

Healthcare Quality Improvement Strategies: A Meta-analysis of Their Impact on Patient Safety and Satisfaction

Strategi Peningkatan Kualitas Layanan Kesehatan: Sebuah Meta-analisis Dampaknya terhadap Keselamatan dan Kepuasan Pasien

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ABSTRACT

Technology-based health service quality improvement strategies aim to increase efficiency, effectiveness and quality of health services. However, key challenges in improving patient satisfaction and safety require further attention. This study aims to evaluate the effectiveness of technology-based strategies in improving patient satisfaction and safety. The research method uses a meta-analysis approach by collecting articles from databases such as Scopus and PubMed, and applying the PRISMA method for filtering articles. The research results show that the use of technology such as wearable devices, artificial intelligence (AI), and the Internet of Things (IoT) has a significant positive impact on patient safety and satisfaction. Implications of this research include recommendations for health policy, clinical practice, training and education, as well as increasing patient involvement in the care process.

Keywords: Improving the quality of health services, health technology, patient safety, patient satisfaction

ABSTRAK

Strategi peningkatan kualitas layanan kesehatan berbasis teknologi bertujuan untuk meningkatkan efisiensi, efektivitas, dan kualitas pelayanan kesehatan. Namun, tantangan utama dalam meningkatkan kepuasan dan keselamatan pasien memerlukan perhatian lebih lanjut. Penelitian ini bertujuan untuk mengevaluasi efektivitas strategi berbasis teknologi dalam meningkatkan kepuasan dan keselamatan pasien. Metode penelitian menggunakan pendekatan meta-analisis dengan mengumpulkan artikel dari database seperti Scopus dan PubMed, serta menerapkan metode PRISMA untuk penyaringan artikel. Hasil penelitian menunjukkan bahwa penggunaan teknologi seperti perangkat wearable, kecerdasan buatan (AI), dan Internet of Things (IoT) memiliki dampak positif yang signifikan terhadap keselamatan dan kepuasan pasien. Implikasi penelitian ini mencakup rekomendasi untuk kebijakan kesehatan, praktik klinis, pelatihan dan pendidikan, serta peningkatan keterlibatan pasien dalam proses perawatan.

Kata Kunci: Peningkatan kualitas layanan kesehatan, Teknologi kesehatan, Keselamatan pasien, Kepuasan pasien

1. Introduction

A strategy to improve the quality of technology-based health services is an approach that aims to increase efficiency, effectiveness and overall quality of services provided to patients. Conceptually, this strategy involves the application of information and communication technology in various aspects of health services, from patient data management to the development of clinical decision support systems. The technology not only supports more

precise and faster decision making by health workers, but also facilitates better access to health information for patients. In this context, patient satisfaction and patient safety play a central role as the main indicators in evaluating the success of implementing the strategy. Patient satisfaction reflects patients' positive perceptions of their experience in receiving health services, while patient safety refers to efforts to prevent unwanted injuries or complications during the medical care process. In an era of modern healthcare characterized by increasing complexity and higher expectations from patients, technology-based strategies are crucial to meeting safe, effective and high-quality service standards for the entire patient population.

The main challenges faced in increasing patient satisfaction and patient safety in the context of modern health services are a critical focus in efforts to improve service quality. Patient satisfaction not only reflects subjective aspects of their experience in interactions with health services, but is also an important indicator of the success of quality management strategies. On the other hand, patient safety is the main priority in preventing medical errors that can have a negative impact on patient health outcomes. The use of technology is considered a potential solution in overcoming this challenge. Information and communication technologies, such as electronic medical record management systems and artificial intelligence applications for risk prediction, can improve care coordination, minimize errors in clinical decision making, and strengthen communication between the care team and the patient. The research question that arises is: "How effective are technology-based health service quality improvement strategies in increasing patient satisfaction and patient safety?" This question led the research to explore empirical evidence about the impact of technology strategies on these two critical aspects in the current health care context.

A review of the literature on technology-based healthcare quality improvement strategies reveals several shortcomings and blank areas that require further attention. Although much research has explored the implementation of technology in the healthcare context, there is still limited understanding of the actual effectiveness of these strategies in improving patient satisfaction and holistic patient safety. Some studies tend to focus on the technical and implementation aspects of the technology, without adequately evaluating its impact on broader patient outcomes. Additionally, there is a need to identify contextual factors that may influence the success of these technology strategies in various health care settings. Further research is needed to fill this gap with stronger and more comprehensive empirical evidence, so as to provide clearer guidance for practitioners and policy makers in effectively adopting and implementing technology-based health service quality improvement strategies.

Exploring new strategies to improve the quality of health services, especially in the context of technology, is of paramount importance today. In an era where technology continues to develop rapidly, its use in health services can provide innovative solutions to complex challenges in increasing patient satisfaction and patient safety. By adopting the right technology, such as an integrated health information management system or artificial intelligence applications for clinical data analysis, healthcare institutions can optimize care processes, improve diagnostic accuracy, and reduce the risk of medical errors. The positive implications of this research are not only limited to increasing the efficiency and effectiveness of health services, but can also influence the formation of health policies that are more adaptive and responsive to technological changes. Thus, it is hoped that this research can provide a solid scientific basis to support the adoption of new strategies that have the potential to change the paradigm in global health services.

This research is expected to make a significant contribution to broadening our understanding of the effectiveness of technology-based strategies in the health care context. Specifically, this research will explore empirical evidence about how technology can impact two critical aspects of health care: patient satisfaction and patient safety. The new approach brought about by this research includes an in-depth assessment of various technologies that

can be used to improve service quality, as well as an analysis of the contextual factors that influence the successful implementation of these strategies in various health settings. Through a systematic and comprehensive approach, this research aims to provide a deeper and more detailed understanding of the working mechanisms, benefits and challenges of using technology in improving patient health outcomes.

The contribution of this research is not only limited to academia, but also has the potential to have a significant impact on health practice. It is hoped that the findings and recommendations from this research will assist practitioners in selecting, implementing, and adapting technology strategies that suit their needs and local context. In addition, this research can become a basis for further research in this field, broadening horizons and directing the direction of future research to continue to improve the quality of health services globally.

2. Research Methods

2.1. Article Collection

To collect related articles, reputable international databases such as Scopus and PubMed are used. The search keywords used included "healthcare quality improvement", "technology-based strategies", "patient satisfaction", and "patient safety". The use of these keywords is designed to cover literature relevant to the implementation of technology in improving the quality of health services.

2.2. The PRISMA method

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method was used as a guide for screening articles. PRISMA helps ensure that the systematic review process is carried out systematically and transparently, from article identification to presentation of final results. This method includes steps such as article identification, quality assessment, and synthesis of relevant data.

2.3. Number of Articles

From the initial search carried out using the keywords mentioned, the total articles found were [number of articles]. The article selection process is carried out in stages, starting from screening the title and abstract to determine whether the article meets the predetermined inclusion criteria.

2.4. Article Inclusion and Exclusion Techniques

Article inclusion criteria include studies that document the use of technology in efforts to improve the quality of health services, both in terms of patient satisfaction and patient safety. These studies may include the use of electronic health information systems, telemedicine applications, or other relevant technologies.

Exclusion criteria included articles that were not relevant to the focus of the study, such as articles that only discussed technical aspects without evaluating their impact on patient health outcomes, or articles that did not provide sufficient data for further analysis.

3. Results and Discussions

3.1. Theoretical Foundation

3.1.1. The concept of a strategy to improve the quality of health services

To improve the quality of health services, a multifaceted strategy is crucial by combining various approaches that have been identified in the literature. One important aspect emphasized is the need for a quality improvement system that is sustainable, covers the entire organization, is well funded, regularly monitored, and integrated into long-term strategies (Meziane et al., 2023). This involves the active involvement of quality managers who can embed quality assurance practices throughout the healthcare organization. In addition, the

integration of patient involvement in quality improvement efforts is critical, with recommendations to adopt a phased approach, build support parties, demonstrate value, focus on resistant groups, prioritize peer support, and link it to patient-based care (Bergerum et al., 2019; Mulvale et al., 2019; Putri et al., 2021).

The role of leadership plays an important role in driving improvements in the quality of health services, with research emphasizing the importance of implementing effective leadership styles within hospitals (Salsabila, 2024). Additionally, addressing managerial challenges in healthcare in rural and underserved areas is crucial for optimizing operational efficiency, recruiting skilled professionals, and integrating new technologies to improve the quality of care (Babawarun, 2024). Public health care agencies are encouraged to bridge existing governance gaps by taking evidence-based actions to pursue high-quality care, despite challenges from traditional health professional models (Leggat & Balding, 2019).

In the context of service quality from the patient's perspective, evaluating and addressing hospital service quality is fundamental for managers and decision makers to plan and implement improvements effectively (Khezeli, 2021). Furthermore, understanding perceptions of service quality, satisfaction, and behavioral intentions in health services is very important, because these things are the main determinants of patient outcomes and experiences (Suhail & Srinivasulu, 2021).

Strategies to improve health services must consider the challenges faced by stakeholders, including service users and health professionals, to ensure comprehensive and effective improvements (Putri et al., 2021). In conclusion, a comprehensive strategy to improve the quality of health services involves the integration of patient involvement, implementation of continuous quality improvement systems, adoption of effective leadership styles, overcoming managerial challenges, and reducing governance gaps. By considering the viewpoints of multiple stakeholders and implementing evidence-based actions, healthcare organizations can work toward high-quality care and improved patient outcomes.

3.1.2. Technology in health services

The integration of technology in healthcare has significantly changed the healthcare landscape, providing innovative solutions to improve patient care, operational efficiency and overall progress in this field. Technologies such as the Internet of Things (IoT), wearable devices, artificial intelligence (AI), blockchain, and digital twins have played an important role in advancing healthcare delivery (Stoumpos et al., 2023; Pradhan et al., 2021; Dwivedi et al., 2019; Vasquez et al., 2023; These technologies enable health professionals to analyze patient needs remotely, provide high-quality medical services, simplify the diagnosis and treatment process, and improve scalability and security in the health system (Pradhan et al., 2021; Dwivedi et al., 2019; Vasquez et al., 2023; Cheung et al., 2023; Additionally, the adoption of advanced technologies such as IoT, wearable devices, and digital twins has resulted in improved patient outcomes, increased efficiency, and reduced healthcare costs (Cheung et al., 2019; Das et al., 2022).

Apart from improving the quality of services, technological advances are also revolutionizing medical practice and patient care, marking a paradigmatic shift in the healthcare industry (Yadav, 2024; "Securing the Future: Technological Innovations for Social Medical Public Healthcare Security", 2024). Governments and policymakers around the world are implementing technology-based policies to address health challenges, including those posed by the COVID-19 pandemic, and to improve health service delivery (Khan, 2024). The integration of innovative technologies such as AI, mobile health (mHealth), and advanced radiology has become essential in the global health system, emphasizing the critical role of digitalization in healthcare (Najjar, 2024).

Additionally, the evolution of wearable devices, real-time disease monitoring, and personalized healthcare solutions have significantly improved the quality and effectiveness of

medical services, enabling personalized diagnosis and prognosis through small sensors and biomedical devices (Guk et al., 2019). These technological strides not only improve medical precision and quality but also make healthcare more accessible and efficient, fundamentally changing healthcare delivery and patient care (Guk et al., 2019). In conclusion, the integration of technology in healthcare has brought about a paradigmatic shift in the healthcare industry, offering unprecedented opportunities to improve patient care, increase operational efficiency, and drive overall progress. By leveraging technologies such as IoT, AI, wearable devices, and digital solutions, healthcare providers can deliver more personalized, efficient, and safe services, ultimately improving patient outcomes and changing the healthcare landscape altogether.

3.1.3. The relationship between patient satisfaction and patient safety

Several studies have investigated the complex relationship between patient satisfaction and patient safety, which is an important component of healthcare quality. Alolayyan et al. (2023) found a significant relationship between pharmacist performance and patient satisfaction, where pharmacist performance mediated the relationship between patient safety culture and patient satisfaction. This emphasizes the importance of effective pharmacy practices in improving the overall patient experience and safety. Similarly, Jaber et al. (2022) highlighted that nurses' satisfaction with shift reports and attitudes toward bedside shift reports were significantly correlated with patient safety culture, suggesting that improving nursing practice can have a positive impact on patient safety.

Apart from that, Kusnitalia et al. (2020) demonstrated a direct relationship between patient safety and family satisfaction, indicating that high levels of patient safety contribute to increased levels of family member satisfaction. Additionally, Fadli et al. (2020) and Purwani et al. (2020) support a positive relationship between patient safety initiatives and patient satisfaction, highlighting that strong safety practices lead to increased levels of patient satisfaction.

Further studies emphasize the role of the nurse-patient relationship in improving nurses' care satisfaction, which in turn contributes to better patient safety (Guo et al., 2023). Burlakov et al. (2021) highlight the importance of creating a supportive safety climate in hospital wards and empowering family members, which can ultimately increase patient satisfaction levels.

Overall, these findings demonstrate a strong interdependence between patient satisfaction and patient safety. Improving the performance of health service providers, building a supportive safety culture, strengthening positive interactions between nurses and patients, and empowering family involvement, are crucial strategies for increasing patient satisfaction levels and ultimately improving patient safety in various health care settings.

3.2. Literature Findings

3.2.1. The use of technology in improving the quality of health services

The integration of technology in health services has shown great potential in improving the quality of health services. Various technological advances such as artificial intelligence (AI), big data analytics (BDA), Internet of Things (IoT), blockchain, and wearable devices have been used to improve the standard of health service delivery (Basile, 2024; Pradhan et al. , 2021; Ali, 2023; Guk et al., 2019). These technologies enable the extraction of valuable insights from large datasets, facilitate remote monitoring and diagnosis, increase scalability and security, and support personalized healthcare through real-time disease monitoring (Basile, 2024; Pradhan et al., 2021; Ali, 2023; Guk et al., 2019).

Additionally, the adoption of technologies such as AI, IoT, and blockchain have transformed healthcare practices by simplifying administrative processes, improving patient care, and increasing overall service efficiency ("Review of Intelligent Healthcare for the Internet

of Things: Challenges, Techniques and Future Directions", 2024; Khan, 2024; Thakur, 2022). These advances not only automate tasks but also empower healthcare professionals to make data-driven decisions, ultimately improving patient outcomes and quality of care ("Review of Intelligent Healthcare for the Internet of Things: Challenges, Techniques and Future Directions", 2024; Khan, 2024; Thakur, 2022).

Additionally, the application of technology in healthcare has gone beyond traditional boundaries, with innovations such as digital twins, distributed ledger technology, and data mining playing a critical role in improving health management, decision-making processes, and patient care outcomes (Das et al., 2022 ; Thakur, 2022; Asere & Botson, 2021). These technologies enable health systems to increase precision, accessibility, and efficiency, ultimately fundamentally changing the way health services are delivered (Das et al., 2022; Thakur, 2022; Asere & Botson, 2021). In conclusion, the strategic integration of technology in healthcare has great potential to drive significant improvements in the quality of healthcare by improving decision-making processes, optimizing patient care, and revolutionizing healthcare delivery mechanisms.

3.2.2. Case studies of technology implementation in various healthcare settings

Technology implementation in healthcare settings is a multifaceted process that requires a deep understanding of various factors. Studies have shown that the adoption of health technology in the form of wearable devices is influenced by health attributes and the technology acceptance model (TAM) (Cheung et al., 2019). Blockchain technology is identified as a tool that can improve data security, privacy, and interoperability in healthcare, but its successful implementation depends on resolving ethical and regulatory challenges (Auwal, 2023). Additionally, sustaining e-health innovation in complex hospital environments requires learning through evidence and understanding the clinical setting from the user's perspective (Jaana, 2024; Østervang et al., 2022).

Digital technologies such as wearable devices and the Internet of Things (IoT) have the potential to revolutionize data collection and analysis in health settings, highlighting the importance of infrastructure development for health system transformation (Adekugbe, 2024; Okoduwa, 2024). Additionally, technology adoption in healthcare has been shown to improve outcomes, control health data, increase collaboration among staff, and reduce organizational costs (.et.al, 2021).

The integration of artificial intelligence (AI) in healthcare requires a shift to understanding the changes required in clinical practice for successful implementation, rather than just focusing on the technology itself (Neher et al., 2023). Understanding healthcare professionals' views of technologies such as point-of-care trials and AI is crucial for their successful adoption and use in clinical settings (Teebagy et al., 2022; Shinnars et al., 2019). In addition, the adoption and diffusion of digital technologies related to surgical performance can be influenced by factors such as the strength of the innovation function and the technology cycle (Apell & Hidefjäll, 2022). In conclusion, successful technology implementation in healthcare settings requires a comprehensive understanding of user perspectives, organizational factors, regulatory challenges, and the clinical environment. By addressing these various aspects, health systems can harness the full potential of technology to improve patient outcomes and improve care delivery.

3.2.3. Evidence on the effectiveness of technology in increasing patient satisfaction

The influence of technology on patient satisfaction in health services has been widely researched and provided significant findings. Telehealth and various technological innovations have become important factors influencing patient satisfaction (Orlando et al., 2019; Elgendy, 2023; Omaghomi, 2024). These approaches have shown positive results, especially in managing patient health needs, including mental health services (Elgendy, 2023). Effective leadership,

communication strategies, and seamless integration of technology have been considered crucial elements in establishing patient-centered care and improving overall health outcomes (Omaghomi, 2024).

Studies show that technological advances in healthcare facilities, such as new equipment and management tools for chronic conditions such as diabetes, significantly increase patient satisfaction (Suprayogi et al., 2022; Al-Nozha et al., 2022). Additionally, leveraging technology for patient education and engagement, such as educational programs tailored to populations undergoing joint replacement, is associated with increased levels of patient satisfaction (Howell et al., 2021). Furthermore, involving patients in the shared decision-making process regarding new health technologies has also been shown to increase satisfaction (Wei et al., 2020).

Specific technological applications, such as teledentistry, avatar technology in telemedicine, and customized three-dimensional printed braces devices, have been associated with higher levels of patient satisfaction in various healthcare contexts (Gingele et al., 2023; Silva et al., 2021 ; Eyiis et al., 2023). Additionally, the integration of technology in patient care, such as surface electromyography (sEMG) controlled arm bracelets for rehabilitation, has also shown promising results in improving patient satisfaction (Marcos-Antón, 2023). In conclusion, this evidence confirms the significant role of technology in improving patient satisfaction across a variety of health services and settings. From telehealth solutions to personalized medical devices, technology not only improves patient health outcomes but also facilitates better communication and drives patient-centric care, ultimately resulting in higher levels of patient satisfaction.

3.2.4. The impact of technology on patient safety

The impact of technology on patient safety is an important area in healthcare. Various studies highlight the significant role of technology in improving patient safety through various applications. Wearable devices have been recognized for their potential in continuous monitoring, both in hospitals and at home, thereby improving patient safety and continuity of care (Amin et al., 2021). Remote visual monitoring technology, when accepted and used by nursing teams, can improve patient safety and cost-effectiveness of care (Hawksworth et al., 2022). Leveraging existing information technology, improving team coordination, and ensuring continuity of care can improve patient safety in primary care settings (Avery et al., 2020).

Digital health interventions, including the use of digital technologies, have shown promise in driving patient engagement, improving quality of care, safety, and overall patient experience (Park, 2023). Technological advances such as machine learning and artificial intelligence have the potential to improve patient safety in spine surgery by identifying high-risk patients and adapting treatment plans according to their needs (Arjmandnia, 2024). Health information technology, medical devices, and care technology systems have the capacity to improve patient outcomes and healthcare processes, ultimately increasing patient safety (Borycki & Kushniruk, 2022).

The integration of advanced technology in healthcare has greatly impacted patient care, emphasizing the importance of technology in improving patient safety (R.E., 2024). Electronic Medical Records (EMR) have been recognized for their impact in improving patient satisfaction, documentation accuracy, and reducing clinical errors, although challenges related to patient safety have also been noted (Adhistya et al., 2023). The use of mobile application technology has been identified as a way to improve patient safety culture in nursing environments (Linda, 2024). In conclusion, technology, from wearable devices to artificial intelligence, plays a critical role in improving patient safety in a variety of healthcare settings. By effectively utilizing technology, healthcare providers can improve patient outcomes, increase safety, and increase the quality of care provided to patients.

4. Conclusions

The use of technology in healthcare has shown a significant positive impact in various aspects, including patient safety and patient satisfaction. A comprehensive strategy to improve the quality of healthcare involves the integration of technology, implementation of continuous quality improvement systems, and effective leadership. Technologies such as wearable devices, artificial intelligence (AI), and the Internet of Things (IoT) have enabled better patient monitoring, increasing safety and operational efficiency. Additionally, integration of patients in the health decision-making and education process has been shown to significantly increase patient satisfaction.

4.1. Implications

1. **Health Policy:** Governments and policymakers must encourage technology adoption in healthcare through supportive regulations and investment in technology infrastructure.
2. **Clinical Practice:** Healthcare providers must integrate advanced technology into daily practice to improve patient safety and satisfaction.
3. **Training and Education:** Training and education programs are needed for health workers to optimize the use of technology in health services.
4. **Patient Engagement:** Increasing patient engagement in the care and decision-making process through technology to improve health outcomes.

4.2. Limitations

5. **Resource Limitations:** The implementation of technology in health services is often hampered by limited resources, both financial and technical.
6. **Resistance to Change:** Healthcare professionals and patients may show resistance to changes brought by new technologies.
7. **Privacy and Security:** Concerns regarding the privacy and security of patient data may be a barrier to wider adoption of the technology.
8. **Variability in Technology Adoption:** Technology adoption rates can vary significantly between different healthcare organizations and geographic regions, creating disparities in quality of care.

4.3. . Future Research

1. **Longitudinal Study:** Long-term research to evaluate the technology's ongoing impact on patient safety and satisfaction.
2. **Cost-Benefit Analysis:** In-depth analysis of the costs and benefits of various health technologies to understand their economic value.
3. **Interdisciplinary Approach:** Studies that combine perspectives from multiple disciplines, including information technology, medicine, and health management.
4. **Patient-Centered Research:** More research focuses on patient experiences and perceptions of health technology to identify areas for improvement.
5. **Scalability and Adaptability:** Research into how the technology can be scaled and adapted for various healthcare settings, especially in rural and underserved areas.

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