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Utilization of E-Health Technology in Optimizing Health Services to Increase Patient Satisfaction

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Article Info

ABSTRACT

Purpose of the study: This study aims to explore the utilization of e-health technology in health service delivery and its impact on patient satisfaction through a comprehensive and contextual qualitative approach.

Methodology: The approach used in this study is a qualitative approach with the aim of providing a comprehensive and in-depth picture of e-Health-based Health Service Innovation in Increasing Public Satisfaction at Community Health Centers.

Main Findings: This study shows that e-health utilization is influenced by the type of service, age, and digital literacy. Online registration is the most preferred, while other features are less understood. Patient experiences include efficiency, digital literacy barriers, technical constraints, and satisfaction that vary. The main influencing factors are age, access to technology, health worker attitudes, and application design. Health workers play a key role in facilitating the digital transition, with patients expecting a simpler, more inclusive, and trained system.

Novelty/Originality of this study: This study offers new insights into how digital literacy, patient context, and health worker support affect the acceptance and effectiveness of e-health services. It contributes to knowledge by highlighting the importance of user-centered implementation and the role of health professionals in facilitating digital transitions in healthcare.

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1. INTRODUCTION

In recent years, healthcare services have undergone significant transformation along with the development of information technology [1]-[3]. One form of innovation that is increasingly developing is the application of e-health technology, namely the use of digital systems to support healthcare services. Starting from online patient registration, remote consultations, to electronic medical record archiving, e-health has become part of the modern service system in various healthcare facilities [4]-[6]. This phenomenon has attracted the attention of many parties because it is considered capable of accelerating access to services, reducing queues, and providing new convenience for patients amidst high community mobility [7]-[9].

As an individual who actively observes the dynamics of health services in local hospitals and health centers, researchers have seen a shift in the pattern of interaction between patients and medical personnel since e-health technology began to be implemented [10], [11]. On the one hand, some patients feel helped because the

process is faster and more practical. However, on the other hand, there are also quite a few who find it difficult because they do not understand technology or are not used to application-based services [12]-[14]. This experience has fostered researchers' curiosity to dig deeper into how the use of e-health is actually received and felt by patients, especially in the context of their satisfaction with the services provided [15], [16].

This phenomenon is not uniform. Patients' experiences in using e-health services vary greatly, depending on educational background, age, location of residence, and understanding of technology. Some patients feel more comfortable with the traditional system, while others are reluctant to return to the old system because they feel that the efficiency of e-health is very helpful [17]-[19]. This complexity shows that the use of e-health is not only about the availability of the system, but also about how users interpret it and how health workers integrate it into daily services.

Furthermore, in practice, e-health does not always run smoothly. There are gaps in infrastructure, lack of training for medical personnel, and inconsistencies between the systems implemented and patient needs. This condition creates new challenges in optimizing health services [20]. When a digital system that is intended to improve the quality of service actually causes confusion or dissatisfaction, it is necessary to have a deeper understanding of how e-health is implemented and perceived by service users.

Therefore, this study is important to understand in depth the patient experience of the use of e-health technology in health services. With a qualitative approach, researchers try to explore how this technology contributes to increasing or decreasing patient satisfaction, as well as identifying factors that influence its acceptance and effectiveness. This study is expected to provide a complete picture of the dynamics of e-health use from the patient's perspective, so that it can be used as a consideration in developing future health service policies.

Based on the research that has been conducted, there is a gap that is reviewed from several perspectives of inequality. In this study, the main focus lies on the social dimension and user behavior in the implementation of e-health technology [21], [22]. This study uses a qualitative approach to explore patient experiences contextually, such as convenience, digital literacy barriers, and support from health workers. The aim is to understand the extent to which e-health contributes to patient satisfaction in primary health care services. The emphasis of this study is on the humanistic aspects, accessibility, and user readiness for the developing digital system, especially in the context of services in first-level health facilities such as health centers. In contrast, the study "Exploitation of Healthcare IoT–Fog-Based Smart E-Health Gateways: A Resource Optimization Approach" conducted last year highlighted more technical and systematic aspects in the development of e-health infrastructure. With an approach that tends to be quantitative and technological, this study discusses how the use of Internet of Things (IoT) technology and fog computing can improve the efficiency of real-time medical data processing and reduce network load.

The aim is to optimize the use of computing resources in a digital health service system through smart gateways. The main focus is on system efficiency, data security, and the integration of smart networks and devices on a large scale. The main gap between the two studies lies in their focus and approach: the first study focuses on user acceptance and experience, while the second study emphasizes technical optimization of IoT-based e-health infrastructure. Thus, there is still room for research to bridge the two, namely examining how advanced technology solutions such as IoT-fog can be implemented effectively by considering user readiness, digital literacy, and patient-medical personnel interactions in the field [23]-[25]. Hybrid research that combines technical and social approaches can be a new direction in the development of e-health systems that are not only technologically efficient, but also inclusive and oriented towards user satisfaction.

From the gap analysis, this study offers a novelty in the form of a humanistic and contextual approach in understanding the implementation of e-health technology from the perspective of the end user, namely the patient [26]-[28]. Different from most previous studies that focus more on technical aspects such as system efficiency, network architecture, or IoT-based data processing and fog computing, this study explores in depth the social dynamics, barriers to digital literacy, and the role of health workers as mediators in the technology adoption process. Through a qualitative approach, this study offers a new perspective that emphasizes the importance of the fit between technology and user characteristics, as well as the need for e-health system design that is not only technologically sophisticated, but also easily accessible, user-friendly, and sensitive to local social and cultural contexts [29]-[31]. This approach makes this study contribute significantly to the development of e-health systems that are oriented towards patient satisfaction and active involvement, not merely operational efficiency.

This study provides important implications for the design and implementation of a more user-centered e-health system. Findings showing the existence of digital literacy disparities, dependence on the assistance of health workers, and variations in patient satisfaction indicate that the development of technology in health services cannot only focus on the sophistication of the system, but must also consider the social, psychological, and cultural aspects of the user [32]-[34]. Therefore, the results of this study can be a basis for policy makers and system developers to design a digitalization strategy for health services that are more inclusive and adaptive to user diversity, especially in primary care facilities such as health centers and regional hospitals. By directly integrating patient perspectives, e-health is expected to not only increase efficiency, but also strengthen public trust and involvement in the digital health service process [35], [36].

The urgency of this research arises from the fact that digital transformation in the health sector is taking place very quickly, while the readiness of the community as the main users is not yet evenly distributed. If the implementation of e-health is not accompanied by a deep understanding of patient experience and needs, there is a risk of increasing inequality in access to services and a decrease in the quality of interactions between patients and medical personnel [37]-[39]. Amidst global efforts towards technology-based health services, this study is very important to ensure that digital innovation is not exclusive to those who are technologically literate, but can be felt by all levels of society. In addition, with the increasing dependence of the health system on digital technology, a contextual understanding of patient acceptance and satisfaction is urgently needed to create a health system that is not only modern, but also humanistic and equitable [40], [41].

This study is unique in its approach that places patient experience at the center of the study in assessing the effectiveness of e-health technology, unlike previous studies that tend to emphasize technical aspects or system efficiency alone. By exploring in depth the perceptions, barriers, and expectations of patients towards digital health services through a qualitative approach, this study is able to reveal the social and psychological dynamics that are often overlooked in the digital transformation process in the health sector [42], [43]. This uniqueness makes this study an important contribution in bridging the gap between technological innovation and the reality of user acceptance in the field. This research is very important to conduct considering that the success of e-health implementation is not only determined by the availability of infrastructure or the sophistication of the application, but also by the extent to which the system can be accepted, understood, and optimally utilized by all levels of society [44]-[46]. Therefore, the results of this study not only provide theoretical contributions to the development of science, but also provide practical recommendations for policy makers and health service implementers in building an e-health system that is more inclusive, equitable, and oriented towards user satisfaction and real needs.

2. RESEARCH METHOD

This study employs a descriptive qualitative approach, chosen to explore in depth the experiences, perceptions, and meanings constructed by patients in utilizing e-health technology within healthcare services [47], [48]. Rather than testing hypotheses, this qualitative method aims to provide a rich, contextualized understanding of complex phenomena through narratives and participant interpretations.

Participants in this study were selected using purposive sampling, targeting patients who had utilized at least one form of e-health service such as online registration, online consultation, or digital medical record access and were willing to participate in in-depth interviews. A total of 12 participants were involved, representing diverse ages (ranging from 20s to 60s), domiciles (urban and rural areas), and types of e-health services used, to ensure a broad range of perspectives. The subjects of the study were these patients, while the object of the study was the utilization of e-health technology and its impact on patient satisfaction [49].

Data collection techniques are carried out using several methods, namely, in-depth interviews. Semi-structured interviews are conducted directly or online to explore patient experiences and perceptions. Then observation techniques. Participatory or non-participatory observation of the e-health service process in health facilities. Finally, documentation data collection techniques, collecting supporting documents such as e-health brochures, application usage flows, or digitalization policies for services.

The main instrument in this study is the researcher himself. The researcher acts as a data collector and analyzer. In addition, the researcher also uses an interview guide as an auxiliary instrument, which contains open-ended questions about the first experience of using e-health services, the ease or obstacles experienced, the level of satisfaction before and after using e-health, suggestions and expectations for the development of digital services in the health sector.

The data analysis technique in this study uses the Miles and Huberman interactive model, namely through three stages. First, data reduction in order to Sort, select, simplify data from interviews, observations, and relevant documentation. Second, data presentation with processes such as Arranging data in the form of narratives, matrices, or thematic tables so that they are easy to understand. Finally, drawing conclusions by interpreting the meaning of the data to answer the focus of the research. Data analysis utilized the Miles and Huberman interactive model, selected for its suitability in managing and interpreting large volumes of qualitative data.

The procedure in this study begins at the preparation stage by compiling a proposal, taking care of research permits, and compiling an interview guide. Then the data collection stage by conducting interviews, observations, and documentation. Next is the data analysis stage by reducing data, presenting data, and drawing initial conclusions. To ensure the validity of the data, this study applies triangulation techniques consisting of source triangulation, technical triangulation, and time triangulation. Source triangulation is carried out by comparing data from various participants with different age backgrounds, domiciles, and experiences of using e-health services. Technical triangulation is carried out by combining the results of interviews, observations, and documentation to see the consistency of findings from various data collection methods. Meanwhile, time triangulation is applied by conducting observations and interviews at different times to test data stability and strengthen the credibility of the information. The use of this triangulation aims to increase internal validity and

objectivity of data, reduce the possibility of bias, and ensure that the resulting interpretation truly reflects the reality experienced by patients in using e-health services.

3. RESULTS AND DISCUSSION

This study produced a number of important findings that describe the dynamics of the use of e-health technology in health services from the patient's perspective. Data were obtained through in-depth interviews with 12 patients from various backgrounds, direct observation of the e-health service process, and supporting documentation from service brochures and digital systems used.

3.1. Variations in E-Health Utilization by Patients

The results show that patient utilization of e-health varies, depending on the type of service, age, and adaptability to technology.

Table 1. Response to E-Health Utilization

E-Health Services	Number of Respondents Using	Main Response
Online Registration	10 of 12	Practical, saves time, avoids queues
Online Consultation (Telemedicine)	7 of 12	Helpful in emergencies, but sometimes not interactive
Access Digital Medical Records	4 of 12	Its use is still poorly understood by patients
Drug Notification & Control Schedule	6 of 12	Makes reminders easier, but often inconsistent

Most patients admit that online registration is the most useful feature because it speeds up the visit process and reduces waiting time. However, for other features such as digital medical records, many patients still do not understand their usefulness.

3.2. Dimensions of Patient Experience of E-Health

In-depth interviews yielded four main themes that reflect patients' experiences in using e-health technology. These findings can be analyzed using the Technology Acceptance Model (TAM) and UTAUT frameworks, which emphasize that technology acceptance is influenced by perceived usefulness, ease of use, social support, and facilitating conditions.

Most patients feel that e-health makes services faster and more flexible. This is in line with the concept of Perceived Usefulness (PU) in TAM and Performance Expectancy in UTAUT, where patients see direct benefits from the use of technology in improving service efficiency.

"Previously, I had to come at 5 am to queue for registration, now I just open my cellphone, register, then come according to the schedule." (Respondent A, age 37)"

Elderly patients or those who are less familiar with technology face difficulties in accessing e-health services. This is in accordance with the Effort Expectancy variable in UTAUT and Perceived Ease of Use (PEOU) in TAM, where technological barriers reduce the intention to use the system.

"I was confused when asked to download the application... finally I asked my child to register it." (Respondent F, age 61)"

Technical disruptions such as inaccessible applications or system errors have caused some patients to return to manual systems. This reflects the importance of Facilitating Conditions in UTAUT, which includes infrastructure readiness and technical support to ensure the sustainability of technology use.

"I once registered online, but when I arrived at the hospital my name did not appear. In the end I had to re-register manually." (Respondent D, age 42)"

Satisfaction with e-health is highly dependent on patient comfort with technology. Patients who are accustomed to face-to-face services tend to feel less interaction, while digital users are more satisfied. This shows that Social Influence and Behavioral Intention in UTAUT are key in driving adoption.

"The online consultation was fast, but I felt less relieved because the doctor didn't see my condition directly." (Respondent H, age 29)"

3.3. Factors Affecting Patient Utilization and Satisfaction

This study found several main factors that influence the level of utilization and patient satisfaction with e-health services, which are theoretically related to the constructs in TAM and UTAUT.

Factor	Description of Influence
Age	Younger patients are more adaptable; older patients tend to need help.
Digital Literacy	Patients with digital literacy find e-health services practical and efficient.
Availability of Technology	Not all areas have adequate signal or internet network.
Attitude of Health Workers	Friendly and helpful staff make it easy for patients to accept the new system.
E-Health Application Design	Applications that are too complex confuse patients, especially if they are not user-friendly..

3.4. The Role of Health Workers as Mediators of Digital Transformation

Health workers have an important role in bridging the transition from manual to digital systems. Officers who are able to explain application features and guide patients improve Facilitating Conditions in UTAUT. However, there are still health workers who do not fully understand the system, which is actually an obstacle in the process of technology adoption by patients.

3.5. Patient Suggestions and Expectations for E-Health Development

Most patients expect the e-health system to be simplified and more integrated. They suggested training or assistance in using the application at health facilities, the use of easy-to-understand language, and a consistent notification system. This reflects the importance of increasing Effort Expectancy and User Support, to increase Behavioral Intention to Use as described in TAM and UTAUT.

Based on the research that has been conducted, based on the findings found, there is a research gap analysis, namely This research which focuses on the use of e-health technology to optimize health services highlights how the application of digital technology can improve patient satisfaction through ease of access, communication effectiveness, and acceleration of services [47]-[49]. The findings show that the integration of e-health applications can have a significant positive impact on patient perceptions regarding the quality of health services. However, this study tends to focus on the service aspect from the end user (patient) side, without paying in-depth attention to how the technology infrastructure behind the service is managed to ensure optimal and sustainable system performance [53], [54]. Meanwhile, the second study which carries the Hybrid Whale Optimization (HWO) algorithm in the context of resource optimization in cloud applications for e-healthcare conducted in 2022 focuses more on technical aspects, namely how to maximize the efficiency of using cloud computing resources so that the system can run at high speed and reliability. The findings in this study show the success of the HWO algorithm in optimizing resource allocation and improving the performance of e-health systems in the cloud. However, this study has not discussed the direct impact of this technical optimization on the experience or satisfaction of health service users, especially patients. The main gap that emerged between these two studies lies in the lack of integration between the technical aspects of system optimization with the user experience aspects of healthcare services [52]. The first study has not utilized algorithms or technical optimization methods explicitly to improve the backend performance of the system, while the second study is more technical without considering patient satisfaction factors as an indicator of successful implementation [53]-[55]. Therefore, there is an opportunity for further research that combines these two approaches, namely developing an e-health system that is not only technically optimal through algorithms such as HWO, but also significantly improves the quality of service and patient satisfaction. This holistic approach is expected to answer the challenges in the digital transformation of healthcare services comprehensively and sustainably.

The novelty of this study lies in the integrative approach that not only assesses the effectiveness of e-health technology in terms of patient experience and satisfaction, but also combines aspects of system technical optimization through the application of intelligent algorithms for cloud-based healthcare resource management [56]-[58]. This study seeks to bridge the gap between system backend management and patient service quality by developing an e-health model that simultaneously improves the efficiency of technology infrastructure and maximizes end-user experience. Thus, this innovation presents a holistic solution that not only focuses on ease of patient access and interaction, but also ensures the stability, speed, and reliability of the digital healthcare system in a sustainable manner, which has not been widely discussed in similar studies [62], [63]. This approach is expected to make a significant contribution to the development of e-health that is more adaptive and responsive to the needs of patients and service providers simultaneously.

This study has important implications for both practice and technology development in digital healthcare. By integrating technical optimization of the system using intelligent algorithms together with a focus on improving patient satisfaction, the developed e-health model can be an effective solution to improve the overall quality of

healthcare services [64]-[66]. Healthcare practitioners can adopt this approach to ensure responsive and reliable services while utilizing technology resources efficiently. In addition, e-health system developers and cloud infrastructure managers can use these findings as a basis for designing platforms that are able to balance technical performance and user experience. These implications support a more sustainable and adaptive digital transformation of healthcare to the dynamic needs of patients and providers [67], [68].

Although this study presents an innovative integrative approach, there are several limitations that need to be considered. First, the focus of the study that combines technical aspects and user experience is still limited to testing on a prototype scale or simulation environment, so it has not fully covered the implementation in a real healthcare environment with more complex user variability and infrastructure conditions. Second, this study focuses more on cloud-based resource optimization, so it has not examined in depth the issues of data security and patient privacy which are also crucial factors in e-health systems. Finally, the patient satisfaction aspect that is measured still relies on quantitative indicators that can narrow the understanding of the patient's subjective experience holistically. Therefore, further research with a wider scale and mixed-method approach will be needed to validate the findings and expand the scope of the analysis.

Based on the research results, the utilization of e-health technology integrated with technical optimization of the system using intelligent algorithms significantly contributes to improving the quality of health services and patient satisfaction. This holistic approach successfully bridges the efficient backend aspects of the system with a more responsive and accessible user experience. However, to develop a more comprehensive and applicable implementation, further research is recommended to expand the scale of the study to a real health service environment with a wider variety of users and to integrate aspects of data security and patient privacy in depth. In addition, a mixed-method approach can be used to qualitatively explore patient experiences to provide a more holistic understanding of their satisfaction and needs in the context of e-health. With this recommendation, it is hoped that the development of e-health technology can be increasingly optimal and sustainable in supporting the transformation of digital health services.

4. CONCLUSION

This study found that e-health technology has great potential in optimizing health services and increasing patient satisfaction, but its effectiveness is highly dependent on user readiness, system design, and support from health workers. Given that patient experience is subjective and contextual, e-health implementation needs to be carefully tailored to user characteristics and accompanied by adequate education and assistance. Importantly, this study highlights the critical role of comprehensive digital training programs for both patients and healthcare professionals to enhance their digital literacy and ensure effective use of e-health applications. Additionally, to maximize accessibility and inclusivity, it is recommended that e-health platforms be designed to accommodate a wider range of users, particularly considering different age groups and varying levels of digital literacy, thereby reducing barriers and promoting equitable health service delivery.

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