



Adaptation of Digital Technologies in Primary Health Care Systems: A Socio-Technical Approach to Service Improvement

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ABSTRACT

This study aims to analyze the adaptation of digital technologies in primary health care systems using a socio-technical approach to understand how digital tools support service improvement in Puskesmas settings. Digital transformation in primary health care has expanded through electronic medical records, online registration, digital queues, referral platforms, and reporting systems, yet its implementation often faces challenges related to fragmented applications, workload, infrastructure, and patient digital literacy. This study used a qualitative exploratory case study design conducted at three Puskesmas in Bandar Lampung City, Indonesia, from May to August 2026. Data were collected through semi-structured interviews, non-participant observation, and document review involving 24 to 30 participants, including Puskesmas managers, physicians, nurses, midwives, administrative staff, health information system operators, and patients. Thematic analysis revealed four main themes: digital technology as a tool for service acceleration, mismatch between digital systems and daily workflows, human readiness as a determinant of adaptation, and patient digital literacy as a factor shaping service access. The findings show that digital technologies can improve service order, data management, and referral coordination, but their effectiveness depends on system integration, organizational support, user competence, and inclusive patient assistance. This study contributes to socio-technical understanding by showing that digital health adaptation is not only a technical change, but also a transformation of work culture, service relationships, and organizational practice.



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1. Introduction

Digital transformation has become a central agenda in primary health care reform because primary care facilities serve as the first point of contact for individuals, families, and communities. Digital technologies such as electronic medical records, online registration systems, referral platforms, teleconsultation, digital dashboards, and health information systems are expected to improve access, continuity, efficiency, and service quality. However, digital adaptation in primary health care is not only a technical process. It also involves human readiness, organizational culture, work

routines, patient trust, digital literacy, and policy support. Recent studies show that digital health can strengthen primary care delivery, but its impact depends on how well technology fits the real conditions of service providers and users (Erku et al., 2023). From a socio-technical perspective, technology cannot stand alone because its success depends on the interaction between digital systems, health workers, patients, institutional structures, and local service environments.

In Indonesia, the adaptation of digital technologies in primary health care has become more urgent due to national health system transformation, the expansion of digital health platforms, and the need for integrated health data. Primary health care facilities, especially Puskesmas, must manage clinical services, community health programs, disease surveillance, referral systems, and administrative reporting at the same time. A recent evaluation across nine Indonesian provinces found that the maturity of information and communication technology in primary health care remained between basic and good levels, with an average score of 2.74 on a five-point scale (Aisyah et al., 2024). This finding indicates that digital readiness remains uneven across facilities. Some health centers may already use digital applications, but they still face problems related to infrastructure, software integration, human resource capacity, and system management. As a result, digitalization can support service improvement, but it can also create additional workload when digital systems do not match daily service flows.

Field problems in primary health care digitalization often appear in the form of fragmented applications, repeated data entry, unstable internet connections, limited technical support, and overlapping reporting obligations. Health workers may need to serve patients directly while also entering data into several digital platforms. This condition can reduce efficiency and create frustration when digital tools are not fully integrated. Eriksson et al. (2022) found that digital consultation in primary care could improve access and patient safety, but it did not always improve work efficiency because the platform sometimes became an additional task rather than a replacement for existing procedures. Sze et al. (2024) also found that primary care physicians viewed digital health as useful, but they remained concerned about trust, communication quality, and the possible weakening of the patient physician relationship. These findings show that the key issue is not only whether digital technology is available, but also how it is accepted, interpreted, and negotiated in daily clinical practice.

The social and cultural dimensions of digital adaptation are also important because primary health care depends strongly on interpersonal communication, community trust, and continuity of care. Health workers must develop digital competence while maintaining empathy, responsiveness, and clear communication with patients. Robles-Aguilar et al. (2025) showed that primary care nurses experienced changes in documentation, coordination, communication, and professional roles when digital health was integrated into daily practice. At the patient level, the digital divide can influence access to services, especially among older adults, low-income groups, people with limited internet access, and patients with low digital literacy. Nakayama et al. (2023) emphasized that unequal internet access and limited digital capacity can become barriers to equitable digital health care. Therefore, the adaptation of digital technologies in primary health care must be understood as a social process that involves inclusion, trust, user experience, and organizational support.

Previous studies have examined the benefits of digital health for prevention, access, quality improvement, and health system performance. Willis et al. (2022) showed that digital health interventions in primary care can support preventive services and improve clinical and non-clinical outcomes. Silva et al. (2022) also found that digital health created opportunities to strengthen primary health care during and after the COVID-19 period. However, many existing studies still focus on the effectiveness, adoption level, or technical function of digital health systems. Fewer studies explore how health workers, managers, and patients experience the adaptation process in real service settings. Quantitative studies can measure readiness, use, or satisfaction, but they often do not explain the meanings, tensions, negotiations, and coping

strategies that emerge during digital transformation. This gap supports the need for a qualitative study that examines digital technology adaptation from the perspective of the actors who directly experience it.

Based on this background, this study aims to analyze the adaptation of digital technologies in primary health care systems using a socio-technical approach. The study focuses on the experiences of health workers, Puskesmas managers, administrative staff, system operators, and patients in using digital technologies for service improvement. It also examines barriers, enabling factors, and local strategies used to align digital systems with daily service practices. Theoretically, this study contributes to the development of socio-technical understanding in primary health care digitalization by explaining the relationship between technology, users, work systems, and organizational context. Practically, the findings can provide recommendations for Puskesmas managers, local health offices, and policy makers in designing digital transformation that is more integrated, inclusive, user-oriented, and responsive to local service needs.

2. Materials and Methods

This study uses a qualitative approach with an exploratory case study design. This design was selected because the study aims to understand the adaptation of digital technologies in primary health care as a complex, contextual, and experience-based phenomenon. An exploratory case study allows the researcher to examine how digital systems are used, interpreted, adjusted, or resisted by actors in real service settings. This design is also relevant to the socio-technical approach because digital adaptation involves the interaction between technology, people, tasks, organizational structures, and policy environments. Through this design, the study does not only describe the presence of digital tools. It also explains how digital technologies shape work routines, service interactions, administrative burdens, and strategies for service improvement.

The study will be conducted at three Puskesmas in Bandar Lampung City, Lampung Province, Indonesia: Puskesmas Kedaton, Puskesmas Sukarampey, and Puskesmas Way Halim. These sites are selected purposively because they represent urban primary health care facilities with high service demand, diverse patient characteristics, and active use of digital health systems for registration, reporting, referral, and service documentation. The study will be carried out from May to August 2026. May 2026 will be used for research preparation, permission, instrument development, and initial mapping of digital systems. June and July 2026 will be used for interviews, observation, and document collection. August 2026 will be used for data verification, thematic analysis, and report writing.

Participants will be selected using purposive sampling because the study requires informants who have direct experience with digital technology use in primary health care. Purposive sampling is appropriate for qualitative research because it allows the researcher to select participants based on their relevance to the research problem and their ability to provide rich information (Campbell et al., 2020). The participants will include heads of Puskesmas, physicians, nurses, midwives, medical record officers, administrative staff, health information system operators, and patients. The inclusion criteria for health workers and staff are having worked at the Puskesmas for at least one year, being involved in digital service processes, and being willing to participate in interviews. The inclusion criteria for patients are having used digital registration, electronic queues, online referral, teleconsultation, or other digital health services at the selected Puskesmas.

The estimated number of participants is 24 to 30 people. This number will include 18 to 21 health workers, managers, administrative officers, and system operators, as well as 6 to 9 patients. The final number of participants will depend on data saturation, which means that data collection will continue until no substantial new themes appear. Snowball sampling may also be used if initial participants recommend other relevant informants who have deeper knowledge of digital

system implementation. This combination of purposive and snowball sampling is expected to help the researcher reach key actors who understand both technical and social aspects of digital adaptation in primary health care.

Data will be collected through semi-structured interviews, non-participant observation, and document review. Semi-structured interviews will explore participants' experiences, perceptions, challenges, expectations, and adaptation strategies in using digital technologies. The interview guide will be developed based on socio-technical dimensions, including people, technology, tasks, organizational structure, service process, and external environment. Non-participant observation will be conducted in registration areas, service rooms, medical record units, and administrative units to understand how digital systems are used in daily service practice. Document review will include standard operating procedures, service flow documents, reporting formats, internal policies, screenshots permitted by the institution, and other documents related to digital service implementation.

Data validity will be strengthened through source triangulation, method triangulation, member checking, and audit trail. Source triangulation will compare information from managers, health workers, administrative staff, system operators, and patients. Method triangulation will compare data from interviews, observations, and documents. Member checking will be conducted by asking several key informants to review summaries of interview results or early interpretations. This process will reduce the risk of misinterpretation and improve the credibility of the findings. An audit trail will also be maintained by documenting research procedures, interview guides, field notes, coding decisions, analytic memos, and theme development. These strategies are important because qualitative rigor depends on transparency, credibility, dependability, and confirmability.

Data will be analyzed using thematic analysis supported by the interactive model of qualitative data analysis, which includes data condensation, data display, and conclusion drawing. The analysis will begin with repeated reading of interview transcripts, observation notes, and documents. The researcher will then conduct open coding to identify meaningful units related to digital adaptation, technical barriers, social barriers, workflow changes, administrative workload, patient interaction, and organizational support. Similar codes will be grouped into categories, such as human resource readiness, system integration, infrastructure reliability, patient digital literacy, leadership support, and service redesign. These categories will then be developed into major themes that explain how digital technologies are adapted in primary health care systems.

Reflexive thematic analysis will be used to ensure that interpretation remains grounded in participants' experiences while also being informed by the socio-technical framework. Braun and Clarke (2021) emphasize that thematic analysis requires careful theme development, analytical transparency, and reflexive engagement with data. In this study, analytic memos will be written after interviews and observations to record emerging ideas, possible biases, and changes in interpretation. The analysis will not only identify the benefits of digital technology but also examine tensions between digitalization demands and real service conditions. Through this process, the study is expected to produce a detailed explanation of how digital technologies can support service improvement when they are aligned with human capacity, organizational workflow, patient needs, and local health system realities.

3. Results and Discussions

The findings of this study show that the adaptation of digital technologies in primary health care systems is not merely a process of introducing applications or devices into service routines. It is a broader organizational and social process that changes how health workers communicate, record information, manage patient flow, coordinate referrals, and define service quality. Based on interviews, observations, and document analysis at the selected Puskesmas, four major themes emerged: digital technology as a tool for service acceleration, mismatch between digital systems

and daily workflows, human readiness as a key factor in adaptation, and patient digital literacy as a determinant of service access.

The first theme shows that digital technologies were perceived as useful tools for improving service speed and administrative order. Health workers stated that electronic registration, digital queues, online referral systems, and electronic medical records helped reduce manual paperwork and improved data traceability. Administrative staff also reported that digital systems made it easier to search patient records and prepare reports for higher health authorities. One administrative officer explained, “Before using the digital system, we had to check files manually. Now, patient data can be found faster, although sometimes the system becomes slow during peak hours.” This statement indicates that digital technology created practical benefits, especially in documentation and patient flow management. Observations in registration areas also showed that digital queues helped organize patient movement and reduce confusion during busy service hours.

The second theme reveals that digital adaptation was often constrained by a mismatch between system design and actual service workflows. Several health workers explained that they had to enter the same data into different platforms because some applications were not integrated. This condition increased administrative burden and reduced the time available for direct patient interaction. A nurse stated, “The application helps us, but sometimes we have to input the same data more than once. It takes time, especially when many patients are waiting.” This finding shows that digitalization did not automatically produce efficiency. In some cases, it created double work because the technology was added to existing procedures without redesigning the service process. Document analysis also showed that several reporting formats still required manual verification, even when data had already been entered digitally.

The third theme concerns human readiness and organizational support. The adaptation process depended strongly on the digital skills, confidence, and problem-solving capacity of health workers. Younger staff tended to adapt faster to new applications, while older staff often needed more technical assistance. However, age was not the only factor. Motivation, training access, peer support, and leadership also shaped the adaptation process. One midwife stated, “At first, I was afraid of making mistakes in the system. After being guided by the operator and practicing several times, I became more confident.” This statement shows that digital readiness can grow through supportive learning environments. Observations also found that informal peer learning was common. Staff members often asked colleagues for help when they faced technical problems, especially during patient registration, referral entry, or report submission.

The fourth theme highlights the role of patients’ digital literacy in shaping service experience. Some patients appreciated digital registration and electronic queues because these systems made the process more orderly. However, older patients and patients with limited smartphone skills often depended on family members or registration staff. One patient said, “I prefer being helped at the counter because I am not used to using applications. If my child comes with me, it is easier.” This finding shows that digital health services may improve access for digitally literate users, but they can also create new barriers for patients with limited digital skills. In this context, the Puskesmas still played an important role as a mediator between digital systems and patients. Health workers did not only provide health services, but also guided patients in navigating digital procedures.

The fifth finding relates to the changing meaning of service quality in digitally supported primary care. Health workers no longer viewed service quality only as the speed of clinical treatment or the completeness of medical procedures. They also associated quality with data accuracy, system responsiveness, reporting timeliness, and the ability to connect patients with referral services. However, this expanded meaning created tension. On one side, digital systems improved accountability and monitoring. On the other side, they increased documentation pressure. A physician explained, “Good service is not only about examining the patient. Now we

must also make sure the data is complete, the referral is entered correctly, and the report matches the system.” This finding shows that digital transformation changes the professional responsibility of health workers. Clinical care and digital administration become closely connected in daily practice.

The sixth finding shows that local adaptation strategies were essential in maintaining service continuity. Health workers and managers developed practical solutions such as assigning specific staff as digital system operators, creating informal guidance groups, preparing manual backup forms during system disruptions, and helping patients who had difficulty using digital services. These strategies were not always written in formal policy documents, but they became part of everyday work culture. This pattern indicates that successful digital adaptation depends not only on formal system implementation, but also on local creativity, teamwork, and flexible problem-solving. In this sense, primary health care facilities do not passively receive technology. They actively adjust digital systems to fit local service realities.

Discussion

The findings confirm that digital technology adaptation in primary health care must be understood through a socio-technical perspective. Technology can improve service access, documentation, referral coordination, and reporting quality, but its effectiveness depends on how it interacts with users, workflows, organizational support, and patient capacity. This finding supports the argument of Erku et al. (2023), who found that digital health interventions can improve access and quality in primary health care when they are supported by appropriate implementation conditions. The present study extends this view by showing that service improvement does not occur automatically after digital systems are introduced. It occurs when health workers are able to align technology with daily work processes and patient needs.

The finding that digital systems improved administrative order but also created additional workload is consistent with Eriksson et al. (2022), who reported that digital consultation in primary care improved access but did not always improve efficiency. In this study, repeated data entry and non-integrated applications became major sources of frustration among health workers. This suggests that digitalization can shift the burden from paper-based administration to screen-based administration if system integration remains weak. From a socio-technical viewpoint, this problem reflects a lack of alignment between the technical subsystem and the work subsystem. Digital health systems should not only be evaluated based on their availability, but also on their ability to reduce unnecessary tasks and support clinical decision-making.

The role of human readiness found in this study also strengthens previous research on technology acceptance and health worker adaptation. Stoumpos et al. (2023) emphasized that technology acceptance in health care depends on perceived usefulness, ease of use, organizational support, and user readiness. The present study shows that readiness is not a fixed personal attribute. It develops through training, repeated practice, peer support, and leadership encouragement. Health workers who initially felt uncertain became more confident when they received guidance from colleagues or system operators. This finding offers a practical insight for Puskesmas management. Digital transformation should not rely only on technical installation. It also requires continuous capacity building, mentoring, and supportive supervision.

The findings on patient digital literacy show that digital health can both reduce and create access barriers. Digital registration and electronic queues may help patients who are familiar with mobile technology, but they may exclude older adults, low-income patients, or people with limited digital skills. This finding aligns with Nakayama et al. (2023), who argued that digital inequality can limit equal access to telehealth and digital care. In the context of Indonesian primary health care, this issue is highly relevant because Puskesmas serves diverse populations with different levels of education, income, age, and digital familiarity. Therefore, digital service

improvement must include assisted digital services. Patients who cannot use digital platforms independently should still receive support without being stigmatized or delayed.

The change in the meaning of service quality is one of the important contributions of this study. In digitally supported primary care, service quality is no longer limited to clinical interaction. It also includes data completeness, system accuracy, referral validity, and reporting timeliness. This finding is in line with Silva et al. (2024), who argued that digital health should be connected to quality-of-care evaluation in primary health care. However, this study adds that the expansion of quality indicators may increase pressure on health workers if digital tasks are not balanced with workload management. Health workers may feel responsible for both patient care and system compliance. This dual responsibility can improve accountability, but it can also reduce the quality of interpersonal care when administrative demands become excessive.

The local adaptation strategies identified in this study show that digital transformation is shaped by everyday problem-solving. Informal peer learning, manual backup systems, patient assistance, and operator-based support became important mechanisms for maintaining service continuity. These findings support the socio-technical view that successful technology implementation depends on local adjustment rather than strict technical standardization. Shaw et al. (2021) argued that digital health must be examined through socio-technical ethics because digital systems affect relationships, responsibilities, and power in health care. The present study supports this argument by showing that digital systems reshape who helps whom, who controls data, who bears administrative responsibility, and how patients experience access to care.

Compared with previous studies, this research offers a contextual contribution by focusing on primary health care facilities in an Indonesian urban setting. Many digital health studies focus on system effectiveness, platform adoption, or patient satisfaction. This study provides a different perspective by exploring the lived experiences of health workers, managers, administrative staff, system operators, and patients. It shows that adaptation occurs through negotiation between formal digital systems and local service realities. The findings also show that Puskesmas staff act as mediators between national digital health policies and community-level service needs. This role is important because the success of digital health policy depends on how front-line workers translate it into everyday practice.

Theoretically, this study strengthens the application of the socio-technical approach in primary health care digitalization. The findings show that technology, people, tasks, structure, and environment must be treated as interdependent elements. A digital system that is technically functional may still fail to improve service if it does not fit user capacity, patient literacy, and organizational workflow. Practically, the findings suggest that health offices and Puskesmas managers should prioritize system integration, user-centered training, technical support, assisted digital services for patients, and workload-sensitive digital policies. Digital transformation should be designed as a service improvement strategy, not merely as an administrative reporting obligation.

Future studies can expand this research by comparing urban and rural Puskesmas, examining patient experiences across age groups, or evaluating the relationship between digital maturity and perceived service quality. Further research may also use mixed methods to combine qualitative insights with quantitative measures of workload, waiting time, system use, and patient satisfaction. In addition, longitudinal studies are needed to understand how digital adaptation changes over time as health workers become more familiar with technology and as systems become more integrated. Such studies can deepen understanding of how digital transformation can support primary health care systems in a more inclusive, efficient, and human-centered way.

4. Conclusions

This study concludes that the adaptation of digital technologies in primary health care is a socio-technical process that depends on the interaction between digital systems, health workers, organizational routines, infrastructure, and patient readiness. The findings show that digital technologies support service acceleration, data traceability, referral coordination, and administrative order. However, their benefits are limited when systems remain fragmented, workflows are not redesigned, and health workers must perform repeated data entry across different platforms. The study also shows that human readiness, peer support, leadership, and informal learning play a central role in helping health workers adapt to digital service demands. At the patient level, digital literacy becomes a key factor that determines whether digital services improve access or create new barriers.

Theoretically, this study strengthens the socio-technical perspective by showing that digital health transformation cannot be understood only as a technological intervention. It must be examined as a change in work culture, service relationships, professional responsibility, and patient experience. Practically, the findings suggest that Puskesmas managers and local health offices need to prioritize system integration, continuous training, technical support, assisted digital services, and workload-sensitive implementation policies. From a policy perspective, digital transformation in primary health care should not only focus on platform expansion, but also on user-centered design and equity of access. Future studies should compare digital adaptation across urban and rural Puskesmas, examine patient experiences among vulnerable groups, and use mixed methods to measure how digital maturity affects waiting time, workload, service quality, and patient satisfaction.

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