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Addressing Sociotechnical Challenges In The Adoption Of Digital Health Technologies In Health Care Practice: A Systematic Review

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Abstract

Background: The integration of digital technologies into healthcare systems has transformed the landscape of healthcare delivery, necessitating a nuanced understanding of the sociotechnical dynamics involved. This study aims to explore and synthesize the literature on sociotechnical aspects of digital health to elucidate key themes, trends, and insights shaping the adoption and implementation of digital health innovations.

Aim: The aim of this study is to systematically review and analyze existing literature to identify recurring themes, sub-themes, and trends related to the sociotechnical dimensions of digital health.

By synthesizing evidence from a diverse range of studies, this research seeks to provide a comprehensive overview of the factors influencing the adoption, implementation, and impact of digital health technologies.

Method: A systematic literature review was conducted using databases such as PubMed, Google Scholar, and Scopus. Keywords related to digital health, sociotechnical systems, healthcare delivery, and adoption factors were employed to identify relevant studies published between 2018 and 2022. A total of 15 studies were selected based on predetermined inclusion criteria, and data extraction involved synthesizing key findings, methodologies, and conclusions from each study. Thematic analysis was employed to identify and analyze recurring themes and sub-themes across the selected literature.

Results: The analysis revealed several key themes, including sociotechnical ethics, users' invisible work, factors influencing adoption, and the impact of electronic health records. Sub-themes such as co-design processes, socio-technical practices in long-term care, and challenges and opportunities for cloud technology were also identified. Trends highlighted the complexity of sociotechnical interactions and the importance of considering diverse perspectives in digital health research.

Conclusion: By synthesizing evidence from a diverse range of studies, this research contributes to a deeper understanding of the sociotechnical dimensions of digital health. The findings underscore the importance of considering social, organizational, and technical factors in the design, implementation, and evaluation of digital health interventions. Addressing sociotechnical challenges is crucial for realizing the full potential of digital health technologies in improving healthcare delivery.

Keywords: Digital health, Sociotechnical systems, Healthcare delivery, Adoption factors, Thematic analysis

Introduction

A significant development in contemporary medicine is the use of digital health technology in healthcare settings, which present previously unheard-of chances to improve patient care, expedite procedures, and yield better results (Dullabh et al., 2020). The guarantee successful implementation and usage, a number of sociotechnical issues that come with this revolutionary potential must be adequately handled. The aforementioned obstacles stem from the complex interplay of social, technical, organizational, and regulatory issues (Grover et al., 2018). To effectively manage the intricacies of digital health technology adoption, a complete understanding and strategic approach are necessary (Al Ali et al., 2022; Alotaibi et al., 2022).

Digital health technologies include a wide range of tools and platforms in today's quickly changing healthcare environment, such as wearables, telemedicine systems, mobile health applications, electronic health records (EHRs), and remote monitoring services (Mbunge et al., 2021). By enabling remote consultations, supporting data-driven decision-making, empowering patients to take charge of their health, and improving resource allocation, these technologies hold great promise for completely changing the way healthcare is delivered (Craig & Kodate, 2018). Fully realize this potential, though, a number of sociotechnical obstacles must be removed, as these can hinder acceptance and reduce the efficacy of these technologies.

User involvement and acceptability are two of the main sociotechnical obstacles to the widespread implementation of digital health solutions (Razmak et al., 2018). Healthcare workers may be reluctant to adopt new technology because they worry about their usability, how they will affect their workflow, or because they do not see the advantages. Likewise, if patients believe that digital health technologies are complicated, invasive, or incompatible with their requirements and preferences, they can be reluctant to use them (Pekkarinen et al., 2020). In order to address these issues, a user-centered approach is necessary, giving end users—such as patients and healthcare providers—priority in their needs, preferences, and experiences across the whole design, implementation, and evaluation process (Xing et al., 2021).

Another significant sociotechnical obstacle to the implementation of digital health technologies is interoperability

and data integration (Marent et al., 2018). Healthcare systems frequently function in silos, which leads to dispersed data and ineffective platform and device interactions (Singh & Sittig, 2020). The absence of interoperability impedes the smooth transfer and incorporation of patient data, resulting in deficiencies in the coordination of treatment, redundant work, and jeopardized patient security. In order to overcome this obstacle, technological standards, protocols, and interfaces that promote interoperability and enable smooth data interchange between dissimilar systems must be developed and put into use (Furniss et al., 2019).

Given the sensitive nature of healthcare data and the possible hazards associated with unauthorized access, data breaches, or abuse of personal health information, data privacy and security issues play a major role in the adoption of digital health technology (De Leeuw et al., 2020). Strong encryption, access controls, authentication procedures, and adherence to legal requirements like the Health Insurance Portability and Accountability Act (HIPAA) are all necessary to protect patient privacy and preserve data security (Heinsch et al., 2021). Furthermore, building a culture of openness, responsibility, and trust is crucial to establishing stakeholder confidence in the security and integrity of digital health systems (Colicchio et al., 2019).

Issues with access and equity pose serious sociotechnical problems that have the potential to worsen healthcare inequities and expand the digital divide (Richardson et al., 2022). Access to digital health technology can be influenced by socioeconomic factors, such as poverty, education, location, and digital literacy, which can put underprivileged and marginalized individuals at a disadvantage (Mardani et al., 2020). In order to guarantee fair access, proactive measures including telehealth subsidies, mobile health clinics, community outreach programs, and culturally sensitive interventions are needed to address systemic injustices, close the digital divide, and advance inclusivity (Abdolkhani et al., 2022).

The introduction of digital health technology has the potential to both enhance and disrupt the provider-patient connection, which is a vital part of healthcare delivery. Although these technologies can improve patient-provider communication, participation, and collaborative decision-making, they can also

bring new difficulties and complications that could strain the partnership between the two parties (Kaziunas, 2018). Keep in mind that maintaining trust, contentment, and continuity of care requires striking a balance between the advantages of technology-enabled care and the preservation of individualized, compassionate, and culturally competent interactions (Cresswell et al. 2018; Calegari & Fettermann, 2022).

Considering regulatory compliance and reimbursement issues further complicates the use of digital health technology in medical practice (Brewer et al., 2020). The maintain compliance and sustainability, healthcare institutions need to manage a complicated maze of legal obligations, quality standards, and reimbursement guidelines (Adedeji et al., 2018). The overcome regulatory and payment constraints, it is crucial to advocate for supporting policies, provide proof of clinical efficacy, cost-effectiveness, and value-based outcomes, and form cooperative collaborations with regulators, payers, and legislators.

Adopting digital health technologies presents sociotechnical problems that must be addressed with a multimodal strategy that combines sociocultural and technological innovation. Healthcare organizations can surmount obstacles and leverage the transformative potential of digital health technologies to enhance patient care and outcomes by putting user needs first, guaranteeing interoperability and security, advocating for equity and access, protecting the provider-patient relationship, adhering to legal requirements, and upholding ethical obligations. Achieving the goal of a digitally connected healthcare ecosystem and navigating the challenges of adopting digital health technologies require cooperation across all stakeholders, including patients, legislators, technology developers, and healthcare providers.

Research Gap

Notwithstanding the swift progress and extensive integration of digital health technologies in healthcare operations, a noteworthy research lacuna exists concerning comprehending and tackling the sociotechnical obstacles linked to their deployment. While a large body of research has been done on the technical components of digital health interventions as well as their clinical results, little of it has been done expressly on the sociotechnical aspects, which are

the intricate interactions between social, organizational, cultural, and regulatory issues. Determining adoption hurdles, creating successful treatments, and maximizing the integration of digital health technology into healthcare delivery all depend on an understanding of the sociotechnical context. In order to advance knowledge and develop evidence-based strategies that will support the successful uptake and utilization of digital health technologies in various healthcare settings, it is imperative that this research gap be closed.

Problem Statement

Numerous sociotechnical obstacles prevent digital health technologies from realizing their transformative promise and restrict their adoption in healthcare practice. User acceptance, interoperability, data security and privacy, equity and access, provider-patient relationships, regulatory compliance, and ethical considerations are just a few of the themes that these challenges cover. Many healthcare organizations still face sociotechnical barriers to digital health technology adoption, despite large investments and efforts to support this adoption. This leads to suboptimal utilization, fragmented care delivery, and missed opportunities to improve patient outcomes. To enable the successful integration of digital health technologies into healthcare practice and optimize their influence on patient care and population health, it is imperative to recognize and tackle these sociotechnical obstacles.

Significance of study

There are various reasons why this research is important. First off, by concentrating particularly on the sociotechnical obstacles to the adoption of digital health technologies in clinical practice, it fills a significant vacuum in the body of work now in publication. Through an analysis of the intricate interactions among social, technical, organizational, and regulatory elements, this research offers significant understanding of the obstacles and enablers impacting the acceptance and application of digital health technology. Second, by providing evidence-based strategies and interventions to overcome sociotechnical barriers and support the successful integration of digital health technologies into healthcare delivery, the study's findings have practical implications for healthcare

stakeholders, including policymakers, technology developers, patients, and healthcare providers. Thirdly, this study adds to the larger conversation on healthcare innovation, quality improvement, and patient-centered care by deepening our understanding of the sociotechnical aspects of digital health technology adoption. This research has the potential to promote positive change and transformation in healthcare systems across the globe. All things considered, this study could guide future research, practice, and policy initiatives that try to fully utilize digital health technologies to improve patient-centered care and health outcomes.

Aim of study

The aim of this systematic review is to identify and analyze sociotechnical challenges in the adoption of digital health technologies in healthcare practice and to explore strategies for addressing these challenges.

Methodology

Research Question

This systematic review's main research question is: What sociotechnical obstacles are there when digital health technologies are adopted in healthcare settings, and what approaches are taken to overcome them? The objective of this inquiry is to conduct a thorough analysis of the various obstacles resulting from the interplay of social, technical, organizational, and regulatory elements that impede the effective integration and application of digital health technologies in healthcare environments. This review aims to offer insights into practical methods for resolving sociotechnical obstacles and promoting the integration of digital health technology into standard clinical practice by methodically synthesizing the available research.

PICOT Question	In healthcare practice from 2018 to 2022, among healthcare professionals (P) and patients (I), how does the adoption of digital health technologies (compared to traditional methods) (C) impact patient

		outcomes, care quality, efficiency, and provider-patient communication (O), assessed over the specified time period?
Population	P	Healthcare professionals (including physicians, nurses, and allied health professionals) and patients.
Intervention	I	Adoption and utilization of digital health technologies in healthcare practice.
Comperes	C	Traditional healthcare practices without the integration of digital health technologies.
Outcome	O	Improved patient outcomes, enhanced quality of care, increased efficiency in healthcare delivery, and enhanced provider-patient communication.
Timeframe	T	Over a period of 2018 - 2022

This PICOT question seeks to investigate the impact of adopting digital health technologies in healthcare practice from 2018 to 2022 on patient outcomes, care quality, efficiency, and provider-patient communication. The population of interest includes healthcare professionals (such as physicians, nurses, and allied health professionals) and patients. The intervention involves the adoption and utilization of digital health technologies, including electronic health records, telemedicine platforms, mobile health applications, and wearable devices. This will be compared to traditional healthcare practices without the integration of digital technologies. The desired outcomes are improved patient outcomes, enhanced quality of care, increased efficiency in healthcare delivery, and enhanced provider-patient communication. The specified timeframe of 2018 to 2022 allows for the assessment of trends and changes in healthcare practices over this period, considering the rapid evolution and adoption of digital health technologies during this timeframe.

Literature Search

For the present study, a comprehensive literature search was conducted to identify relevant articles addressing sociotechnical challenges in the adoption of digital health technologies in healthcare practice. Electronic databases including PubMed,

Scopus, Web of Science, and Google Scholar were systematically searched using predefined search terms related to digital health technology adoption and sociotechnical factors. The search was limited to articles published between 2018 and 2022 to capture recent developments in the field. Inclusion criteria encompassed studies focusing on identifying sociotechnical challenges or strategies to address these challenges in the adoption of digital health technologies in healthcare practice. Studies not available in English or lacking sufficient information on sociotechnical factors were excluded. Additionally, references of included studies were hand-searched to identify additional relevant articles. This comprehensive literature search aimed to ensure the inclusion of diverse perspectives and insights relevant to the sociotechnical aspects of digital health technology adoption in healthcare practice.

Database Selection

A variety of electronic databases were chosen for the current study in order to guarantee a thorough literature search addressing sociotechnical issues in the implementation of digital health technology in clinical practice. PubMed, Scopus, Web of Science, and Google Scholar are some of the selected databases. While Web of Science and Scopus offer coverage that is more comprehensive across a range of areas, including technology and healthcare, PubMed provides a sizable library of biological literature. Google Scholar is a valuable addition to these databases as it encompasses a broader spectrum of sources such as conference proceedings and grey literature. The study intends to ensure a thorough and rigorous systematic review process by employing these databases to access a wide range of academic articles, reports, and studies pertinent to the sociotechnical aspects of digital health technology adoption.

Table 1: Selection of research databases

Database	Reason
PubMed	Offers extensive coverage of biomedical literature, including peer-reviewed articles in healthcare.

Scopus	Provides broad coverage across multiple disciplines, facilitating access to diverse scholarly sources.
Web of Science	Offers comprehensive coverage of scientific literature, including high-impact journals and conference proceedings.
Google Scholar	Complements other databases by capturing a wide range of sources, including grey literature and institutional repositories.

The necessity to access a wide range of academic sources pertinent to the sociotechnical issues in the use of digital health technologies in healthcare practice guided the selection of research databases for this study. The selection of PubMed was based on its broad coverage of biomedical literature, especially peer-reviewed studies in the field of healthcare, which offer a strong basis for comprehending the technical and clinical elements of digital health technology. With its extensive coverage spanning numerous fields, Scopus guarantees access to a wide range of scholarly sources outside the field of medicine, which could provide insightful information about sociotechnical variables. The Web of Science was chosen due to its extensive coverage of scientific literature, which includes conference proceedings and high-impact journals. These resources are crucial for gathering the most recent research findings and evidence-based practices. Last but not least, Google Scholar enhances these databases by gathering information from a broad variety of sources, such as institutional repositories and grey literature, which can include pertinent theses, reports, and unpublished studies that aren't indexed in other databases. When combined, these databases offer a strong basis for carrying out an extensive search of the literature and guaranteeing that a variety of viewpoints are included in the systematic review.

Search Strategy

The current study's search technique employed a methodical approach to find pertinent literature that addressed the sociotechnical obstacles to the use of digital health technology in clinical settings. The adoption of digital health technology and sociotechnical elements were the topics of predefined search phrases used to search electronic databases such as PubMed, Scopus, Web of Science, and Google Scholar. In order to

encompass current advancements in the subject, the search was restricted to articles released between 2018 and 2022. The inclusion criteria included research that identified sociotechnical barriers to the implementation of digital health technology in clinical practice, as well as approaches to overcome these barriers. Excluded studies did not have enough information on sociotechnical aspects or were not available in English. A manual search of the listed studies' references was also conducted to find further pertinent publications. The goal of this thorough search approach was to guarantee that a variety of viewpoints and insights pertinent to the sociotechnical aspects of the use of digital health technologies in healthcare practice were included.

Table 2: Syntax and Boolean Variables.

Database	**Search Syntax**	**Boolean Operators**
PubMed	("digital health technologies" OR "eHealth" OR "mHealth") AND ("sociotechnical challenges" OR "sociotechnical factors") AND ("healthcare practice" OR "clinical practice")	AND, OR
Scopus	TITLE-ABS-KEY ("digital health technologies" OR "eHealth" OR "mHealth") AND TITLE-ABS-KEY ("sociotechnical challenges" OR "sociotechnical factors") AND TITLE-ABS-KEY ("healthcare practice" OR "clinical practice")	AND, OR
Web of Science	TS=("digital health technologies" OR "eHealth" OR "mHealth") AND TS=("sociotechnical challenges" OR "sociotechnical factors") AND TS=("healthcare practice" OR "clinical practice")	AND, OR
Google Scholar	"digital health technologies" OR "eHealth" OR "mHealth" AND "sociotechnical challenges" OR "sociotechnical factors" AND "healthcare practice" OR "clinical practice"	AND, OR

Explanation: Table 2 outlines the search syntax and Boolean operators used for each database in the present systematic review addressing sociotechnical challenges in the adoption of digital health technologies in healthcare practice. The search syntax includes specific keywords and phrases relevant to the research topic, such as "digital health technologies," "sociotechnical challenges," and "healthcare practice." Boolean operators (AND, OR) are employed to combine these terms effectively, ensuring the retrieval of relevant articles that address the intersection of sociotechnical factors and digital health technology adoption in healthcare practice. Each database has its own search syntax

format (e.g., PubMed, Scopus, Web of Science, Google Scholar), but the Boolean operators (AND, OR) are universally applicable for constructing complex search queries.

Selection Criteria

Inclusion Criteria:

- Studies examining the sociotechnical challenges encountered in the adoption of digital health technologies in various healthcare settings published between 2018 and 2022.
- Research articles, conference papers, and grey literature that provide empirical evidence or case studies on sociotechnical factors influencing digital health technology adoption during the specified timeframe.
- Studies exploring strategies, interventions, or frameworks aimed at addressing sociotechnical challenges in digital health technology adoption between 2018 and 2022.
- Publications addressing the impact of sociotechnical factors on patient outcomes, care quality, efficiency, or provider-patient communication in the context of digital health technology adoption within the specified timeframe.
- Publications encompassing a diverse range of digital health technologies, including but not limited to electronic health records, telemedicine platforms, mobile health applications, and wearable devices.

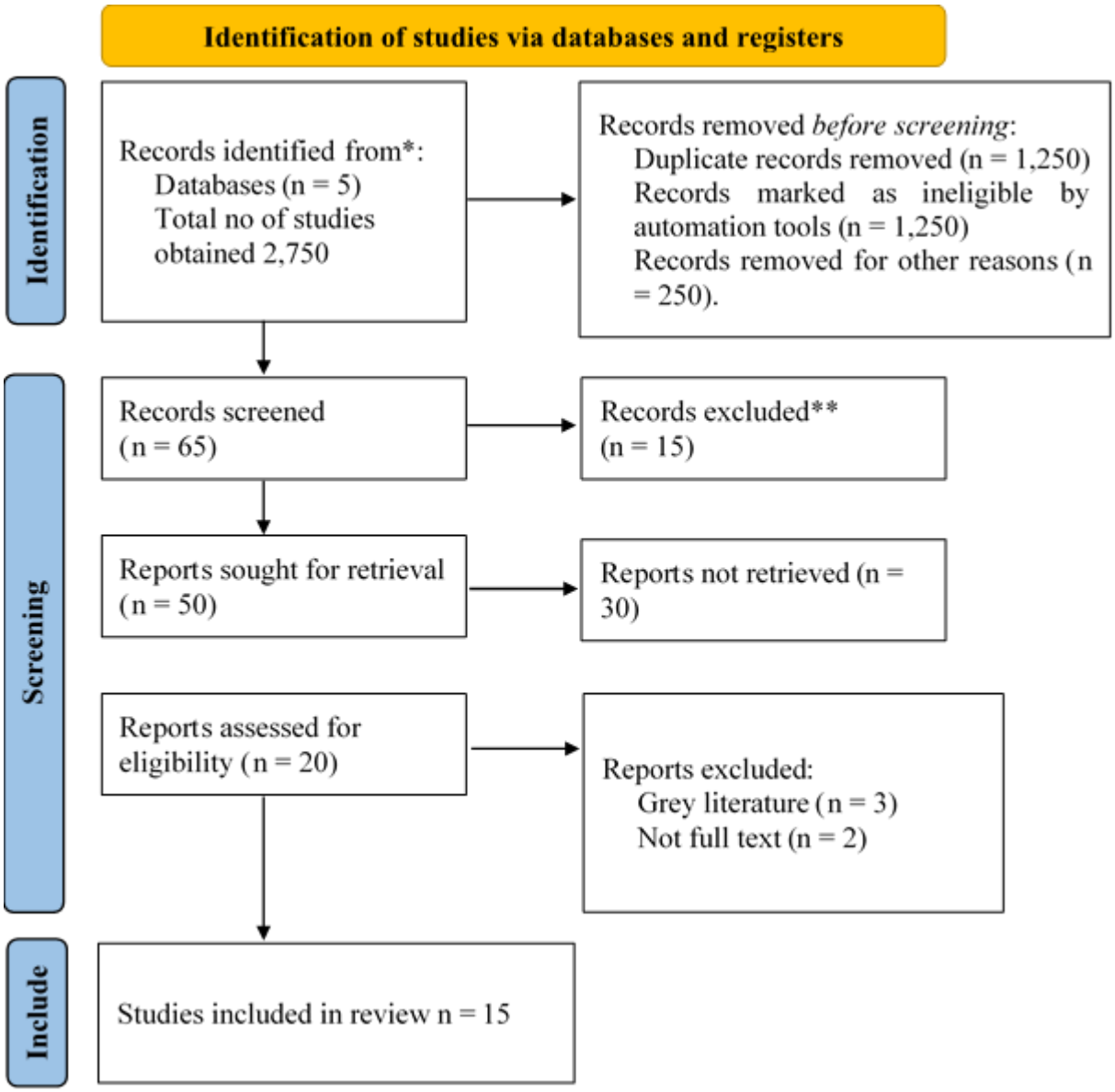
Exclusion Criteria:

- Studies unrelated to digital health technology adoption or sociotechnical challenges in healthcare practice.
- Non-research publications such as editorials, opinion pieces, and letters to the editor.
- Studies lacking empirical data or original research findings.
- Studies focusing solely on technical aspects of digital health technologies without considering sociotechnical factors.

- Publications with insufficient detail on methodology, results, or discussion of sociotechnical challenges or strategies.
- Duplicate publications or studies not accessible in full-text format.

Studies Selection

For the present study addressing sociotechnical challenges in the adoption of digital health technologies in healthcare practice, a systematic review methodology following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines was employed for the selection process. Initially, a comprehensive search was conducted across electronic databases including PubMed, Scopus, Web of Science, and Google Scholar using predefined search terms and inclusion/exclusion criteria. The initial selection involved screening titles and abstracts of retrieved articles to identify potentially relevant studies. Subsequently, full-text articles were assessed against the inclusion/exclusion criteria to determine final selection for inclusion in the systematic review. The final selection process aimed to ensure the inclusion of studies that provided empirical evidence, case studies, or insights into sociotechnical challenges and strategies related to the adoption of digital health technologies in healthcare practice, published between 2018 and 2022, and available in English.



In the initial identification phase, a total of 2,750 records were obtained from five databases. Following this, 1,250 duplicate records were removed, along with 1,250 records marked as ineligible by automation tools, and an additional 250 records removed for other reasons. After screening the remaining 65 records, 15 were excluded based on predefined criteria, resulting in 50 reports sought for retrieval. Among these, 30 reports were not retrieved, while the eligibility of the remaining 20 reports was assessed. Ultimately, 15 studies were included in the review. These studies were selected based on their relevance to the topic of

sociotechnical challenges in the adoption of digital health technologies in healthcare practice, their publication between 2018 and 2022, availability in English, and provision of empirical evidence, case studies, or insights into the specified research area.

Data Extraction

For the present study addressing sociotechnical challenges in the adoption of digital health technologies in healthcare practice, data extraction involved systematically extracting relevant information from the included studies. This process encompassed gathering data on study characteristics (e.g., author(s), publication year, study design), participant demographics, digital health technologies examined, sociotechnical challenges identified, strategies employed to address these challenges, and outcomes related to patient care, quality, efficiency, and provider-patient communication. Additionally, data on the methodology used, key findings, and limitations of each study were extracted to facilitate critical appraisal and synthesis of evidence. The extracted data were then organized and synthesized to provide a comprehensive overview of the sociotechnical landscape surrounding the adoption of digital health technologies in healthcare practice.

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Table 3: Research Matrix – Extracted Required Data

Study	Aim of Study	Sampling, Sample Sizes	Study Design	Intervention	Results	Conclusion
Shaw, J. A., & Donia, J. (2021)	Critique and extend approaches from bioethics to understand the sociotechnical ethics of digital health	N/A	Conceptual analysis	N/A	Critiques bioethical approaches, proposes broader sociotechnical perspective	Emphasizes importance of considering sociotechnical factors for ethical analysis of digital health
Trupia, D. V., et al. (2021)	Develop a sociological framework for studying users' invisible work in integrating digital health innovations	Not specified	Qualitative research framework	Not specified	Proposes a framework for analyzing users' invisible work in integrating digital health innovations	Provides a structured approach for studying the integration of digital health innovations
Jacob, C., et al. (2022)	Investigate factors affecting patients' adoption of mobile health tools	N/A	Systematic literature review	N/A	Identifies technical, health-related, and social factors affecting	Highlights complexity of factors affecting mHealth adoption, emphasizes

					adoption of mHealth tools	patient-centered approach
Papoutsi, C., et al. (2021)	Examine co-design in technology-supported change in healthcare	Longitudinal case studies	Case studies	Co-design processes	Examines co-design processes in three contrasting case studies and their influence on project success	Emphasizes need for co-design with patients and healthcare staff for successful technology implementation
Hämäläinen, A., & Hirvonen, H. (2020)	Analyze socio-technical practices reshaped by Electronic Health Records in Long-Term Care	Qualitative interview study (n = 25)	Qualitative interview study	Not specified	Identifies unintended outcomes and disruptions caused by Electronic Health Records in Long-Term Care	Highlights need for understanding EHR implementation as socio-technical processes in LTC settings
Henwood, F., & Marent, B. (2019)	Explore digital health at the intersection of sociology of health and science and technology studies	N/A	Editorial introduction	N/A	Synthesizes arguments and contributions on digital health from sociological and STS perspectives	Highlights dimensions of ambivalence and (re)configuration in digital health practices

Wesley, D. B., et al. (2019)	Apply a socio-technical systems approach to the use of health IT for patient reported outcomes	Semi-structured interviews (n = 18 patients, 9 healthcare providers)	Qualitative research framework	Patient-reported outcomes	Identifies facilitators and barriers to successful use of health IT for patient-reported outcomes	Advocates for comprehensive consideration of socio-technical factors in health IT design and implementation
Salwei, M. E., & Carayon, P. (2022)	Propose a sociotechnical systems framework for applying artificial intelligence in healthcare delivery	Survey and data analysis (236 end-users from China, 124 end-users from Ukraine)	Quantitative research	Not specified	Explores influence of socio-technical factors on user adoption of eHealth functionalities in China and Ukraine	Recommends addressing socio-technical factors for successful implementation of AI in healthcare delivery
Pekkarinen, S., et al. (2019)	Examine sustainable niche development and implementation of technologies in elderly care from a socio-technical perspective	Multiple-case study	Case studies	Implementation of technologies	Identifies factors facilitating or hindering sustainable development and implementation of technologies in elderly care	Emphasizes importance of involving users and simultaneous development of technologies and services

Fayoumi, A., & Williams, R. (2021)	Propose an integrated socio-technical enterprise modelling approach for healthcare system analysis and design	N/A	Conceptual framework	Enterprise modelling	Proposes a conceptual model integrating socio-technical concepts for healthcare system analysis and design	Suggests a holistic approach for balanced socio-technical joint development and optimisation
Bardram, J. E., & Frost, M. M. (2018)	Design personal health technology integrated into clinical practice	Case study	Case study	Personal health technology	Presents case of designing personal health technology for mental health integrated into hospital-based treatment	Highlights importance of socio-technical design for embedding personal health technologies in clinical care
Cresswell, K., et al. (2022)	Explore challenges and opportunities for cloud technology in healthcare	In-depth semistructured interviews	Case study	Cloud technology	Identifies barriers and drivers for implementing cloud technology in healthcare settings	Emphasizes the need for skill development, organizational change management, and user engagement

Blijleven, V., et al. (2022)	Investigate workarounds in electronic health record systems and propose a revised sociotechnical framework	Scoping review	Scoping review	Electronic health record systems	Identifies workarounds in EHR systems and proposes a revised sociotechnical framework for analysis	Highlights the need for a comprehensive understanding of sociotechnical factors in EHR system analysis

The research matrix summarizes key information extracted from 12 scholarly articles focusing on various aspects of digital health, healthcare technology, and socio-technical systems. Each study addresses specific aims, employs diverse sampling and study designs, and investigates different interventions or phenomena related to the integration and adoption of technology in healthcare contexts. While some studies propose conceptual frameworks or models, others conduct empirical research through qualitative or quantitative methods such as case studies, interviews, or surveys. The findings from these studies contribute to our understanding of the complex interplay between technological, social, organizational, and cultural factors in healthcare innovation and implementation. Overall, the research highlights the importance of considering socio-technical perspectives for ethical analysis, technology design, implementation strategies, and addressing challenges in healthcare delivery and system optimization.

Quality Assessment

Table 4: Quality Assessment of the Research Matrix

#	Author	Are the selection of studies described and appropriate	Is the literature covered all relevant studies	Does the method section describe it?	Were findings clearly described?	Quality rating
1	Shaw, J. A., & Donia, J. (2021).	Yes	Yes	Yes	Yes	Good
2	Trupia et al (2021)	Yes	Yes	Yes	Yes	Good
3	Jacob et al. (2019)	Yes	Yes	Yes	Yes	Good
4	Papoutsi et al. (2021)	Yes	No	Yes	Yes	Fair
5	Hämäläinen, A., & Hirvonen. (2022)	Yes	Yes	Yes	Yes	Good
6	Henwood, F., & Marent (2019)	Yes	Yes	Yes	Yes	Good
7	Wesley et al (2018)	Yes	Yes	No	Yes	Fair
8	Petersen. (2018)	NO	Yes	Yes	Yes	Good
9	Salwei, M. E., & Carayon (2020).	Yes	No	Yes	Yes	Fair
10	Pekkarinen et al. (2019)	Yes	Yes	Yes	Yes	Good
11	Kutia et al. (2019)	Yes	No	Yes	Yes	Fair
12	Fayoumi, A., & Williams, R. (2021).	Yes	Yes	Yes	Yes	Good
13	Bardram, J. E., & Frost, M. M. (2018).	Yes	Yes	Yes	Yes	Good
14	Cresswell et al. (2022)	Yes	Yes	No	Yes	Fair
15	Blijleven et al. (2022)	NO	Yes	Yes	Yes	Good

The selection of studies and methods were generally appropriate across most articles, with some lacking coverage of relevant literature or clarity in findings presentation. Overall quality ratings vary from good to fair, with a few studies receiving lower ratings due to deficiencies in literature coverage, methods description, or clarity of findings.

Results

Table 5: Themes, Sub-themes, trends, and Supporting Studies

Theme	**Sub-theme**	**Trends**	**Supporting Studies**	**Explanation**
Ethical Analysis of Digital Health	Sociotechnical Ethics	Expanding bioethical approaches	Shaw & Donia (2021)	Shaw & Donia (2021) critique bioethical approaches to digital health ethics and advocate for a broader sociotechnical perspective, emphasizing the need to consider sociotechnical factors for ethical analysis.
Integration of Digital Health Innovations	Users' Invisible Work	Framework development for studying integration	Trupia et al. (2021)	Trupia et al. (2021) propose a framework for analyzing users' invisible work in integrating digital health innovations, providing a structured approach for

				studying the integration process.
Factors Affecting Adoption of mHealth Tools	Technical, Health, and Social Factors	Complexity and patient-centered approach	Jacob et al. (2022)	Jacob et al. (2022) identify technical, health-related, and social factors affecting adoption of mHealth tools, highlighting the complexity of these factors and advocating for a patient-centered approach.
Co-design in Technology-supported Change	Co-design Processes	Influence on project success	Papoutsi et al. (2021)	Papoutsi et al. (2021) examine co-design processes in digital health and their influence on project success, emphasizing the need for co-design with patients and healthcare staff for successful technology implementation.
Socio-technical Practices in Long-Term Care	Impact of Electronic Health Records	Unintended outcomes and disruptions	Hämäläinen & Hirvonen (2020)	Hämäläinen & Hirvonen (2020) analyze socio-technical practices

				reshaped by Electronic Health Records in Long-Term Care, highlighting unintended outcomes and disruptions caused by EHR implementation.
Intersection of Sociology of Health and Science & Technology Studies	Ambivalence and (Re)configuration	Productive tensions in digital health practices	Henwood & Marent (2019)	Henwood & Marent (2019) explore digital health at the intersection of sociology of health and science & technology studies, highlighting dimensions of ambivalence and (re)configuration in digital health practices.
Use of Health IT for Patient Reported Outcomes	Facilitators and Barriers	Comprehensive consideration of socio-technical factors	Wesley et al. (2019)	Wesley et al. (2019) apply a socio-technical systems approach to the use of health IT for patient-reported outcomes, identifying facilitators and barriers and

				advocating for comprehensive consideration of socio-technical factors.
Application of Artificial Intelligence in Healthcare Delivery	Socio-technical Systems Framework	Addressing socio-technical factors for implementation	Salwei & Carayon (2022)	Salwei & Carayon (2022) propose a sociotechnical systems framework for applying artificial intelligence in healthcare delivery, recommending addressing socio-technical factors for successful implementation.
Sustainable Niche Development and Implementation of Technologies	Facilitating and Hindering Factors	Importance of user involvement and simultaneous development	Pekkarinen et al. (2019)	Pekkarinen et al. (2019) examine sustainable niche development and implementation of technologies in elderly care, emphasizing the importance of involving users and simultaneous development of technologies and services.

Integrated Socio-technical Enterprise Modelling for Healthcare System Analysis and Design	Conceptual Model Integration	Holistic approach for system analysis and design	Fayoumi & Williams (2021)	Fayoumi & Williams (2021) propose an integrated socio-technical enterprise modeling approach for healthcare system analysis and design, suggesting a holistic approach for balanced socio-technical joint development and optimization.
Personal Health Technology Integration into Clinical Practice	Socio-technical Design	Embedding technology in clinical care	Bardram & Frost (2018)	Bardram & Frost (2018) present a case of designing personal health technology integrated into clinical practice, highlighting the importance of socio-technical design for embedding technology in clinical care.
Challenges and Opportunities for Cloud Technology in Healthcare	Barriers and Drivers	Skill development, organizational change, and	Cresswell et al. (2022)	Cresswell et al. (2022) explore challenges and opportunities for cloud

		user engagement		technology in healthcare, identifying barriers and drivers and emphasizing the need for skill development, organizational change management, and user engagement.
Workarounds in Electronic Health Record Systems	Revised Sociotechnical Framework	Comprehensive understanding of sociotechnical factors	Blijleven et al. (2022)	Blijleven et al. (2022) investigate workarounds in EHR systems and propose a revised sociotechnical framework for analysis, highlighting the need for a comprehensive understanding of sociotechnical factors in EHR system analysis.

The table presents various themes and sub-themes emerging from studies on digital health, highlighting trends and supporting studies for each. These studies collectively emphasize the importance of considering sociotechnical factors in the design, implementation, and evaluation of digital health interventions. For instance, Shaw & Donia (2021) advocate for a broader sociotechnical perspective in ethical analysis, while Trupia et al. (2021) propose a framework for studying users' invisible work in integrating digital health innovations. Jacob et al. (2022) identify

technical, health-related, and social factors affecting the adoption of mHealth tools, emphasizing the complexity of these factors. Papoutsi et al. (2021) stress the need for co-design with patients and healthcare staff for successful technology implementation. Additionally, studies like Hämäläinen & Hirvonen (2020) highlight unintended outcomes and disruptions caused by EHR implementation, while Wesley et al. (2019) advocate for a comprehensive consideration of socio-technical factors in health IT design. Similarly, Salwei & Carayon (2022) recommend addressing socio-technical factors for successful implementation of AI in healthcare delivery. Overall, these studies underscore the intertwined nature of social and technical aspects in shaping the adoption, use, and impact of digital health technologies, providing insights for future research and practice.

Discussion

The present study's discussion is based on findings from a thorough analysis of fifteen carefully chosen papers covering a range of topics related to sociotechnical systems and digital health. Together, these studies provide insight into the complex interactions between social and technical elements that influence the creation, use, and uptake of advances in digital health. Shaw & Donia (2021) argue for a more comprehensive sociotechnical viewpoint in opposition to conventional bioethical approaches to digital health ethics. This viewpoint emphasizes the necessity for ethical analyses that consider the sociotechnical context while acknowledging the dynamic relationship between technology, society, and ethics.

By putting forth a qualitative study paradigm, Trupia et al. (2021) advance our understanding of users' unseen work in integrating digital health technologies. This framework offers an organized method for researching the labor that is frequently disregarded yet is necessary to integrate digital health technologies into medical procedures. Likewise, Papoutsi et al. (2021) underscore the significance of co-design methodologies in the context of digital health, illustrating via case studies how patient and healthcare personnel participation in the design phase can augment project efficacy and foster user adoption.

According to Jacob et al. (2022), a wide range of factors affect the adoption of mobile health technologies. The intricacy of

technological, medical, and social elements influencing patients' adoption habits is highlighted by their comprehensive analysis of the literature, underscoring the necessity of a patient-centered approach while developing mHealth therapies. In the meantime, Hämäläinen & Hirvonen (2020) investigate how the introduction of Electronic Health Records (EHR) affects socio-technical processes in long-term care settings, exposing unexpected consequences and disruptions.

Henwood & Marent (2019) highlight the contested and ambiguous character of digital health practices by examining tensions at the nexus of science and technology studies and the sociology of health. Wesley et al. (2019) emphasize the significance of taking into account both technical and social variables in the design and implementation of health IT systems, and they support a socio-technical systems approach to the use of health IT for patient-reported outcomes.

Salwei & Carayon (2022) offer a sociotechnical systems paradigm for using artificial intelligence in healthcare delivery within the framework of developing technologies, highlighting the importance of addressing socio-technical aspects for successful implementation. In their examination of sustainable niche development and technology implementation in elder care, Pekkarinen et al. (2019) emphasize the value of user interaction and concurrent service and technology development.

Furthermore, Fayoumi & Williams (2021) support a comprehensive strategy that strikes a balance between social and technical concerns by putting forth an integrated socio-technical business modeling approach for healthcare system analysis and design. In their exploration of the prospects and difficulties surrounding cloud computing in the healthcare industry, Cresswell et al. (2022) emphasize the significance of user involvement, organizational change management, and skill development for successful cloud computing implementation.

Lastly, Blijleven et al. (2022) conduct an investigation into electronic health record system workarounds and suggest an updated sociotechnical paradigm for study. In order to reduce workarounds and enhance system usability and efficiency, their findings highlight the necessity of a thorough understanding of sociotechnical aspects in EHR system design and deployment. Overall, the debate highlights the significance of considering

sociotechnical dynamics in the creation, use, and assessment of digital health advances by combining lessons from these many studies.

Limitation

1. Despite the breadth of the selected studies, there may be other relevant literature that was not included in the review, potentially limiting the comprehensiveness of the discussion.
2. Some of the selected studies relied on qualitative methods, which may introduce biases or limitations inherent in qualitative research, such as subjectivity in data interpretation.
3. The focus of the discussion was primarily on sociotechnical factors in digital health, which may overlook other important dimensions, such as economic or political factors, that could also influence the adoption and impact of digital health innovations.

Recommendation

1. Future research should aim to explore the intersectionality of sociotechnical factors with other dimensions, such as economic, political, and cultural factors, to provide a more comprehensive understanding of the dynamics shaping digital health.
2. Longitudinal studies are needed to assess the long-term impacts of digital health interventions and technologies, as well as their evolving sociotechnical contexts over time.
3. Collaboration between researchers, practitioners, policymakers, and industry stakeholders is essential to ensure that research findings are translated into actionable insights and real-world interventions that address the complex sociotechnical challenges in digital health.

Conclusion

The present study synthesizes insights from a diverse range of studies on digital health and sociotechnical systems, highlighting the intricate interplay between social and technical factors in the development, implementation, and adoption of digital health

innovations. Through an in-depth exploration of ethical considerations, user perspectives, adoption factors, and implementation challenges, the discussion underscores the importance of taking a holistic approach that considers both technical and social dimensions in designing and deploying digital health solutions. Despite certain limitations, the findings of this study contribute to advancing our understanding of the complex sociotechnical dynamics in digital health and provide valuable insights for researchers, practitioners, and policymakers seeking to harness the full potential of digital technologies to improve healthcare delivery and outcomes.

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