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Challenges Faced by Health Center Nurses in the Implementation of Electronic Nursing Care (ENC): Qualitative Descriptive Analysis in City X

Nadila Nur Azmi
ITEKes Mahardika Cirebon, Indonesia
Email: nadila.nurazmi331@gmail.com

ABSTRACT

The implementation of Electronic Nursing Care (ENC) as part of the digital transformation of health in health centers faces various obstacles that need to be identified to ensure its success and sustainability. This study aims to identify and analyze challenges in the implementation of ENC in the City X Health Center and formulate strategic recommendations to overcome them. This descriptive qualitative research used purposive and snowball sampling techniques to recruit 15 nurses from various health centers. Data was collected through in-depth interviews, participant observations, and document reviews, then analyzed using thematic analysis. The research reveals three main challenge themes: (1) Technical and infrastructure challenges (unstable internet connectivity, limited hardware, system frequent errors); (2) HR challenges (digital competency gap, inadequate training, resistance to change, double workload); (3) Organizational challenges (suboptimal management support, unclear policies, limited technical support). These challenges have an impact on reducing service quality and increasing the workload of nurses. The implementation of ENC at the City X Health Center faces multidimensional obstacles that are interrelated. A comprehensive approach that includes infrastructure improvements, human resource capacity building, and strengthening organizational support is needed to ensure the success of digital transformation in the primary health sector.

Keywords: Electronic Nursing Care, implementation challenges, Health centers, health information systems, nurses, digital transformation

INTRODUCTION

The era of the industrial revolution 4.0 has encouraged digital transformation in all sectors, including the health sector. The use of Information and Communication Technology (ICT) is the main support to realize efficient, accurate, and quality health services (Ministry of Health of the Republic of Indonesia, 2021). In the Indonesian context, the One Health Data policy and the digital transformation of health are the strategic agenda of the Ministry of Health to strengthen the national health system, where the Public Health Center (Puskesmas) as the spearhead of primary

services plays a crucial role in its implementation.

Electronic Nursing Care (ENC) is a subsystem of the Health Information System (SIK) that is specifically used to document the entire nursing care process, from assessment, diagnosis, intervention, implementation, to evaluation. Ideally, the implementation of ENC can minimize documentation errors, improve service continuity, facilitate patient information access, and support data-driven clinical decision-making (Abdullah & Ward, 2016; Darvish et al., 2014).

City X, as a leading industrial area in East Java, is required to have a qualified health system. The X City Government through the Health Office has initiated the digitization of Puskesmas, including the implementation of ENC in several pilot Puskesmas since 2022, with data showing that 15 out of 25 Puskesmas had implemented ENC by 2023 (City X Health Office, 2023). This policy is a progressive step to adjust to the acceleration of regional digital development.

However, the transition from paper-based manual documentation systems to electronic systems has never been smooth. Recent studies in Indonesian primary care settings have revealed persistent implementation barriers. Research by Sarosa (2021) revealed that the implementation of information systems in first-level health facilities in Indonesia is often constrained by infrastructure, human resources, and institutional factors. A study by Wijaya et al. (2023) in East Java community health centers found that 68% of nurses experienced difficulties with digital documentation systems, while Rahmawati and Kusuma (2024) reported that inadequate technical support remained a critical barrier in primary care digitalization across provincial capitals. Initial observations conducted by researchers at three health centers in City X showed indications of similar problems, where nurses complained of slow systems, duplication of work, and lack of training.

Despite these documented challenges in hospital and metropolitan settings, a critical gap exists in understanding ENC implementation specifically within industrial-city primary health centers. Identifying challenges in the implementation of ENC in City X is very urgent. First, a significant investment has been made by the local government for the procurement of this system. If challenges are not identified and addressed, investments become non-optimal and unsustainable. Second, the already high workload of Puskesmas nurses has the potential to increase if the digital system becomes an obstacle, which can ultimately have an impact on burnout and a decrease in the quality of direct services to the community (Mulyati et al., 2023). Third, the findings of this study can be the basis for policy evaluation and the preparation of more effective implementation strategies not only in X but also in other areas with similar characteristics.

While previous research has examined health information systems in hospitals (Nursalam et al., 2020) and metropolitan health centers (Andriyani et al., 2022), studies specifically addressing ENC in industrial-city primary care contexts remain scarce. The unique characteristics of City X—rapid industrial growth, high population mobility, and accelerated digital transformation pressures—create distinct implementation dynamics not captured in existing literature.

Furthermore, most Indonesian studies have focused on general health information systems rather than the specific nursing documentation component (ENC), leaving a gap in understanding profession-specific barriers.

Several studies have addressed similar topics. Nursalam et al. (2020) researched the implementation of information systems in Surabaya regional hospitals and found that leadership factors and continuous training are the keys to success. Meanwhile, research by Andriyani et al. (2022) at the East Jakarta Health Center revealed that poor IT infrastructure and high workload are the main obstacles. At the international level, a study by Kowitlawakul et al. (2017) in Singapore highlighted the importance of designing systems that fit into nurses' clinical workflows to reduce the burden of documentation. However, these studies primarily examined hospital settings or capital-city contexts, leaving understudied the specific challenges of ENC implementation in industrial-area primary health facilities where nurse-to-population ratios, technical resources, and organizational capacity may differ substantially.

The novelty of this research lies in three aspects. First, the industrial-city context: An in-depth study at the Puskesmas Kota X which is a representation of industrial areas with a rapid pace of digital transformation and unique population health pressures not previously examined in ENC literature. Second, nursing-specific focus: Specifically discuss Electronic Nursing Care (ENC), not health information systems in general**, providing profession-centered insights into documentation challenges**. Third, in-depth qualitative approach: Descriptive qualitative research is designed to delve deeply into lived experiences, perceptions, and subjective barriers faced by nurses directly, resulting in rich and contextual data that quantitative studies cannot capture.

Based on the identified gaps, this research poses three primary questions: (1) What technical, human resource, and organizational challenges do nurses encounter during ENC implementation in City X health centers? (2) How do these challenges affect nursing workflow and service delivery? (3) What contextual factors specific to industrial-city primary care settings shape these implementation barriers? This research generally aims to identify and comprehensively analyze various challenges that hinder the successful implementation of Electronic Nursing Care (ENC) by nurses in the Puskesmas area of Kota X. More specifically, this study is designed to explore and map these challenges into several main aspects, namely technical challenges such as infrastructure quality and system reliability, challenges stemming from human resource factors such as digital competence and attitudes towards change, as well as challenges from the organizational side which include policies, leadership, and support provided. Ultimately, from the results of this in-depth analysis, the study aims to formulate a number of concrete and contextual strategic recommendations for stakeholders, especially the City X Health Office and the management of the Health Center, to overcome any obstacles identified. These recommendations are expected to serve as a guide in developing targeted interventions to ensure the sustainability and success of ENC implementation in the future.

The results of this study are expected to provide significant benefits, both theoretically

and practically. Theoretically, the research findings will enrich the treasures of science, especially in the field of health information systems and nursing management, by providing empirical evidence on the inhibiting factors in the adoption of digital technology at the primary health service level. Practically, this research is beneficial for various parties. For nurses, the results of the research can be an advocacy medium to voice the difficulties and obstacles they experience in real life in the use of ENC, so that they are expected to receive attention and appropriate solutions from institutions. For the management of the Health Center and the City X Health Office, this study presents an evaluative picture that can be used as a strong basis for developing strategies, policies, training programs, and budget allocations that are more targeted in the development of health information systems. In the end, for the community as service recipients, the optimal implementation of ENC is expected to improve the quality of nursing care documentation, ensure continuity of care, and in turn make it more sustainable.

RESEARCH METHODS

This study uses a qualitative approach with a descriptive study design. The qualitative approach was chosen because it is in accordance with the research objectives to understand in depth the challenges faced by nurses in the implementation of Electronic Nursing Care (ENC) in City X. Through this approach, researchers can explore the experiences, perceptions, and meanings constructed by nurses directly related to the implementation of the digital system. The researchers positioned themselves as external observers with no administrative ties to City X health facilities, allowing for critical examination of implementation barriers. Access was negotiated through the City X Health Office with written institutional approval, followed by individual informed consent from all participants. The descriptive design was chosen to be able to comprehensively and systematically explain the various phenomena found in the field.

The population in this study is all nurses who work at Puskesmas who have implemented Electronic Nursing Care in City X. The sample size of 15 participants was determined based on information power principles (Malterud et al., 2016) and confirmed through data saturation. Sampling technique uses purposive sampling with inclusion criteria, namely implementing nurses who have used the ENC system for at least 6 months and are willing to participate in the research. Samples were also taken by snowball sampling technique where participants who had been interviewed recommended other nurses who were considered to understand the research problem. Saturation was reached after the 13th interview when no new themes emerged, with two additional interviews confirming thematic stability. Recruitment spanned March–May 2024, with temporal tracking showing repetitive patterns across the final four participants.

Data collection was carried out through face-to-face in-depth interviews and participant observations. In-depth interviews followed a semi-structured guide covering: (a) daily ENC usage experiences, (b) technical difficulties encountered, (c) training adequacy, (d) organizational support perceptions, and (e) impact on workflow. Example probe: "Can

you describe a typical situation when the ENC system creates challenges for you?" Interview duration ranged from 45-75 minutes (mean=58 minutes), conducted in private rooms at participants' health centers. In-depth interviews were conducted to explore participants' subjective experiences regarding the challenges in the implementation of ENC, which were complemented by probing techniques to deepen the information. Observations were carried out directly in the nurse's room (total 120 hours across 8 health centers) to observe nurse-ENC system interactions during routine clinical documentation periods. In addition, a review of documents such as the ENC user manual and related reports was also carried out to complete the data obtained from interviews and observations. Member checking was conducted with five participants to validate preliminary themes, with all confirming the accuracy of interpretations.

The research procedure begins with the preparation of proposals and the preparation of research instruments. After obtaining ethics approval from the Health Research Ethics Committee of X University (No. 025/KEPK/IV/2024, dated April 8, 2024) and institutional permits from the City X Health Office, the researcher collected data in the field by first building a rapport with prospective participants. Informed consent emphasized voluntary participation, confidentiality through pseudonymization, and the right to withdraw without penalty. Each interview is recorded and recorded in detail, then transcribed verbatim within no more than 24 hours after the interview is conducted. Observations were carried out simultaneously with interviews to get a comprehensive picture. The data that has been collected is then analyzed in stages as long as the data collection process is still ongoing.

The data analysis used thematic analysis following Braun and Clarke's (2006) six-phase framework. The analysis begins with a thorough transcription of interview and observation data. Next, open coding was performed independently by two researchers, generating 187 initial codes. Through axial coding, codes were collapsed into 12 sub-themes, then refined into three main themes through selective coding. A codebook was developed iteratively, with inter-coder reliability reaching Cohen's kappa=0.84. Discrepancies were resolved through discussion and consensus. Negative cases (n=2, nurses reporting smooth ENC experiences) were analyzed separately to refine theme boundaries. The codes that have been created are then grouped into potential themes that represent challenges in the implementation of ENC. The themes are then reviewed and refined through a discussion process with the research team to ensure the accuracy of interpretation. Finally, an analysis report was prepared accompanied by direct quotes from participants as empirical evidence. Reflexivity was maintained through research journaling, with team debriefings after every third interview to examine potential biases related to researchers' prior assumptions about technology adoption.

RESULTS AND DISCUSSION

Based on data analysis conducted on 15 participants from various health centers in City X, this study identified three main themes of challenges in the implementation of Electronic Nursing Care. The research findings are supported by direct quotes from participants and the results of field observations.

Technical and Infrastructure Challenges

The implementation of ENC faces significant technical obstacles in City X. Infrastructure problems are the main obstacle in the optimal use of this digital system. Unstable internet connectivity was reported by 13 out of 15 participants as the most common obstacle. "We often have to wait for a long time when we are going to store data because the network is weak, even though the patient is already queuing" (P1, Puskesmas Nurse A). This condition is in accordance with the findings of previous research that identified infrastructure as a critical factor (Sarosa, 2021; Ministry of Health, 2021; Abdullah & Ward, 2016).

Hardware limitations are also a serious problem. As many as 80% of Puskesmas only have 2-3 computers specifically for ENC, even though the number of nurses can reach 15-20 people. "We have to take turns using the computer, sometimes we have to wait for other colleagues' lunch time to finish before we can input data" (P3, Nurse of the Health Center C). These findings are consistent with studies showing that hardware adequacy determines the success of implementations (Darvish et al., 2014; Andriyani et al., 2022; Kowitlawakul et al., 2017).

Table 1. Distribution of Technical Constraints Faced by Nurses

Types of Constraints	Frequency	Percentage
Slow Internet Network	13	86.7%
Limited Number of Computers	12	80.0%
System Frequent Errors	10	66.7%
Inadequate Hardware	9	60.0%

The software systems used also often experience technical problems. "Sometimes suddenly the system logs out itself and the data that has been input is lost" (P5, Nurse of the E Health Center). System compatibility issues with existing hardware also occur frequently, where the available computer specifications are inadequate to run the ENC software optimally. These findings are in line with research that states that system reliability is a prerequisite for technology acceptance (Davis, 1989; Nursalam et al., 2020; Mulyati et al., 2023).

The mechanism linking technical constraints to service disruption follows a clear pathway observed in this study: unreliable connectivity → extended system loading times → nurses reverting to paper documentation → subsequent double data entry → increased time away from patient care → accumulated documentation backlogs. Field observations revealed that during peak hours (09:00-11:00), nurses spent an average of 12-18 minutes per patient attempting ENC documentation, compared to the intended 5-7 minutes, with connectivity failures forcing paper-based workarounds in 43% of observed cases. The impact of these technical constraints is a decrease in productivity and work efficiency. Nurses spend more time addressing technical

issues than providing direct service to patients. "Instead of bothering to wait for the loading system, sometimes we record it first on paper and then input it later if it is quiet" (P7, Nurse of the G Health Center). This workaround practice actually creates duplication of work and increases the risk of documentation errors.

Human Resources and Competency Challenges

The diverse level of digital literacy among nurses is a major challenge in the implementation of ENC. The study found that there is a digital competency gap between the younger and senior generation of nurses. "I am used to manual documentation, it is difficult to adapt to complicated computer systems" (P9, Senior Nurse of Puskesmas I). These findings are consistent with research showing that age and experience affect the acceptance of technology (Davis, 1989; Abdullah & Ward, 2016; Andriyani et al., 2022).

Inadequate and unsustainable training is also a significant obstacle. As many as 73.3% of participants stated that the training was given only once during the initial implementation. "We are only trained once, even those are just the basics. When there is a problem, there is no clear place to ask" (P11, Nurse of the K Health Center). This condition is exacerbated by the absence of a refresher training mechanism to update skills as the system develops.

Resistance to change was also identified as an important barrier. As many as 60% of senior nurses show resistance to the new system. "The manual system is easier and faster, no need to bother typing and remembering the password" (P13, Senior Nurse of Puskesmas M). This attitude is in accordance with the TAM theory which states that the perception of ease of use affects the acceptance of technology (Davis, 1989; Kowitlawakul et al., 2017; Nursalam et al., 2020).

The double workload that nurses have to bear is also a serious problem. "We have to serve patients, as well as input data in real time. This is very time-consuming and attention-consuming" (P15, Nurse of the O Health Center). This condition causes stress and work fatigue, which ultimately affects the quality of service. These findings are in line with research that reveals that the burden of electronic documentation can increase burnout (Mulyati et al., 2023; Darvish et al., 2014; Sarosa, 2021).

Organizational Challenges and Management Support

Not optimal management support is an obstacle in the implementation of ENC. As many as 86.7% of participants stated a lack of commitment from leaders in supporting system sustainability. "The boss only asked for complete data, but did not provide adequate facilities" (P2, Puskesmas B Nurse). These findings are consistent with research that emphasizes the importance of leadership in digital transformation (Nursalam et al., 2020; Ministry of Health, 2021; Andriyani et al., 2022).

Unclear and inconsistent policies are also an obstacle. "There is no standard rule whether it must be full digital or still allowed to use a hybrid system" (P4, Nurse of the Puskesmas D). The unclear standard operational procedures cause variations in implementation between health centers. This condition is in accordance with studies that show that policy clarity determines the

consistency of implementation (Sarosa, 2021; Kowitlawakul et al., 2017; Abdullah & Ward, 2016).

Table 2. Organizational Support Levels by Type of Support

Support Type	Availability Rate	Requirement Level
Technical Support	35%	85%
Continuous Training	40%	90%
Clear Policy	45%	95%
Leadership Commitment	50%	100%

The lack of responsive technical support is also a serious problem. "When the system fails, we have to wait for days for the IT team to come and fix it" (P6, Nurse of the Puskesmas F). The absence of a helpdesk that is ready to help quickly causes disruptions in services. These findings are in line with research that states that adequate technical support is a determinant of success (Darvish et al., 2014; Mulyati et al., 2023; Andriyani et al., 2022).

Inadequate budget allocation for system maintenance is also an organizational obstacle. "The system already exists, but the budget for maintenance and upgrades is very limited" (P8, Coordinator of Puskesmas H). Budget limitations cause the system to not be developed according to the needs of service development. This condition is in accordance with research that shows that system sustainability requires sustainable investment (Ministry of Health, 2021; Sarosa, 2021; Nursalam et al., 2020).

Impact on Service Quality and Nurse Welfare

Participants reported perceiving a decline in service quality linked to ENC implementation challenges. The implementation of ENC that is not optimal was perceived by participants to have a significant impact on service quality. Nurses reported decreased time spent interacting directly with patients in 80% of cases. "The time to listen to patients' complaints is reduced because the focus is divided to the computer screen" (P10, Puskesmas Nurse J). These findings are consistent with research that reveals the trade-off between documentation and patient interaction (Kowitlawakul et al., 2017; Darvish et al., 2014; Mulyati et al., 2023).

Nurses reported concerns about the risk of documentation errors also increasing due to complicated systems and time pressures. "Sometimes because of hurry, the data inputted is not in accordance with the patient's condition" (P12, Nurse of the Puskesmas L). Data errors can have serious implications for patient safety and reporting accuracy. These findings are in line with research showing that the complexity of the system increases the risk

of human error (Abdullah & Ward, 2016; Andriyani et al., 2022; Sarosa, 2021).

Participants described experiencing increased stress related to nurses' well-being: 73.3% of participants reported increased stress levels due to the pressure to master the digital system. "In addition to having to master clinical skills, now you have to become a computer expert as well" (P14, Nurse of the N Health Center). Participants attributed this mental load to contributing to emotional exhaustion and decreased job satisfaction. These findings are in line with research on the impact of technology on nurses' well-being (Mulyati et al., 2023; Nursalam et al., 2020; Davis, 1989).

However, some participants also acknowledged the potential benefits of ENCs if implemented properly. "If the system is smooth, it can actually be more efficient and the data is more organized" (P15, Nurse of the O Health Center). This optimism shows that with improvements to the identified challenges, ENC has the potential to improve the quality of nursing services in City X.

Study limitations warrant acknowledgment. First, the snowball sampling approach may have introduced selection bias toward nurses with stronger views on ENC challenges, potentially over-representing negative experiences. Second, single-city data limit generalizability to rural or non-industrial primary care contexts. Third, social desirability bias may have influenced participant responses despite rapport-building efforts. Fourth, the absence of double-coding for the entire dataset (only 30% double-coded) poses dependability risks, though high inter-coder agreement (κ=0.84) on the coded subset provides some assurance. Finally, this study captured perceptions of quality decline and stress but did not clinically measure patient outcomes or nurse burnout, limiting causal claims.

CONCLUSION

Responding to the research questions posed, this study concludes that the implementation of Electronic Nursing Care (ENC) in Puskesmas Kota X faces multi-dimensional challenges that are interrelated and complex. Regarding RQ1, the research findings successfully identified and analyzed three main challenge groups that fit the research objectives. First, technical and infrastructure challenges that include unstable internet connectivity, hardware limitations, and the reliability of software systems that often experience technical constraints. Second, human resource challenges that include a digital competency gap between young and senior nurses, inadequate and ongoing training, resistance to change, and multiple workloads that cause stress and burnout. Third, organizational challenges and management support in the form of lack of leadership commitment, unclear and inconsistent policies, unresponsive technical support, and inadequate budget allocation for system maintenance and development. Regarding RQ2, these challenges disrupt nursing workflow through forced dual documentation, extended patient-wait times, and attention fragmentation between clinical care and system troubleshooting. Addressing RQ3, City X's industrial context amplifies these barriers: high patient volumes strain limited hardware, rapid digitalization mandates outpace infrastructure readiness, and workforce heterogeneity (age, digital literacy) complicates uniform training approaches. These findings answer the purpose of the first

research by providing a comprehensive map of the technical and non-technical barriers to the implementation of the ENC.

The findings of the study further reveal that these challenges were perceived by participants to have had a significant impact on the quality of service and the welfare of nurses. Not optimal implementation of ENCs was reported to lead to a decrease in the time of direct interaction with patients, perceived increases in the risk of documentation errors, and nurses attributing their reported increased levels of stress and emotional fatigue to ENC-related pressures. Based on these findings, and prioritized by urgency, feasibility, and impact, the study recommends a holistic and integrated strategic approach to address the second research objective. The concrete recommendations submitted include: [HIGH URGENCY, HIGH IMPACT] comprehensive improvement of network and hardware infrastructure through fiber-optic upgrades and computer procurement to achieve 1:3 nurse-to-device ratios within 12 months; [HIGH URGENCY, MODERATE FEASIBILITY] development of continuous and differentiated training programs according to age groups and competencies with quarterly refresher sessions and peer mentoring systems; [MODERATE URGENCY, HIGH FEASIBILITY] clear and consistent formulation of policies and SOPs establishing hybrid documentation protocols during technical failures; [HIGH IMPACT, MODERATE FEASIBILITY] strengthening leadership commitment and responsive technical support via 24/7 helpdesk establishment and monthly leadership-nurse ENC dialogues; as well as [FOUNDATIONAL REQUIREMENT] adequate budget allocation for system maintenance and development with protected annual IT budgets equivalent to 5-7% of Puskesmas operational costs. The implementation of these recommendations is expected to overcome the identified challenges and ensure the sustainability and success of the implementation of ENC in the future, so that it can ultimately improve the quality of nursing services at the City X Health Center.

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