

Barriers in Health Information Systems and Technologies to Support Maternal and Neonatal Referrals at Primary Health Centers

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Objectives: This study explored health workers' perceptions and experiences regarding the maternal and neonatal referral system, focusing on barriers of health information systems and technologies (IS/IT) at primary health centers (PHCs) in South Tangerang, Indonesia. **Methods:** This qualitative study was conducted using semi-structured interviews, which were conducted at the South Tangerang District Health Office and three PHCs. Interviews were conducted with nine participants responsible for maternal and neonatal referrals in their organizations. The data were analyzed using qualitative content analysis. **Results:** In South Tangerang, the Primary Health Care Information System (SIMPUS) is used to register patients and record data on medical treatment. To facilitate referrals, the PHCs currently use the Integrated Referral Information System (SISRUTE), P-Care, and the Integrated Emergency Management System (SPGDT). The following four IS/IT barriers to support maternal and neonatal referrals were found: technology, human resources, organizational support, and the referral process and implementation. **Conclusions:** The barriers in technology, human resources, and organizational support cause problems in the maternal and neonatal referral process and in the implementation of referrals. Barriers to referrals can influence patients' ability to receive appropriate care in a timely fashion and lead to inefficiency in maternal and neonatal referrals. This study contributes knowledge about IS/IT implementation in maternal and neonatal referral systems and provides recommendations to health regulators and application developers for the implementation of IS/IT in Indonesia.

Keywords: Referral and Consultation, Health Information Systems, Primary Health Care, Maternal Health, Newborn Infant

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I. Introduction

The referral system is an essential element of maternal and neonatal health [1]. Some developing countries have implemented health information systems or technologies (IS/IT) to support communication, transportation, or documentation in maternal and neonatal health referrals [2]. Previous studies about these technologies have primarily focused on design [3] and the benefits of IS/IT to support referrals [4,5]. However, there is a lack of research exploring users' perspectives on using technologies to support maternal and neonatal referrals.

The effective deployment of IS/IT requires both organizational support and users' ability to use technologies [6].

Unreliable infrastructure, lack of interoperability of systems, lack of regulations, and lack of healthcare workers' commitment are common barriers to IS/IT implementation in developing countries [7,8]. Barriers to IS/IT can cause inefficiency in maternal and neonatal referrals [2]. Discussing users' perspectives on current IS/IT use can determine future improvements for maternal and neonatal referral systems.

Limited research has been conducted on technologies to support maternal and neonatal referrals in Indonesia, which is a developing country. Moreover, research on the referral system in Indonesia still focuses on its implementation in hospitals, and little research has been conducted at primary health centers (PHCs) [9]. PHCs play an essential role as gatekeepers for curative and public health services [10] and link patients to Indonesia's referral system [11]. Some PHCs in districts/cities in Indonesia still process data manually [12], and there is rarely a designated person to manage health information systems [10]. The Indonesian government has developed IS/IT systems to support maternal and neonatal referral, such as the Information and Communication System for Maternal and Neonatal Referral Networks (SijariEMAS) and SMSBunda—a text messaging service for pregnant women and postnatal mothers [13]. However, these systems did not work effectively in several regions because they did not consider each region's specific characteristics [13].

The district of South Tangerang in Banten Province is an urban area in Indonesia that is currently developing an integrated referral system focusing on individual health referrals [14]. In Indonesia, maternal and neonatal referral health systems have different guidelines and requirements from those of individual health referrals [15]. This study explored health management and health workers' experiences with

the maternal and neonatal referral system, focusing on IS/IT barriers at PHCs in South Tangerang.

II. Case Description

1. Participant Selection

The South Tangerang has 25 PHCs in seven sub-districts and one public hospital [16]. This study was conducted at three PHCs (Pamulang, Pondok Benda, and Pisangan) and the South Tangerang District Health Office (DHO) as the regulator of PHCs. These PHCs were selected based on a recommendation from the DHO and were considered to have exemplary IT implementation. This study used purposive sampling to select participants with the best knowledge concerning the research topic. The participants from the DHO worked in the family health section and the health human resources section, while the participants from the PHCs were workers in the maternal and child health section and administrative staff (Table 1).

2. Data Collection

The authors conducted semi-structured interviews between April and September 2019, with an average duration of 30–45 minutes. The interview questions were related to the maternal and neonatal referral process and health IS/IT that can support referrals (Table 2). Interviews were recorded and transcribed for analysis.

3. Data Analysis

This study used content analysis, consisting of decontextualization, recontextualization, categorization, and compilation [17] (Figure 1). In the decontextualization step, the authors read each transcribed text, broke the text into smaller mean-

Table 1. Participants' profile

Code	Respondent's position	Experience	Education	Section	Organization
R1	Head of family health section	10 years	Master's degree	Family health	South Tangerang DHO
R2	Staff of family health section	14 years	Master's degree	Family health	South Tangerang DHO
R3	Staff of health human resource section	7 years	Bachelor's degree	Health human resources	South Tangerang DHO
R4	Midwife	5 months	Diploma	Maternal and child health	Pondok Benda PHC
R5	Admin	7 years	Bachelor's degree	Administrative	Pondok Benda PHC
R6	Doctor	5 years	Bachelor's degree	Maternal and child health	Pamulang PHC
R7	Midwife	8 years	Diploma	Maternal and child health	Pamulang PHC
R8	Admin	5 years	High school	Administrative	Pamulang PHC
R9	Midwife	3 years	Diploma	Maternal and child health	Pisangan PHC

DHO: District Health Office, PHC: primary health center.

Table 2. Interview questions

Interview questions in DHO		Interview questions in PHCs
Maternal and neonatal referral process and implementation		
Q1	What are the procedures for the maternal and neonatal referral system implemented by South Tangerang DHO? Is there a regional mapping and referral system flow?	What are the procedures for the maternal and neonatal referral system implemented in PHC?
Q2	Does the South Tangerang DHO have a complete list of healthcare facilities and their availability in the South Tangerang area?	Does the PHC have a complete list of healthcare facilities and their availability in the South Tangerang area?
Q3	How does South Tangerang DHO manage transportation in maternal and neonatal referrals in the South Tangerang area?	How does PHC manage transportation in maternal and neonatal referrals in the South Tangerang area?
Q4	How does South Tangerang DHO manage the communication or feedback on maternal and neonatal referrals in the South Tangerang area?	How does PHC manage the communication or feedback on maternal and neonatal referrals in the South Tangerang area?
Q5	How does the South Tangerang DHO monitor and evaluate the maternal and neonatal referral systems in all PHCs in the South Tangerang area?	How does the PHC manage back-referral cases from higher health facilities?
Q6	How does the South Tangerang DHO conduct guidance and supervision of referrals in all PHCs in the South Tangerang area?	How does PHC monitor and evaluate the implementation of maternal and neonatal referrals?
Q7	How does the South Tangerang DHO conduct the validation or checking of reporting data from all PHCs?	How does the PHC report the data about maternal and neonatal referral system to the South Tangerang DHO or other related parties?
Q8	What are some problems often experienced related to maternal and neonatal referral?	What are some problems often experienced related to maternal and neonatal referral?
Health information systems and technologies		
Q9	What are health information systems and technologies used by the South Tangerang DHO? Is there any health information system related to maternal and neonatal referral systems?	What are health information systems and technologies used by the PHC? Is there any health information system related to maternal and neonatal referral systems?
Q10	What problems are often experienced by the South Tangerang DHO regarding the implementation of health information systems and technologies?	What problems are often experienced by the PHC regarding the implementation of health information systems and technologies?
Q11	What are expectations regarding the implementation of health information systems and technologies to support maternal and neonatal referral?	What are expectations regarding the implementation of health information systems and technologies to support maternal and neonatal referral?

DHO: District Health Office, PHC: primary health center.

ing units, and created codes inductively [17]. In recontextualization, the authors compared the original data by re-reading the transcribed text and the list of meaning units to check whether there are unmarked texts to be included. In the categorization step, the authors identified the categories and sub-categories from the meaning units. Finally, the authors choose the appropriate meaning units presented in the

running text as quotations [17]. The authors did not find new codes and themes after analyzing interview results from five participants. The remaining interview results confirmed the answers of the other participants. The first author conducted the analysis, while others reviewed the process and categorization to ensure its trustworthiness.

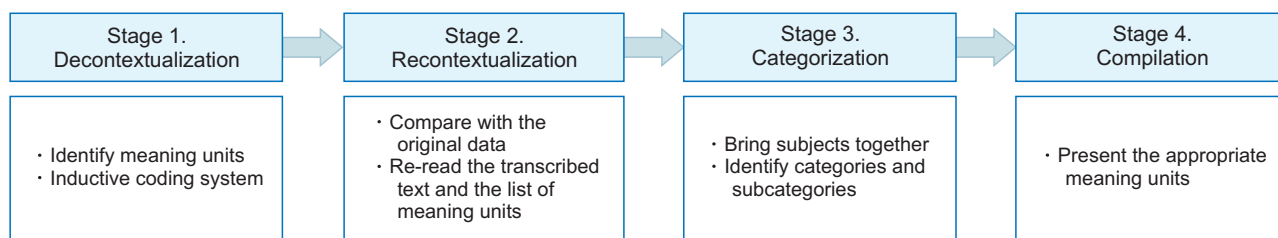


Figure 1. Qualitative content analysis process [17].

Table 3. Health information systems and technologies in South Tangerang PHCs

No	Name	Type	Function(s)
1	SIMPUS	Web-based application	Register patients and record data on the medical treatment.
2	SISRUTE	Web-based application	Manage general referral information exchange and communication.
3	P-Care	Web-based application	Register patients, record diagnoses results and facilitate referrals for BPJS Kesehatan patients.
4	SPGDT	Call center	Manage emergency cases.

PHC: primary health center, SIMPUS: Primary Health Care Information System, SISRUTE: Integrated Referral Information System, BPJS Kesehatan: Social Health Insurance Administration Body, SPGDT: Integrated Emergency Management System.

4. Maternal and Neonatal Referral System in South Tangerang

After a patient arrives at the maternal and child health section at a PHC, a health worker examines the patient. The health worker refers the patient to a hospital if complications are identified. The health worker communicates with the hospital to check available rooms and equipment and inform the hospital of the patient’s condition. Furthermore, The health worker calls an ambulance for the patient, but the health worker also accompanies the patient in the ambulance.

In South Tangerang, the Primary Health Care Information System (SIMPUS) is used to register patients, record diagnoses, and report activities to the DHO [18]. For referral, PHCs use the Integrated Referral Information System (SISRUTE) for information exchange [19] and P-Care to generate referral letters for patients with coverage through the Social Health Insurance Administration Body (BPJS Kesehatan) [20]. SijariEMAS was replaced by one system, that is SPGDT (the Integrated Emergency Management System). SPGDT is the only emergency call center system in the South Tangerang area [21]. Table 3 presents the IS/IT used in South Tangerang.

5. Results

Barriers to IS/IT to support maternal and neonatal referrals consisted of technology, human resources, organizational support, and the referral process and implementation. Figure 2 illustrates the relationships between the barriers. Table

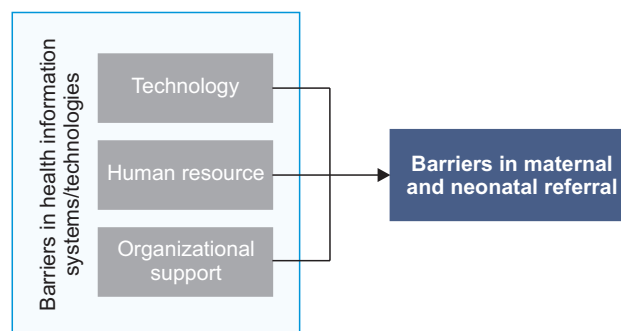


Figure 2. Barriers of health information systems and technologies to support maternal and neonatal referral.

4 describes each sub-category, with a selected quote for each barrier.

1) Technology

Due to the lack of IS/IT simplicity, the process of selecting hospitals is complicated for health workers. They can only refer patients to one hospital and must wait for a response before they make another referral. Delays in referral delivery and responses through this system make it difficult for health workers to refer patients quickly. Furthermore, the call center-based application (SPGDT) that is used nationally has a lack of availability during peak hours.

Existing applications cannot facilitate comprehensive referrals. One application can only serve one type of patient or referral. Another problem is the duplication of data work. For example, a health worker uses SIMPUS to record patient data during registration. When the patient needs to be re-

Table 4. Summary of barriers in health information systems and technologies to support maternal and neonatal referrals at PHCs

Category	Sub-category	Description	Quote
Technology	Lack of simplicity	Complex process of selecting hospitals	“One of the weaknesses of SISRUITE is that this application can only refer to one hospital and we have to wait for a response before we can make a referral to another hospital.” [R6]
	Low responsiveness	Slow system delivery and response	“There is SISRUITE, which is used with computers. Health workers write the patient’s name, complaints, chronology, and lab results, then choose the hospital. Hospitals will get alarms from PHC related to the referral. However, the problem is the slow response.” [R7]
	Lack of availability	The system is difficult to access during peak hours	“We often had difficulty in making calls with SPGDT. Maybe this is because many other users are using it.” [R5]
	Lack of comprehensiveness	No system to support the overall referral process and referral types	“P-Care is only making referral forms. The system that provides a response is SISRUITE. P-Care can be used for elective or non-emergency referral cases. For emergency referral cases, we use SISRUITE.” [R6]
	Duplication of data work	Systems that have not been integrated so that health workers must input the same data in two different systems	“SIMPUS and SISRUITE are two different applications, so users need to input data twice if they need to use both applications. These applications are still not integrated.” [R8]
Human resources	Poor internet connection	Slow internet connection and no backup internet provider	“The internet connection can be a problem. The organization that provides the internet is only Kominfo. If the internet is down, we do not have other backups.” [R3]
	Lack of readiness	Resistance from health workers and lack of skill and knowledge to use IT	“The problem we are experiencing is the lack of readiness of health workers in IT implementation. Many health workers are not yet familiar with the use of applications.” [R8]
	Increased workload	The use of systems increases the workload of health workers	“We used to implement the SijariEMAS application. However, this program was not run well, it increased our workload, and there was too much data that had to be entered.” [R5]
Organizational support	Lack of human resources	Lack of health workers to manage the system	“SISRUITE can be used for emergency referrals. However, the problem is the lack of human resources, which would be fully responsible and available to use the system. This lack of standby health workers causes us to need a long time to receive a response.” [R6]
	Lack of financial support	Lack of financial support to ensure the sustainability of IS/IT	“We adopted SijariEMAS in 2016 with a little support from the EMAS team. Moreover, assistance from the ministry of health is less than one year. Previously, we had asked for support to extend SijariEMAS for one more year. However, in the following year, the support was eliminated.” [R1]
	Lack of policies	Lack of policies to include all parties involved	“In Tangerang district, all parties are involved because there are policies that make the parties involved. It is expected that in the future, there will be support from all parties or across sectors, for example, from the infrastructure development sector, community, or other social services.” [R2]

Table 4. Continued 1

Category	Sub-category	Description	Quote
Referral process and implementation	Non-standardized referral communication	The use of other communication media besides the IS/IT that has been provided for referral	“For communication of emergency referral, we use SPGDT. However, sometimes, the response is not fast. So, many officers come directly to the referral facility or use WhatsApp to find a referral facility.” [R2]
	Hospital touring	Difficulties to find health facilities that have the required and available facilities	“It is hard to find a hospital because beds are often full, NICU or ICU facilities are limited. There are 29 hospitals in South Tangerang, there are quite a lot of facilities, but the beds are often full, the NICU and ICU are limited, or there is a lack of isolation space.” [R1]
	Lack of follow-up and back-referral mechanisms	The process of following up the patient’s condition and back referrals is still done using paper-based forms	“For referrals, most PHCs do not receive back-referrals from the hospital, and there is no further information from the hospital. This is also because PHCs do no following up on the patient’s condition.” [R2]
	Lack of referral success monitoring	Lack of analysis regarding the success of the referral	“In our current health information systems, there is no dashboard for referral trends. For example, which facilities are most often referred to, and what kind of diseases patients are most often referred for.” [R3]

PHC: primary health center, SISRUITE: Integrated Referral Information System, SPGDT: Integrated Emergency Management System, SIMPUS: Primary Health Care Information System, Kominfo: Ministry of Communications and Information, SijariEMAS: Information and Communication System for Maternal and Neonatal Referral Networks, EMAS: Expanding Maternal and Neonatal Survival, NICU: neonatal intensive care unit, ICU: intensive care unit.

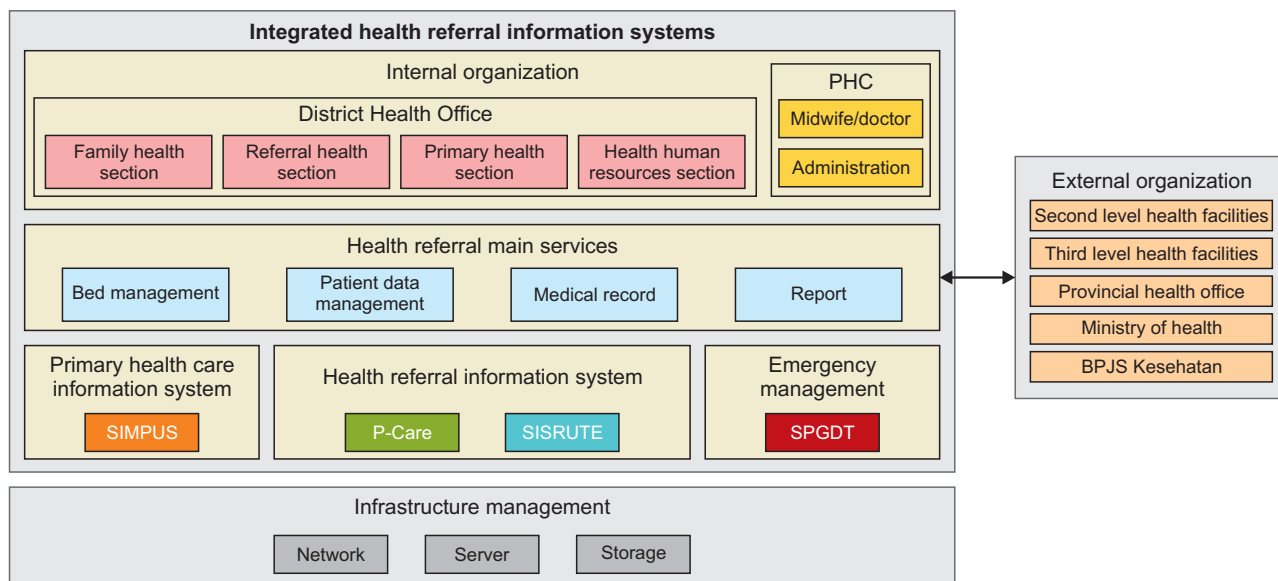


Figure 3. Architectural design of integrated health referral information systems. PHC: primary health centers, SIMPUS: Primary Health Care Information System, SISRUITE: Integrated Referral Information System, SPGDT: Integrated Emergency Management System, BPJS Kesehatan: Social Health Insurance Administration Body.

ferred, the health worker must re-enter the patient's data in SISRUITE. Moreover, all respondents reported poor internet connections. The internet is only provided by the Ministry of Communications and Information (Kominfo), and there is no backup Internet provider.

2) Human resources

Health workers are not fully ready to use IS/IT due to their lack of IT knowledge or skills. Some applications can also increase their workload due to the need to input an excessive amount of data. Another problem is the lack of human resources to manage IS/IT who can be available at any time, especially to handle emergency referrals that need an immediate response.

3) Organizational support

A lack of financial support is one of the reasons why South Tangerang no longer uses SijariEMAS. Financial support is needed to perform server maintenance and training for health workers. Furthermore, a respondent at the DHO suggested that the lack of user involvement with SijariEMAS in South Tangerang stemmed from the absence of policies to involve all relevant stakeholders in the maternal and neonatal referral system.

4) Referral process and implementation

As a result of the above-mentioned IS/IT problems, health workers prefer using other communication media to refer patients or guiding patients and accompanying them to the preferred referral facility. Another problem is "hospital touring," because IS/IT cannot help health workers to see hospitals' capacity and make direct referrals to hospitals capable of admitting the patient. After referral, the hospital can return the patient to the PHC to continue treatment. However, this process is still done manually with a paper-based form. Moreover, there is no dashboard in the existing applications to see referral trends, such as the most referred health facilities and diseases, resulting in a lack of referral monitoring in this area.

III. Discussion

Functioning and available communication media make a significant contribution to referrals [22,23]. Applications that manage emergency cases should have a simple design even for non-computer-literate users [24]. IS/IT design should also facilitate referral comprehensively and consider all the characteristics of referrals [11]. In Indonesia, application

developers often neglect existing IS/IT, which causes a lack of integration [25]. Enterprise architecture [14] and application programming interfaces [25] can serve as solutions to design integrated IS/IT. We proposed an architectural design for integrated health referral IS/IT in PHCs (Figure 3). To overcome internet problems, IS/IT should have the ability to work online and offline, with appropriate syncing [7,8]. The mobile internet, which offers more reliable connectivity, can also be considered [8].

Human resources problems could be caused by the lack of health workers' involvement in IS/IT development, which causes the technical requirements not to match their needs [25]. Training of human resources at all levels should be considered when implementing IS/IT [26]. Moreover, regulations in Indonesia should support IT personnel's needs at PHCs [18]. Appropriate regulations are also needed to strengthen information flow across institutions [8]. Appropriate financial investment levels for IS/IT implementation should also be determined to ensure continuity [26].

This study contributes knowledge about IS/IT implementation in maternal and neonatal referral systems and provides recommendations for health regulators and application developers to implement IS/IT in Indonesia. Applications must consider the needs and capabilities of health workers and the infrastructure conditions. IS/IT policies should include all technological and social aspects and provide sufficient investments to ensure IS/IT continuity. As a limitation, the sample size of this study was small and it only focused on South Tangerang. Therefore, the results may apply only to this local area and not be generalizable to other settings. Future research should analyze IS/IT barriers from different perspectives and explore how IS/IT influences mothers' and their families' acceptance of referrals.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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