprise information systems affect a professional's mobility? An empirical study, Inf. Syst. Res. 30 (2) (2019) 563–594.
[73] H.R. Rao, N. Vemprala, P. Akello, et al., Retweets of officials' alarming vs reassuring messages during the covid-19 pandemic: Implications for crisis management, Int. J. Inf. Manage. 55 (2020) 102187.
[74] C. Moreno, T. Wykes, S. Galderisi, et al., How mental health care should change as a consequence of the covid-19 pandemic, Lancet Psychiatry 7 (9) (2020) 813–824.
[75] E.R. Pfaff, A.T. Girvin, T.D. Bennett, et al., Identifying who has long covid in the USA: A machine learning approach using n3c data, Lancet Digit Health 4 (7) (2022) e532–e541.
[76] L.S. Canas, C.H. Sudre, J.C. Pujol, et al., Early detection of covid-19 in the UK using self-reported symptoms: A large-scale, prospective, epidemiological surveillance study, Lancet Digit Health 3 (9) (2021) e587–e598.
[77] A. Fügener, J.o. Grahl, A. Gupta, et al., Cognitive challenges in human–artificial intelligence collaboration: Investigating the path toward productive delegation, Inf. Syst. Res. 33 (2) (2022) 678–696.
[78] L. Ma, B. Sun, Machine learning and AI in marketing–connecting computing power to human insights, Int. J. Res. Market. 37 (3) (2020) 481–504.
[79] E.v.d. Broek, A. Sergeeva, M. Huysman, When the machine meets the expert: An ethnography of developing ai for hiring, MIS Q. 45 (3) (2022) 1557–1580.
[80] B. Lou, L. Wu, AI on drugs: Can artificial intelligence accelerate drug development? Evidence from a large-scale examination of bio-pharma firms. Evidence from a large-scale examination of bio-pharma firms, MIS Q. 45 (3) (2021) 1451–1482.
[81] T. Sutter, J.A. Roth, K. Chin-Cheong, et al., A comparison of general and disease-specific machine learning models for the prediction of unplanned hospital readmissions, J. Am. Med. Inform. Assoc. 28 (4) (2021) 868–873.
[82] A. Cocos, A.G. Fiks, A.J. Masino, Deep learning for pharmacovigilance: Recurrent neural network architectures for labeling adverse drug reactions in twitter posts, J. Am. Med. Inform. Assoc. 24 (4) (2017) 813–821.
[83] S. Hansen, J. Baroody, Electronic health records and the logics of care: Complementarity and conflict in the U.S. Healthcare system, Inf. Syst. Res. 31 (1) (2020) 57–75.
[84] C. Bao, I. Bardhan, New incentives: Performance of accountable care organizations health information technology and quality–efficiency trade-offs, Inf. Syst. Res. 33 (2) (2022) 697–717.
[85] P.J. Hu, P.Y.K. Chau, O.R. Liu Sheng, et al., Examining the technology acceptance model using physician acceptance of telemedicine technology, J. Manage. Inf. Syst. 16 (2) (1999) 91–112.
[86] A. Bhattacherjee, N. Hikmet, Physicians' resistance toward healthcare information technology: A theoretical model and empirical test, Eur. J. Inf. Syst. 16 (6) (2007) 725–737.
[87] R. Klein, An empirical examination of patient-physician portal acceptance, Eur. J. Inf. Syst. 16 (6) (2007) 751–760.
[88] N.M. Menon, R. Kohli, Blunting damocles' sword: A longitudinal model of healthcare IT impact on malpractice insurance premium and quality of patient care, Inf. Syst. Res. 24 (4) (2013) 918–932.
[89] A. Baird, E. Davidson, L. Mathiassen, Reflective technology assimilation: Facilitating electronic health record assimilation in small physician practices, J. Manage. Inf. Syst. 34 (3) (2017) 664–694.
[90] H.Y. Zhu, S. Samtani, H.C. Chen, et al., Human identification for activities of daily living: A deep transfer learning approach, J. Manage. Inf. Syst. 37 (2) (2020) 457–483.
[91] S. Aral, C. Nicolaides, Exercise contagion in a global social network, Nat. Commun. 8 (2017) 14753.

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