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Application of Agile Methodology in Managing the Healthcare Sector

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ABSTRACT

The healthcare sector has gradually embraced effective project management for improved healthcare outcomes. This paper explores the application of the agile methodology for managing the healthcare sector. This study significantly contributes to the healthcare sector by providing insights into the application of Agile methodology, potentially enhancing healthcare management and patient outcomes. In this article, the author reviews ten peer-reviewed articles, analyses the findings, and generates three themes: Agile methodology development and implementation in the healthcare sector, the healthcare sector's readiness factors/levels for applying the agile methodology, and how agile methods improve healthcare outcomes. The findings across the three identified themes reiterate the crucial role of organizational leadership, flexible structures, and advanced technology in enhancing agility within the healthcare sector. Moreover, the studies highlight the potential of agile principles to enhance customer-centricity, customer satisfaction, and overall adaptability in healthcare organizations. The study recommends healthcare institutions priorities Agile competency development through training programs and cultivate a culture of adaptability to support Agile methodology adoption. Furthermore, it suggests quantitative research to validate readiness factors' influence, focusing on patient-centered outcomes and comparative studies between Agile and traditional healthcare approaches to bridge literature gaps.

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1. Introduction

1.1. Background

The healthcare sector has gradually embraced practical project management approaches for improved healthcare outcomes. With the ever-evolving healthcare needs, healthcare organizations have established the need for robust and healthy interactions with healthcare stakeholders, specifically the patients. However, poor communication has been rampant in the healthcare sector, accounting for most medical errors. Research revealed that ineffective team communication is the primary cause of approximately 66% of medical errors (Ribeiro & Domingues, 2018). The data directly correlates with ineffective team communication and reduced patient outcomes, emphasizing the importance of addressing communication challenges in healthcare settings. Agile methodology, known for improving communication and collaboration among team members, can offer valuable insights for

addressing these issues compared to the waterfall methods *(Rehman, Maqbool, Riaz, Qamar, & Abbas, 2018)* (See Figure 1 below).

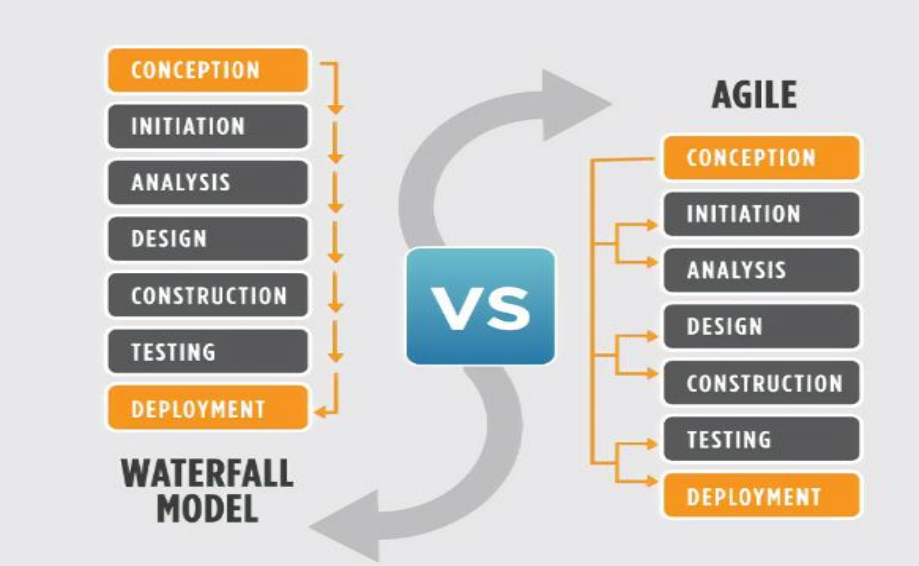

Figure 1: Agile Methodology Versus Waterfall Model (Rehman et al., 2018)

This academic article explores the theoretical relationship between agile methodologies and software maintenance. While agile methods are widely recognized for their effectiveness in producing high-quality software systems, their application in software maintenance has been discussed among researchers and engineers. The article aims to bridge this gap by exploring the implementation of the agile methodology, readiness factors, and the impact of the agile methods on patient outcomes. The article provides insights into how agile methods can be adapted and used to achieve efficient software maintenance by applying theoretical and empirical techniques. This research highlights the potential for agile methodologies to enhance patient outcomes in healthcare settings (Rehman et al., 2018). Therefore, adopting the agile method in managing interprofessional collaboration and communication in the healthcare sector is necessary.

Similarly, the healthcare sector has suffered from a lack of clear metrics for internal efficiency and external effectiveness. Data reveals that healthcare organizations have been driven to use performance data to determine efficiency and effectiveness (Malik, Ahmad, & Hussain, 2019). However, healthcare stakeholders are concerned about the lack of clear metrics for measuring operational effectiveness among healthcare teams. There is a need for healthcare teams to set and monitor the progress of healthcare goals while receiving feedback from the patients on the quality-of-care delivery. In so doing, the healthcare teams demonstrate teamwork in developing and evaluating key healthcare goals and metrics. As a result, adopting the agile methodology for managing healthcare performance is a prerequisite.

The healthcare sector has shown a shift towards technology to improve the quality of healthcare delivery and improved patient outcomes. Most healthcare organizations have experienced difficulties in transitioning to the new technology-based care delivery techniques. For instance, data shows that approximately 19% of healthcare organizations lack functionality in their electronic medical records systems (Lööw, Abrahamsson, & Johansson, 2019). Specifically, the ineffective EMR systems in most healthcare organizations lack alarms to clinicians, ease of order entry, and comprehensive health history. Research shows that the healthcare organizations' experience adapting to change can be attributed to ineffective teamwork (Unterhofer, Rauch, & Matt, 2021). Therefore, there is a need to adopt the agile methodology to make it easy to adopt technological changes and streamline the care delivery pipeline.

The competitiveness of healthcare facilities may be founded on the creative ability of healthcare professionals. Ribeiro and Domingues (2018) note that the healthcare sector evolves quickly, thus rendering some technologies obsolete. In addition, the healthcare sector experiences emerging technologies and delivery devices that allow healthcare professionals to optimize care delivery and improve patient outcomes. Despite the emerging

technologies, healthcare facilities usually face challenges in reduced Innovation and innovativeness among healthcare professionals (Rehman et al., 2018). There is a need to develop the ability to assess and address healthcare problems as they arise quickly. Therefore, adopting the agile methodology may enhance innovativeness among healthcare professionals, thus improving patient outcomes.

1.2. Problem Statement

The healthcare sector faces unprecedented challenges and opportunities in the 21st century (Zimlichman et al., 2013). Rapid technological changes, customer expectations, regulations, and competition require healthcare organizations to innovate and adapt continuously (Goniewicz, Burkle, Hall, Goniewicz, & Khorram-Manesh, 2022). However, traditional project management methods are often rigid, slow, and inefficient, leading to stakeholder delays, errors, and dissatisfaction (Ciric et al., 2019). Agile methodology has been successfully applied in various domains, such as finance, construction, and marketing (Moloto, Harmse, & Zuva, 2020). However, adopting and implementing agile methodology in healthcare is still limited. Therefore, this dissertation aims to explore the application of agile methods in managing the healthcare sector and to identify the benefits, challenges, and best practices of agile project management in healthcare.

2. Literature Review

This review examines existing research on agile implementation in healthcare, addressing its effects on patient outcomes, readiness factors, and challenges. By analyzing the literature, this review aims to provide a comprehensive understanding of the current state of agile methodology in healthcare, identifying research gaps and laying the groundwork for the study's research objectives

2.1. Agile Methodology Effects on Patient Outcomes

Existing literature has also revealed that agile methodology significantly impacts patient outcomes. While some studies assert that agile methods can improve the efficiency and fairness of access to healthcare services by using discrete event simulation and overbooking strategies to manage waiting lists and reduce patient no-shows Improta et al. (2020); Lakhani, Eze, and Peyton (2020), other studies show that Agile methodology can enhance the quality and effectiveness of health care services by using user stories and a standard nursing data model to link nurse contribution to patient outcomes and identify value improvement opportunities (Moon, Clancy, Welton, & Harper, 2019; Tsangaris et al., 2022). Similarly, some studies emphasize that Agile methodology can support clinical decision-making and research using ontologies and linked data technologies to enable semantic interoperability of health data from heterogeneous sources (Moon et al., 2019; Nordmark, Lindberg, & Zingmark, 2022). However, the existing literature does not entirely address patient-centered outcomes, indicating a research gap concerning the direct impact of Agile methodologies on patient satisfaction and engagement.

2.2. Healthcare Sector's Readiness Factors/Levels for Applying Agile Methodology

Several researchers have explored the readiness factors for applying agile methodology. One of them is organizational leadership, which should have a clear vision, mission, and strategy for agility, thus necessitating healthcare corporate leaders to support and empower the employees to make decisions and take actions in a fast and effective way (Thomas & Suresh, 2023; Vaishnavi & Suresh, 2020). Some studies present multi-skilled and multi-knowledgeable employees as a critical readiness factor for agile methodology implementation (Chakraborty, Bhatt, & Chakravorty, 2019; Thomas & Suresh, 2023). The authors further claim that employees should have diverse skills and knowledge to cope with customers' and stakeholders' changing demands and expectations (Moheimani, Sheikh, Hosseini, & Sana, 2021; Suresh, Roobaswathiny, & Lakshmi Priyadarsini, 2021; Vaishnavi, Suresh, & Dutta, 2019). Moreover, the organizational structure should be flexible, flat, and decentralized to facilitate the flow of information and resources (Thomas & Suresh, 2023; Vaishnavi et al., 2019). Furthermore, some studies revealed that the organizational culture

and organisational technology are essential in the implementation process (Chakraborty et al., 2019; Vaishnavi & Suresh, 2020). However, the reviewed articles lack empirical validation through quantitative studies that rigorously measure readiness factors' influence on Agile methodology adoption in healthcare settings.

2.3. Agile Methodology Implementation in the Healthcare Sector

Adopting and adapting Agile methodology in healthcare implementation is crucial in addressing the challenges in healthcare systems and processes (Holden, Boustani, & Azar, 2021; Ribeiro & Domingues, 2018). Agile methodology has been increasingly recognized for its potential benefits in healthcare, such as faster delivery, improved quality, and enhanced user satisfaction compared to traditional methods (Goodison, Borycki, & Kushniruk, 2019; Lakhani et al., 2020; Moloto et al., 2020). The Agile Implementation (AI) process, as described by (Boustani, Alder, & Solid, 2018), offers a structured approach to implementing evidence-based healthcare solutions. This process improves healthcare quality by reducing dementia symptoms, caregiver burden, and care expenditures (Boustani et al., 2018; Improta et al., 2020; Sial, Arshed, Amjad, & Khan, 2022). However, the broader adoption of Agile methodologies in healthcare remains limited due to challenges such as the absence of an agile culture, regulatory constraints, stakeholder complexities, and ethical concerns (Kokol, 2022; Malik et al., 2019; Rehman et al., 2018; Ribeiro & Domingues, 2018). To address these issues and unlock the full potential of Agile methodologies in healthcare, further empirical research is imperative (Kokol, 2022; Unterhofer et al., 2021). The above-reviewed articles reveal specific weaknesses, including the limited literature on adopting the Agile methodology in healthcare, necessitating more research (Improta et al., 2020; Ribeiro & Domingues, 2018).

The above literature highlights several research gaps regarding Agile methodology implementation in the healthcare sector. Firstly, there is a lack of empirical validation, especially in Agile methodology's impact on healthcare outcomes and the influence of readiness factors on adoption. Secondly, while readiness factors such as organizational leadership, multi-skilled employees, and flexible structures Thomas and Suresh (2023); Vaishnavi and Suresh (2020) are identified, there is limited empirical evidence supporting these claims, indicating a research gap in the quantitative measurement of their influence. Moreover, there is a research gap concerning patient-centered outcomes, as the existing literature tends to be less comprehensive in addressing the direct impact of Agile methodologies on patient satisfaction and engagement. Also, the current literature highlights a limited framework for implementing the agile methodology in the healthcare sector. Addressing these gaps would effectively enhance the understanding and application of Agile methodology in healthcare.

2.4. Research Objectives

Based on the above literature review, the following research objectives were formulated for the current study:

1. To evaluate the impact of Agile Methodology on patient-centered outcomes.
2. To identify key readiness factors for Agile Methodology adoption in the healthcare sector.
3. To examine the Agile Methodology implementation in the healthcare sector.

3. Methodology

This section presents the systematic literature review method used in this study.

3.1. Introduction Of Systematic Literature Review

The study adopted the systematic literature review to provide crucial insights into agile applications in the healthcare sector. The systematic literature review (SLR) method is appropriate for this topic as it offers distinct advantages compared to alternative research methods like interviews, surveys, and case studies. Firstly, an SLR provides a comprehensive and systematic analysis of existing research, ensuring that all relevant studies from various domains are included (Kelle, 2006). In contrast, interviews and surveys typically gather data from a limited sample, which may not capture the diversity of insights and perspectives in the literature (Ejimabo, 2015). Secondly, an SLR's rigorous

methodology establishes a solid evidence-based foundation for research objectives Kelle (2006), enabling a holistic understanding of the topic. Interviews and surveys, while essential for collecting primary data, may lack the depth of insights present in the existing literature (VanderWerf & Mahon, 1997). Thirdly, an SLR excels in identifying research gaps and areas lacking empirical evidence, guiding the research focus effectively (Ejimabo, 2015). Interviews and surveys are not designed for this purpose and may not provide a comprehensive view of the existing knowledge gaps (Kelle, 2006). Overall, the SLR method's comprehensiveness, evidence-based approach, and ability to identify research gaps make it a robust choice for the current dissertation.

3.2. Variable Description, Measurement, and Expected Sign

Given that the methodology involves a systematic literature review, the existing research will be synthesized and analyzed to establish the relationship between the study's variables. Table 1 below shows variable description, measurement, and expected sign.

Table 1
Variable Description, Measurement, and Expected Sign

Variable description	Measurement	Expected sign
Impact of Agile Methodology on patient-centered outcomes	Synthesis of findings from selected articles. Assess the extent to which the literature reports positive or negative consequences or mixed effects on patient-centered outcomes.	Positive (if most studies report positive impacts)
Key readiness factors for agile methodology adoption in healthcare	Synthesis of findings from selected articles. Identify and categories readiness factors reported in the literature and assess the frequency of their mention.	There is no expected sign because this objective aims to identify factors, not to measure them.
Agile Methodology implementation	Synthesis of findings from selected articles. Examine the reported challenges, benefits, and success factors related to Agile Methodology implementation in healthcare settings.	There is no expected sign because this objective aims to examine implementation trends and challenges.

3.3. Evaluation framework

The methodology adopted Arksey and O'Malley's framework, which contains five steps: research question identification, identifying relevant studies, selecting the studies to be used, data extraction, and results analysis (Figure 1) to review the literature.

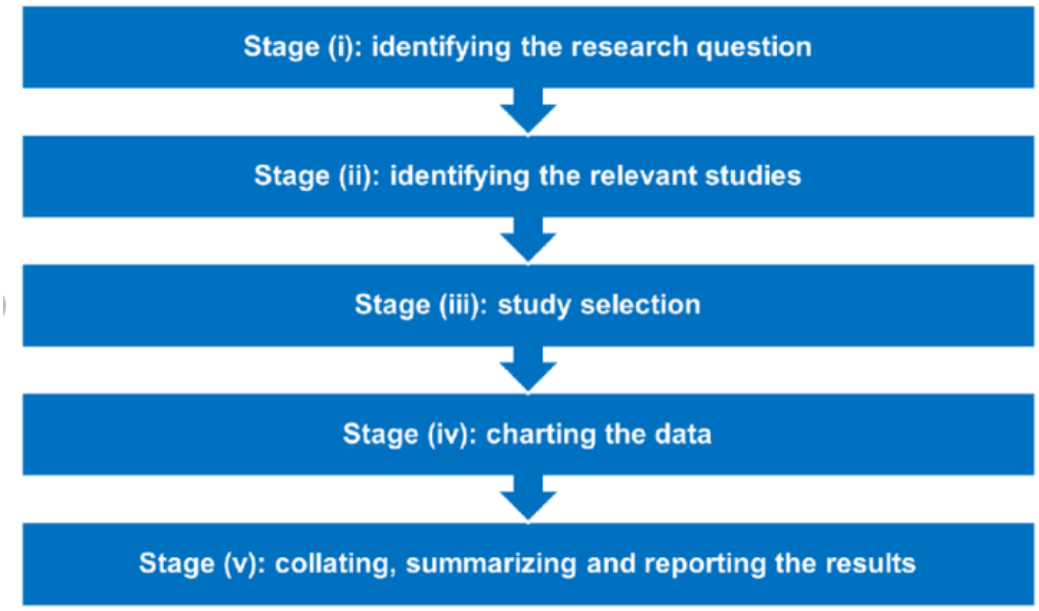

Figure 1: Arksey and O'Malley's framework (McMeekin et al., 2020)

3.3.1. Research Question Identification

The research question addressed in this paper involved "What literature is available on applying the agile methodology in the healthcare sector?" The specific research questions were as follows:

1. How does Agile Methodology impact patient-centered outcomes in the healthcare sector?
2. What are the critical readiness factors that influence the adoption of Agile Methodology in the healthcare sector?
3. How is Agile Methodology implemented in the healthcare sector, and what are the associated challenges?

3.3.2. Identifying relevant studies

The current research searched various databases containing relevant information regarding agile methodology adoption in the healthcare sector. The search engines included Google and Google Scholar. The databases include Springer, ScienceDirect, Interscience, IEEE, Elsevier, and Emerald. The researcher also attempted to retrieve information from medical journals such as TeleMedicine. The key terms used in the search were healthcare management, agile methodology, implementation science, and project management. The keywords guided the researcher to get the relevant information to answer the research question. The search criteria included articles published between 2018 and 2023 (See Table 2). The choice of articles published within the last five years was justified as they contained Up-to-date information regarding applying the agile methodology in the healthcare sector. All the materials used in the current study were in English to allow for accessible communication.

Table 2
The search processes

Search engines	**Google, Google Scholar**
Databases	Springer, ScienceDirect, Interscience, Google Scholar, IEEE, Elsevier, and Emerald. Medical journals such as TeleMedicine, BioMed, and e-Health.
Search terms	Healthcare management, agile methodology, implementation science, and project management.
Period of research	2018-2023

3.3.3. Selecting the Studies to be Used

The studies' selection adopted exclusion and inclusion criteria.

Exclusion and inclusion criteria

All the articles included in the review had to meet the inclusion criteria set by the researcher. For instance, the peer-reviewed publication had to highlight the aspect of agile methodology, especially in line with the healthcare setting. Although some studies discussed agile approaches in general, the most suited articles included the ones highlighting the agile methods within the healthcare sector. The second inclusion criterion included the peer-reviewed publications that offer a framework that guides healthcare professionals in developing and implementing agile practices. Other articles that satisfy the inclusion criterion addressed the positive patient outcomes associated with agile methodology adoption in the healthcare sector. An additional inclusion criterion involves articles addressing the readiness factors/levels of the healthcare organizations regarding the application of agile methodology (See Table 3).

Table 3
Databases used

Search Terms	Springer	Science Direct	Interscience	IEEE	Elsevier	Telemedicine	Total
Agile methodology development and implementation	15	8	12	11	10	11	67
The healthcare sector's readiness factors/levels for applying the agile methodology,	11	7	8	10	8	5	49
How agile methodology improves healthcare outcomes.	10	9	13	9	7	10	58
Total							174

On the other hand, some details were involved in the exclusion criteria. For instance, peer-reviewed articles published before 2018 were excluded as they were considered to contain outdated information relevant to the current study. Additionally, articles not written in English were excluded because of the communication barrier. Most importantly, the papers not addressing the agile methodology were also omitted from the study. The articles discussing agile methodology in other economic sectors were excluded as they were irrelevant to the study. The researcher performed a preliminary search and scanned all the results obtained. The researcher then rejected the articles that did not meet the inclusion criterion.

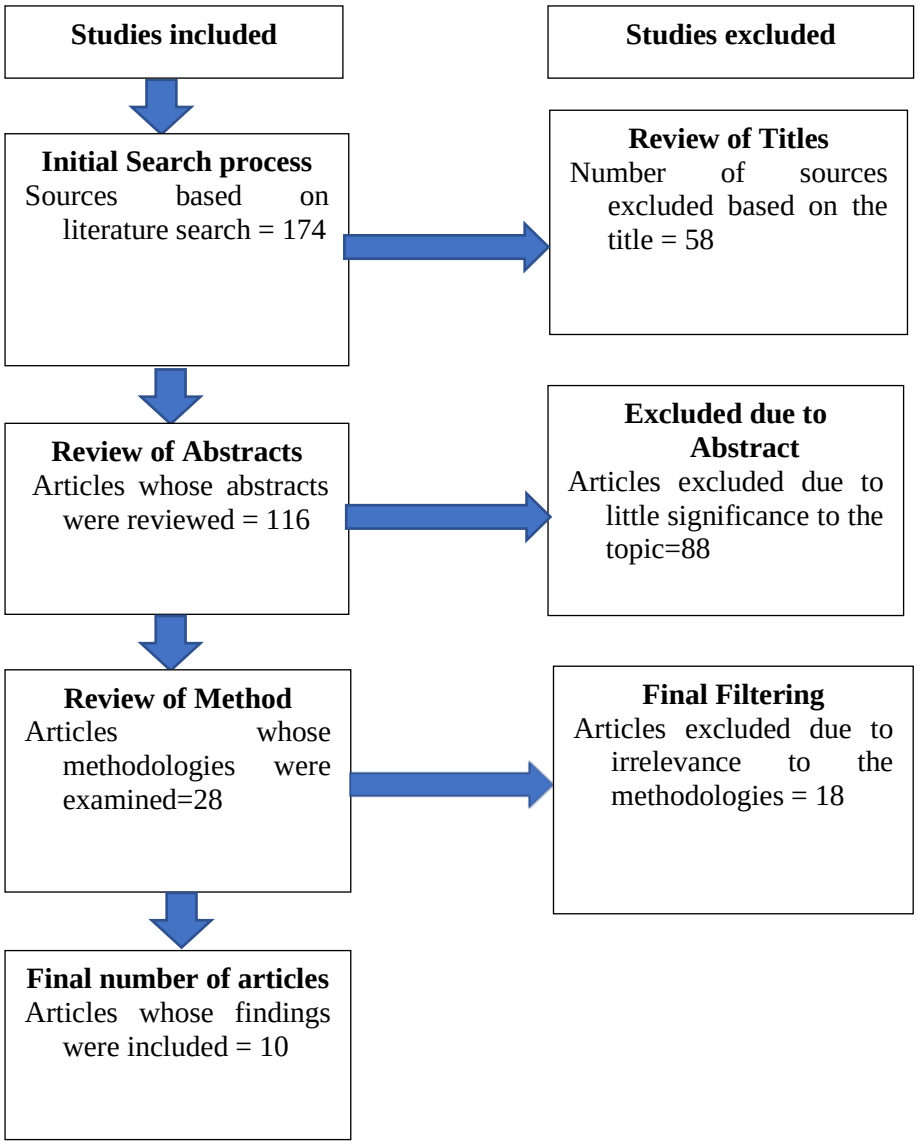

Figure 2: Inclusion and Exclusion Criteria

Notably, the researcher reviewed the abstracts and titles of the studies to determine their applicability in the current study. Further, two other researchers independently reviewed the research methodology to assess the suitability of the selected studies. Although a few disagreements arose among the researchers on the inclusion criteria, the researchers resolved the conflicts by discussing and reaching a consensus. The researcher then retrieved the selected articles from the databases for a full review. The researcher also examined the articles chosen for duplication and redundancy. Based on the above survey, the ten most relevant articles related to agile methodology application in the healthcare sector were selected to write the review paper (See figure 2).

3.3.4. Data Extraction

The researcher extracted the general study themes from the selected articles. The researcher then analyzed the studies according to the identified themes. The application approaches for the agile methodology in the healthcare sector were also extracted. The extracted information was essential in informing the application strategies for the agile method in the healthcare sector.

4. Results Analysis

4.1. Selected Studies and Characteristics

The search process generated 174 peer-reviewed articles for consideration in the current study. Most of the studies were rejected initially as they did not meet the inclusion criteria based on the titles and abstracts. Of the total articles considered, 95 articles failed the inclusion criteria as they did not address the aspect of agile methodology application in the healthcare sector. 11 articles addressed the agile methodology application but in other sectors, such as the engineering field. Six articles failed the inclusion criteria as they were published more than five years ago. Additionally, 42 articles contained duplicated and redundant information. After further reviewing the selected articles, ten were excluded based on their unrelatedness to the current topic. As a result, only ten studies qualified for the present study inclusion.

4.2. Synthesis of Findings

The study utilized the systematic review approach. The review revealed several themes that will be discussed below. Generally, little information exists in the literature regarding the application of the agile methodology in the management of the healthcare sector. Three major themes emerged from reviewing the ten selected articles: Agile methodology development and implementation in the healthcare sector, the healthcare sector's readiness factors/levels for applying agile methodology, and how agile methods improve healthcare outcomes.

4.2.1. Theme One: Healthcare Sector's Readiness Factors/levels for Applying Agile Methodology

The literature review revealed the healthcare sector's readiness factors/levels for using agile methodology as one of the themes across various articles (Thomas & Suresh, 2023; Vaishnavi & Suresh, 2020). The articles identified readiness factors for agile methodology application, such as organizational leadership, flexible structures, advanced technology, and innovativeness (Sindhwani, Mittal, Singh, Aggarwal, & Gautam, 2019; Thomas & Suresh, 2023; Vaishnavi & Suresh, 2020). The authors reiterated that the readiness of healthcare organizations to adopt Agile methodologies relies on such factors. Articles emphasize that organizations must align their strategies with Agile principles and values to successfully implement Agile in healthcare. Additionally, customer focus, teamwork, leadership, Innovation, and learning were identified as enablers of Agile methodology adoption (Sindhwani et al., 2019).

The findings for theme one is presented in the table below.

Table 4
Healthcare Sector's Readiness Factors/levels for Applying Agile Methodology

Author	Findings
Sindhwani et al. (2019)	Agile healthcare systems require customer focus, teamwork, leadership, Innovation, and learning. Barriers include lack of training, resistance to change, regulatory constraints, and complexity of healthcare processes. They are implemented through agile training, pilot projects, and interdisciplinary teams.
Vaishnavi & Suresh (2020)	Readiness factors include organizational leadership, multi-skilled employees, and flexible structures. These factors support agile methodology implementation by enabling quick decision-making and adapting to changing demands.
Thomas & Suresh (2023)	Key readiness factors for agility in healthcare are organizational leadership, flexible service design, advanced technology and innovativeness, and strategy alignment. Achieving agility requires focusing on these factors.

The above findings reiterate the importance of organizational leadership, flexible structures, advanced technology, and innovativeness for achieving agility in healthcare (Sindhwani et al., 2019; Thomas & Suresh, 2023; Vaishnavi & Suresh, 2020). The authors also suggest that these factors can help healthcare organizations to cope with the challenges of complexity, uncertainty, and changing customer needs. While Sindhwani et al. (2019) emphasizes the role of customer focus, teamwork, and learning as enablers of agile methodology, Vaishnavi and Suresh (2020) highlight the need for multi-skilled employees who can perform different roles within the agile team. Thomas and Suresh (2023) also add strategy alignment as a critical readiness factor for agility, which implies that the organizational goals and objectives should be aligned with the agile principles and values.

4.2.2. Theme Two: Impact of Agile Methodology on Patient Outcomes

The second theme that the SLR revealed includes the impact of agile methodology on patient outcomes. This theme highlights the benefits of applying Agile methodologies in healthcare (Amugongo, Kriebitz, Boch, & Lütge, 2023; Lakhani et al., 2020; Miyake, Ito, & Karasuyama, 2022). Agile principles enhance patient outcomes, especially in managing chronic conditions like ADHD, by creating feedback loops between patients, caregivers, and clinicians (Lakhani et al., 2020). Additionally, Agile software development may operationalize AI ethics in healthcare, ensuring fairness, agility, precision, safeguarding humanity, respect for others, trust and accountability, and robustness and reproducibility in AI-enabled mHealth applications (Amugongo et al., 2023). Also, the articles stressed the importance of feedback loops, collaboration, and adaptation to improve patient-centered care (Amugongo et al., 2023; Lakhani et al., 2020; Miyake et al., 2022). The findings for theme two are presented in the table below.

Table 5
Impact of Agile Methodology on Patient Outcomes

Author	Findings
(Lakhani et al., 2020)	Agile principles applied to collaborative healthcare teams can enhance the management of chronic conditions like ADHD by creating feedback loops between patients, caregivers, and clinicians.
(Miyake et al., 2022)	Agile software development can operationalize AI ethics in healthcare, ensuring fairness, agility, precision, safeguarding humanity, respect for others, trust and accountability, and robustness and reproducibility in AI-enabled mHealth applications.
Miyake et al. (2022)	The AIDAF framework integrates enterprise architecture with strategic risk management, facilitating decentralized clinical trials and compliance in healthcare. The model's contribution to Industry 4.0 and Society 5.0 is promising.

The above findings highlight the benefits of applying agile methods and frameworks in healthcare, such as improving patient outcomes, enhancing ethical standards, and facilitating Innovation (Amugongo et al., 2023; Lakhani et al., 2020; Miyake et al., 2022). The authors also emphasize the importance of healthcare feedback loops, collaboration, and adaptation to improve patient outcomes. While Lakhani et al. (2020) focus on the patient-

centered aspect of agile healthcare, Amugongo et al. (2023); Miyake et al. (2022) focus on the technical and organizational aspects. For instance, Amugongo et al. (2023) propose a specific agile software development approach for operationalizing AI ethics in healthcare, while Lakhani et al. (2020); Miyake et al. (2022) offer more general agile principles and frameworks for collaborative healthcare teams and enterprise architecture respectively.

4.2.3. Theme Three: Agile Methodology Development and Implementation in the Healthcare Sector

The literature review also presented Agile methodology development and implementation in the healthcare sector as the third theme. The theme focuses on the application of Agile principles and frameworks in healthcare (Holden et al., 2021; Mamatha & Bhosle, 2023; Rahy & Bass, 2022; Vaishnavi & Suresh, 2020). The articles revealed the importance of customer-centricity in Agile methodologies. "Agile Innovation" is introduced as a customer-centered process for developing innovative solutions in complex healthcare systems (Holden et al., 2021). The articles highlight the adaptability of Agile methods for designing medical devices and software, offering advantages like speed-to-market, flexibility, robustness, and customer satisfaction (Mamatha & Bhosle, 2023). Additionally, managing non-functional requirements (NFRs) in Agile software development is emphasized (Rahy & Bass, 2022). The findings for theme three are presented in the table below.

Table 6
Agile Methodology Development and Implementation in the Healthcare Sector

Author	Findings
(Holden et al., 2021)	Agile Innovation, a customer-centered process for developing and testing innovative solutions in complex healthcare systems, combines insights from design thinking, Agile project management, and complexity sciences.
(Mamatha & Bhosle, 2023)	Agile methods can be adapted for designing and developing medical devices and software in the medical industry. These methods offer advantages like speed-to-market, flexibility, robustness, and customer satisfaction.
(Rahy & Bass, 2022)	Managing non-functional requirements (NFRs) is critical in agile software development. Different methods and tools are proposed to enhance the management of NFRs, ensuring software effectiveness and customer satisfaction.
(Rahy & Bass, 2022)	The article proposes a fuzzy logic approach to assess the readiness level of healthcare organizations for implementing agility, which is the capability to respond quickly and flexibly to changing customer needs and environmental uncertainties. The article calculates the Fuzzy Readiness for the Implementation of the Agility Index (FRAI) and the Fuzzy Performance Importance Index (FPII) to determine the readiness level of the case hospital and its weaker attributes in implementing agility. The article finds that the case hospital is "average ready" for implementing agility and identifies fifteen more invalid features that need improvement. The report also provides suggestions for enhancing readiness based on expert opinions and a literature review.

The above articles emphasize customer-centricity and Agile principles. Specifically, Holden et al. (2021); Mamatha and Bhosle (2023) emphasize the importance of customer-centricity, while Holden et al. introduce "Agile Innovation," which focuses on customer-centered development. While Mamatha & Bhosle highlight Agile's adaptability in enhancing customer satisfaction, Mamatha and Bhosle (2023); Vaishnavi and Suresh (2020) explore applying Agile principles in healthcare. On the one hand, Vaishnavi and Suresh (2020) propose a fuzzy logic approach for assessing the readiness level of healthcare organizations for implementing agility. On the other hand, Rahy and Bass (2022) aim to ensure software effectiveness and customer satisfaction by enhancing the management of NFRs.

5. Discussion, Conclusion, and Recommendations

This section presents the discussion, conclusion, and recommendations for the study.

5.1. Discussion

The findings reveal crucial insights into the agile methodology's effects on patient outcomes. Indicate that Agile methods can enhance healthcare outcomes. For example, Lakhani et al. (2020) emphasize the potential benefits of Agile principles applied to collaborative healthcare teams in strengthening the management of chronic conditions, aligning with the idea of improving healthcare effectiveness. This finding matches existing literature, which asserts that agile methodology can improve the efficiency and fairness of access to healthcare services (Improta et al., 2020; Lakhani et al., 2020). However, the above findings focus more on technical and organizational aspects Amugongo et al. (2023); Miyake et al. (2022), while the literature review emphasizes the need to explore patient-centered outcomes.

Regarding the healthcare sector's readiness factors/levels for applying the agile methodology, the findings highlight the importance of organizational leadership and flexible structures (Thomas & Suresh, 2023; Vaishnavi & Suresh, 2020). These findings match those by Thomas and Suresh (2023); Vaishnavi and Suresh (2020) who identify organizational leadership, multi-skilled employees, flexible structures, corporate culture, and technology as some of the readiness factors for applying Agile methodology in healthcare. Therefore, this indicates that such factors are important considerations in adopting the agile methodology. However, Chakraborty et al. (2019); Vaishnavi and Suresh (2020) introduce the concept of organizational culture and technology as readiness factors, which are not explicitly discussed in this study's findings.

Regarding agile methodology implementation in the healthcare sector, the study's findings recognize the benefits of Agile methodologies in healthcare, such as faster delivery, improved quality, and enhanced user satisfaction compared to traditional (Lakhani et al., 2020; Miyake et al., 2022). They also acknowledge challenges in broader adoption, such as the absence of an agile culture and regulatory constraints. However, the articles mainly focus on specific applications of Agile methodologies, like Agile Innovation Holden et al. (2021) and managing non-functional requirements (Rahy & Bass, 2022). While these applications align with the broader idea of improving healthcare quality and efficiency, they are more specialized. These findings match those by Goodison et al. (2019); Lakhani et al. (2020); Moloto et al. (2020), who identified benefits of agile methodology in healthcare such as faster delivery, improved quality, and enhanced user satisfaction compared to traditional methods.

5.2. Conclusion

This systematic review has successfully met its research objectives, highlighting the growing significance of Agile methodology in healthcare management and its potential to improve patient outcomes. The selected studies' findings indicated that Agile practices can positively influence healthcare efficiency, access, and quality Amugongo et al. (2023); Lakhani et al. (2020); Miyake et al. (2022), aligning with the existing literature. Moreover, the systematic review has validated the importance of readiness factors, including organizational leadership, flexible structures, and employee skills Thomas and Suresh (2023); Vaishnavi and Suresh (2020), as crucial elements for successful Agile adoption in healthcare settings.

However, it also revealed challenges in healthcare organizations' readiness for Agile adoption. This review has provided crucial insights into the state of Agile methodology in healthcare and has contributed to advancing our understanding of how it can positively impact the sector. To realize the full potential of Agile methodologies, healthcare organizations and policymakers must address the identified challenges and priorities the development of Agile capabilities.

5.2.1. Policy Implications

The findings of this systematic review have some policy implications for the healthcare sector. To realize the benefits of Agile methodology, healthcare organizations and policymakers should priorities developing training programs and resources to equip

healthcare professionals with Agile-related skills and knowledge. Moreover, there is a pressing need for policies that promote a flexible and adaptive organizational culture within healthcare institutions. Regulatory frameworks should be updated to accommodate Agile practices while addressing ethical and privacy concerns associated with Agile methodologies in healthcare. Policymakers should encourage research funding to bridge existing gaps and promote further exploration of Agile's applications in healthcare.

5.2.2. Policy Recommendations and Future Research

This study suggests the following recommendations:

- Healthcare institutions should priorities training and development programs to enhance healthcare professionals' Agile competencies.
- Healthcare organizations should cultivate a culture of adaptability and openness to change to facilitate the successful adoption of Agile methodologies.
- More quantitative research studies should be conducted to empirically validate the influence of readiness factors on Agile adoption in healthcare settings.
- Future research should priorities research on patient-centered outcomes associated with Agile methodologies to fill the existing gaps in the literature.
- More research should undertake comparative studies to evaluate the effectiveness of Agile methodologies in healthcare compared to traditional approaches.

5.2.3. Limitations

This study presents several limitations. For instance, the included studies exhibited a specific heterogeneity regarding research methods, populations, and settings. This heterogeneity could introduce variability into the synthesized findings. Secondly, the review was limited to articles published within 2018-2023, thus excluding relevant recent studies. Additionally, the quality of the included articles varied, which may have influenced the robustness of the findings. Additionally, the review primarily focused on Agile methodology in healthcare. While it addressed readiness factors and impacts, a comprehensive examination of specific patient-centered outcomes was not within the scope of the review.

Authors Contribution

Fawaz Alotaibi: Contribution in the research idea and content writing.
Riyad Almudhi: Contributed to the research writing.

Conflict of Interests/Disclosures

The authors declared no potential conflicts of interest w.r.t the research, authorship and/or publication of this article.

References

Amugongo, L. M., Kriebitz, A., Boch, A., & Lütge, C. (2023). Operationalising AI ethics through the agile software development lifecycle: a case study of AI-enabled mobile health applications. *AI and Ethics*, 1-18. doi:https://doi.org/10.1007/s43681-023-00331-3

Boustani, M., Alder, C. A., & Solid, C. A. (2018). Agile implementation: a blueprint for implementing evidence-based healthcare solutions. *Journal of the American Geriatrics Society, 66*(7), 1372-1376. doi:https://doi.org/10.1111/jgs.15283

Chakraborty, S., Bhatt, V., & Chakravorty, T. (2019). Impact of IoT adoption on agility and flexibility of healthcare organization. *International Journal of Innovative Technology and Exploring Engineering, 8*(11), 2673-2681. doi:http://doi.org/10.35940/ijitee.K2119.0981119

Ciric, D., Lalic, B., Gracanin, D., Tasic, N., Delic, M., & Medic, N. (2019). Agile vs. Traditional approach in project management: Strategies, challenges and reasons to introduce agile. *Procedia Manufacturing, 39*, 1407-1414. doi:https://doi.org/10.1016/j.promfg.2020.01.314

Ejimabo, N. O. (2015). The effective research process: Unlocking the advantages of ethnographic strategies in the qualitative research methods. *European Scientific Journal, 11*(23).

Goniewicz, K., Burkle, F. M., Hall, T. F., Goniewicz, M., & Khorram-Manesh, A. (2022). Global public health leadership: The vital element in managing global health crises. *Journal of Global Health, 12*. doi:https://doi.org/10.7189%2Fjogh.12.03003

Goodison, R., Borycki, E. M., & Kushniruk, A. W. (2019). Use of Agile Project Methodology in Health Care IT Implementations: A Scoping Review. *ITCH*, 140-145. doi:https://doi:10.3233/978-1-61499-951-5-140

Holden, R. J., Boustani, M. A., & Azar, J. (2021). Agile Innovation to transform healthcare: innovating in complex adaptive systems is an everyday process, not a light bulb event. *BMJ Innovations, 7*(2). doi:https://doi:10.1136/bmjinnov-2020-000574

Improta, G., Guizzi, G., Ricciardi, C., Giordano, V., Ponsiglione, A. M., Converso, G., & Triassi, M. (2020). Agile six sigma in healthcare: Case study at santobono pediatric hospital. *International journal of environmental research and public health, 17*(3), 1052. doi:https://doi:10.3390/ijerph17031052

Kelle, U. (2006). Combining qualitative and quantitative methods in research practice: purposes and advantages. *Qualitative research in psychology, 3*(4), 293-311. doi:https://doi.org/10.1177/1478088706070839

Kokol, P. (2022). Agile Software Development in Healthcare: A Synthetic Scoping Review. *Applied Sciences, 12*(19), 9462. doi:https://doi:10.3390/app12199462

Lakhani, R., Eze, B., & Peyton, L. (2020). Applying Agile Principles to Collaborative Healthcare Teams. *HEALTHINF*, 506-513. doi:http://dx.doi.org/10.5220/0008984105060513

Lööw, J., Abrahamsson, L., & Johansson, J. (2019). Mining 4.0—The impact of new technology from a work place perspective. *Mining, Metallurgy & Exploration, 36*, 701-707. doi:https://doi.org/10.1007/s42461-019-00104-9

Malik, R. S., Ahmad, S. S., & Hussain, M. T. H. (2019). A review of agile methodology in IT projects. *Proceedings of 2nd International Conference on Advanced Computing and Software Engineering (ICACSE)*. doi:https://dx.doi.org/10.2139/ssrn.3351064

Mamatha, G., & Bhosle, V. (2023). Adaptation of Agile Development in Medical Industry. *Information and Communication Technology for Competitive Strategies (ICTCS 2022) Intelligent Strategies for ICT*, 155-166. doi:https://doi.org/10.1007/978-981-19-9304-6_16

Miyake, K., Ito, J., & Karasuyama, H. (2022). Role of basophils in a broad spectrum of disorders. *Frontiers in immunology, 13*, 902494. doi:https://doi.org/10.3389/fimmu.2022.902494

Moheimani, A., Sheikh, R., Hosseini, S. M. H., & Sana, S. S. (2021). Assessing the agility of hospitals in disaster management: application of interval type-2 fuzzy Flowsort inference system. *Soft Computing, 25*, 3955-3974. doi:https://doi.org/10.1007/s00500-020-05418-1

Moloto, M., Harmse, A., & Zuva, T. (2020). Impact of agile methodology use on project success in organizations-a systematic literature review. *Proceedings of the Computational Methods in Systems and Software*, 267-280. doi:https://doi.org/10.1007/978-3-030-63322-6_21

Moon, L. A., Clancy, G., Welton, J., & Harper, E. (2019). Nursing value user stories: A value measurement method for linking nurse contribution to patient outcomes. *CIN: Computers, Informatics, Nursing, 37*(3), 161-170. doi:https://doi.org/10.1097/cin.0000000000000520

Nordmark, S., Lindberg, I., & Zingmark, K. (2022). "It's all about time and timing": nursing staffs' experiences with an agile development process, from its initial requirements to the deployment of its outcome of ICT solutions to support discharge planning. *BMC Medical Informatics and Decision Making, 22*(1), 186. doi:https://doi:10.1186/s12911-022-01932-4.

Rahy, S., & Bass, J. M. (2022). Managing non-functional requirements in agile software development. *IET software, 16*(1), 60-72. doi:https://doi.org/10.1049/sfw2.12037

Rehman, F., ur, Maqbool, B., Riaz, M. Q., Qamar, U., & Abbas, M. (2018). Scrum software maintenance model: Efficient software maintenance in agile methodology. *2018 21st Saudi computer society national computer conference (NCC)*, 1-5. doi:https://doi:10.1109/NCG.2018.8593152

Ribeiro, A., & Domingues, L. (2018). Acceptance of an agile methodology in the public sector. *Procedia computer science, 138*, 621-629. doi:https://doi:10.1016/j.procs.2018.10.083

Sial, M. H., Arshed, N., Amjad, M. A., & Khan, Y. A. (2022). Nexus between fossil fuel consumption and infant mortality rate: a non-linear analysis. *Environmental Science and Pollution Research, 29*(38), 58378-58387. doi:https://doi.org/10.1007/s11356-022-19975-5

Sindhwani, R., Mittal, V. K., Singh, P. L., Aggarwal, A., & Gautam, N. (2019). Modelling and analysis of barriers affecting the implementation of lean green agile manufacturing system (LGAMS). *Benchmarking: An International Journal, 26*(2), 498-529. doi:https://doi.org/10.1108/BIJ-09-2017-0245

Suresh, M., Roobaswathiny, A., & Lakshmi Priyadarsini, S. (2021). A study on the factors that influence the agility of COVID-19 hospitals. *International Journal of Healthcare Management, 14*(1), 290-299. doi:https://doi.org/10.1080/20479700.2020.1870355

Thomas, A., & Suresh, M. (2023). Readiness for agile-sustainability in health-care organizations. *International Journal of Quality and Service Sciences*. doi:https://doi.org/10.1108/IJQSS-06-2022-0056

Tsangaris, E., Edelen, M., Means, J., Gregorowitsch, M., O'Gorman, J., Pattanaik, R., . . . Schrieber, K. (2022). User-centered design and agile development of a novel mobile health application and clinician dashboard to support the collection and reporting of patient-reported outcomes for breast cancer care. *BMJ Surgery, Interventions, & Health Technologies, 4*(1). doi:https://doi:10.1136/bmjsit-2021-000119

Unterhofer, M., Rauch, E., & Matt, D. T. (2021). Hospital 4.0 roadmap: an agile implementation guideline for hospital manager. *International Journal of Agile Systems and Management, 14*(4), 635-656. doi:https://doi.org/10.1504/IJASM.2021.120230

Vaishnavi, V., & Suresh, M. (2020). Assessing the readiness level of healthcare for implementing agility using fuzzy logic approach. *Global Journal of Flexible Systems Management, 21*(2), 163-189. doi:https://doi:10.1007/s40171-020-00237-7

Vaishnavi, V., Suresh, M., & Dutta, P. (2019). Modelling the readiness factors for agility in healthcare organization: a TISM approach. *Benchmarking: An International Journal, 26*(7), 2372-2400. doi:https://doi:10.1108/BIJ-06-2018-0172.

VanderWerf, P. A., & Mahon, J. F. (1997). Meta-analysis of the impact of research methods on findings of first-mover advantage. *Management Science, 43*(11), 1510-1519. doi:https://doi.org/10.1287/MNSC.43.11.1510

Zimlichman, E., Henderson, D., Tamir, O., Franz, C., Song, P., Yamin, C. K., . . . Bates, D. W. (2013). Health care–associated infections: a meta-analysis of costs and financial impact on the US health care system. *JAMA internal medicine, 173*(22), 2039-2046. doi:https://doi.org/10.1001/jamainternmed.2013.9763