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RESEARCH ARTICLE

EMPOWERING HEALTH: DISCOVERING COMMUNITY AND STAKEHOLDER NEEDS FOR INTEGRATED ADOLESCENT, MATERNAL, AND CHILD HEALTH APPS

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ABSTRACT

This study explores the needs of communities and stakeholders to support the development of an integrated digital health platform for adolescents, pregnant women, and mothers with toddlers.

Using a sequential mixed-method explanatory design, quantitative data were collected from 296 women of reproductive age in Petungsewu Village, Malang, Indonesia through structured questionnaires, followed by qualitative insights from 15 participants in Focus Group Discussions (FGDs). Results showed that 95.61% of respondents agreed to use electronic media to access information and record health services, highlighting the perceived benefits of improving health status. Sociodemographic factors such as education, marital status, and parity were associated with media use and health service preferences. The FGDs reinforced the need for web-based, user-friendly, and validated applications that support information access, digital recording, community empowerment, and health worker involvement.

The study's novelty resided in the integration of quantitative and qualitative evidence to co-design a health informatics system personalized to the specific needs of the life stage. These findings provide a practical basis for policymakers to support digital transformation in public health services by integrating these platforms into primary health care and strengthening the facilitation of health workers and digital literacy.

KEYWORDS

adolescent health services, community networks, maternal-child health services, needs assessment, public health informatics.

INTRODUCTION

Maternal and child mortality remain major public health challenges in Indonesia. The maternal mortality rate (MMR) in 2023 was 189 per 100,000 live births, and the infant mortality rate (IMR) was 16.85 per 1,000 live births [1]. These rates are still significantly higher than the global targets set in the sustainable development goals (SDGs), specifically an MMR of 70

per 100,000 live births and an IMR of 12 per 1,000 live births by 2030. [2]. These indicators reflect not only the accessibility and quality of health services, but also broader systemic issues such as education, equity, and public health literacy. Improving reproductive health outcomes must start early, during adolescence, because health conditions at each stage of life influence future health pathways [3][4].

To address this issue, the Indonesian Ministry of Health is transforming primary health services, with digital health as the main pillar [5]. Health Information Systems (HIS), such as SIMPUS (Community Health Center Management Information System), have been developed as structured digital tools to support clinical documentation and health service monitoring [6] [7]. SIMPUS integrates internal Community Health Center (*Puskesmas*) services but does not have a broader public interface for health education or engagement at the community level. At the same time, several independently developed mHealth applications exist [8]. In addition, various mobile health applications have emerged to support reproductive health and maternal care, including *Health Titeer* for teenage pregnancy prevention [10], *Rumah Bidanku* for reproductive health education [9], *Bumilku* in Kulon Progo [10], *Sayangi Ibuku* [11], and *Sicantik* [12]. However, many of these applications are sourced from grey literature and lack rigorous evaluation. Their reported effectiveness has not been critically appraised in terms of study design, measurable outcomes, or potential biases, highlighting the need for stronger evidence and peer-reviewed validation in future digital health interventions [13][9][10][11][12].

In Indonesia, digital readiness between village and urban populations varies significantly, particularly in terms of smartphone ownership, digital literacy, and internet access. In Petungsewu Village, for example, factors such as shared device usage, data accessibility, and education levels influence the adoption of digital health solutions. However, these contextual aspects are rarely integrated into system development. Although policy-level frameworks such as *SIMPUS* and application-level innovations already exist, the gap lies in co-designed, interoperable, and evidence-based systems that are accessible, acceptable, and equitable.

To address this gap, the technology acceptance model or TAM by Davis and Granic [14] provides a basic framework, stating that perceived usefulness and perceived ease of use influence users' acceptance of new technologies. In this context, survey indicators such as internet access, smartphone usage, and educational background can be mapped onto TAM constructs. For example, users' perceptions that health applications will improve their health behaviours reflect perceived usefulness, while digital literacy and proficiency in using smartphones are related to ease of use. In addition, Rogers' Diffusion of Innovations (DOI) theory [15] further explains the role of compatibility, which refers to the extent to which innovations align with users' values and experiences, as well as observability, or how visible the results are to the user community.

In addition to individual acceptance, the implementation of digital health systems in low- and middle-income countries (LMICs) [16] must also be assessed through system-level frameworks such as the NASSS Framework (Non-adoption, Abandonment, Scale-up, Spread, and Sustainability) and RE-AIM, which emphasize real-world implementation, sustainability, and equity. Using PROGRESS-Plus as a lens for equity helps ensure attention to sociodemographic factors (place of residence, race, occupation, gender, religion, education, socioeconomic status, social capital) in the design and evaluation of health innovations. This framework emphasizes that health applications must not only be functional but also context-oriented and equitable.

Although various mHealth applications exist in Indonesia, no study has combined quantitative community needs assessments with stakeholder focus group discussions to co-design an integrated web application connected to the *Puskesmas* system for adolescent, maternal, and child health. Therefore, this study aims to analyse the needs of the community and stakeholders in developing an integrated information system that supports health services for adolescents, mothers, and children, while also considering contextual readiness, user acceptance, and implementation challenges at the system level.

This study provides a new contribution by conducting a needs assessment using a mixed-methods approach, which combines quantitative survey data and qualitative focus group discussions, to guide the design of an integrated system

in the field of adolescent, maternal, and child health. By adopting the midwifery philosophy of continuity of care, this system will serve as a centralized platform for education, documentation, and reporting of health services across all stages of life.

METHODS

This study used a mixed method with a sequential explanatory design combining quantitative and qualitative methods. This research has passed the research ethics commission from the Malang Health Polytechnic by Ministry of Health (*Politeknik Kesesehatan Kemenkes Malang*), with ethical No. DP.04.03/F.XXI.31/931/2023.

QUANTITATIVE

In the first phase, quantitative research was conducted using a cross-sectional design in Petungsewu village, Dau sub-district, Malang, Indonesia. The population was all women of reproductive age (15-49 years), totalling 945 people. Proportional sampling was used to determine the sample from four hamlets (currently, known to be clusters) in Petungsewu. The allocation of respondents was determined proportionally based on the number of households (*KK*) in each cluster. Respondents in each cluster were selected randomly from a list of mothers who had children under 5 years old and/or were pregnant.

The inclusion criteria for the sample were women of reproductive age (WRA) who were willing to be respondents, able to communicate verbally, and members of integrated health service post (*Posyandu*). Exclusion criteria include individuals who did not attend after three or more visits/rescheduling, were unable to attend the interview, or refused/withdrew consent. The sample size was calculated using the Slovin formula, based on a population of 945 pregnant women and mothers of toddlers. A margin of error of 5% was used, resulting in a theoretical value of 285 samples. To anticipate non-response, 10% of the total sample was added, resulting in a sample size of 311 respondents. The respondent recruitment flow diagram is shown in Figure 1.

The data collection method uses a survey method by distributing questionnaires to respondents who have been determined from May to June 2023. The questionnaire uses a close-ended question to choose one of the alternative answers from each available question [17]. It consists of 15 closed questions that have met the validity and reliability tests. Details regarding the questionnaire form are in Appendix 1.

The validity test estimates the extent to which the tool's content represents aspects of the conceptual framework. Content validity was evaluated using the content validity index (CVI) method by three experts in midwifery and public health. To avoid overlap between behaviour and preferences, questions were structured based on four main constructs:

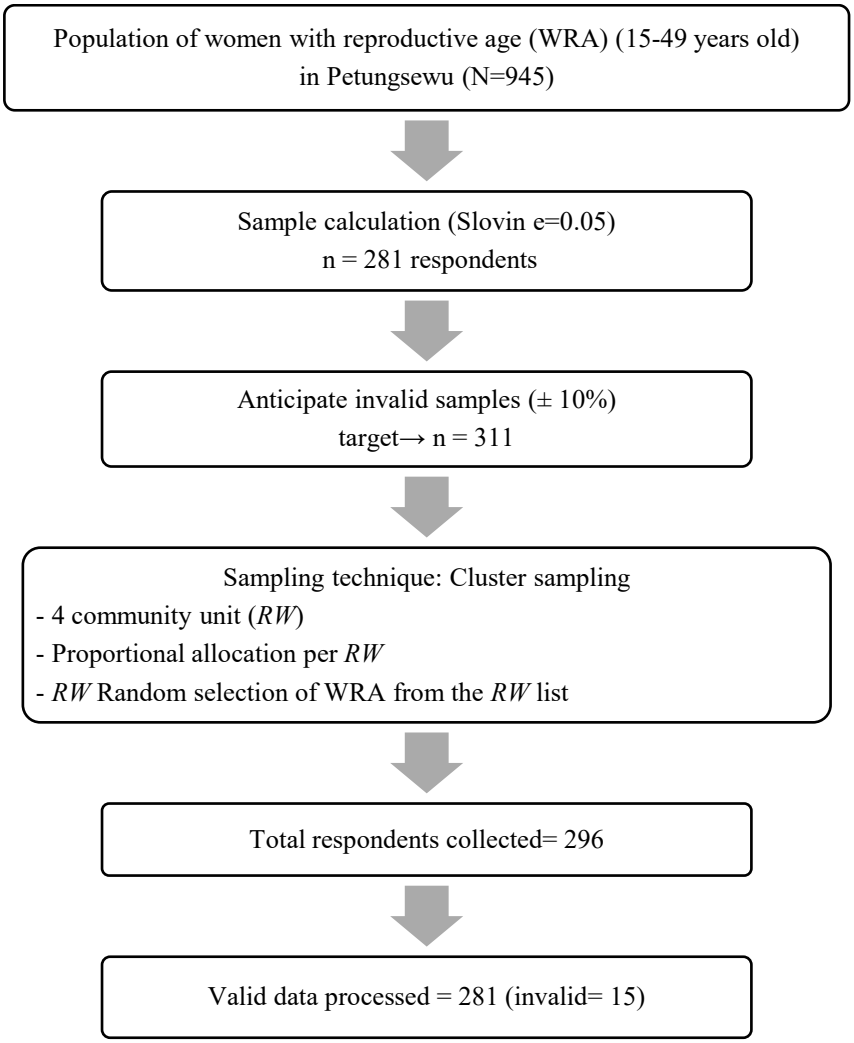
1. Behaviour: measuring actual actions, such as the type of health facilities used or the use of recording media.
2. Attitude: assessing respondents' perceptions of the benefits of health services or media.
3. Feasibility: describing ease of access and availability of supporting facilities.
4. Intention: reflecting preferences or intentions for future use of health services.

The separation of these constructs aims to improve the validity of the instrument and support a more in-depth analysis of the needs and readiness for the use of integrated health applications.

All items obtained an I-CVI score ≥ 0.80. This instrument was tested in March 2023 with 45 respondents who were not respondents this study. After the content validity test, reliability was measured using Cronbach's Alpha, with an overall alpha value (a value) = 0.86. A pre-test was conducted on 45 respondents from similar locations. The "Technological Readiness" subscale has an a = 0.81, and the "Perceived Benefits" subscale has an a = 0.84. The scale structure is based on the TAM theory construct.

The data collection process began with licensing the research site and then determining research respondents based on their area, assisted by health cadres. After the purpose of the survey was explained and the consent of each respondent was obtained, the questionnaire was filled in.

FIGURE 1. RESPONDENT RECRUITMENT FLOW DIAGRAM.



The collected data was analysed quantitatively using IBM SPSS version 21 with three stages: descriptive analysis and inferential analysis that includes bivariate and multivariate.

1. Descriptive analysis was performed to examine the distribution of respondent frequencies and percentages, as well as key variables, and to display proportions with a 95% confidence interval (95% CI).
2. Bivariate analysis was performed to test the relationship between independent variables (sociodemographic characteristics of respondents: age, education, job, marital status, and parity) and dependent variables of the study using the chi-square test. The results are reported as a p-values (a = 0.05) and preliminary interpretations. Example:
   - Agree to use electronic media for health (categorized: agree vs. others).
   - Desired type of health service.
3. Multivariate analysis was performed using multinomial logistic regression to identify the variables that most influence the desired type of health service. The independent variables included in the model were selected based on significant results in the bivariate test. The results are reported as a regression coefficient (B) and significance level ($p < 0.05$).

This inferential approach explains the influence between variables, not only describing general trends but also providing a statistical basis for recommendations for the development of integrated health applications.

QUALITATIVE

Qualitative data collection methods used *Focus Group Discussions* (FGDs) conducted in August 2023 in the Dau sub-district area. FGDs were conducted using guidelines that were developed to suit the study's purposes [18]. The informants were stakeholders, community leaders, community health cadres, and youth representatives. Stakeholders were representatives from the Malang District Health Office, the Head of *Puskesmas* in Dau sub-district, the coordinator midwife of *Puskesmas* in Dau sub-district, and the midwife staff of Petungsewu village. Meanwhile, community leaders included the village head, Petungsewu youth leaders, and the head of the Family Empowerment Movement Team (TPKK) in the Dau subdistrict.

The determination of informants was purposive and selected based on specific considerations. There were several inclusion criteria for selecting informants: (1) pregnant women or mothers with children under 5 years of age, (2) health workers from *Puskesmas* and volunteers, and (3) adolescents aged 15–19 years living in Petungsewu village. Data saturation was achieved in the fourth session (a total of 15 informants) when no new themes or information emerged from the discussion.

FGDs activities were conducted by interviewing each informant, followed by an open discussion, and were conducted for six hours. The questions discussed revolved around the survey results and the need for an integrated health information system. This qualitative research used thematic analysis, an analytical method for clustering and interconnecting codes or characteristics of specific themes. The grouping of each theme is characterized by the primary step of thematic analysis, which determines the point of view of the phenomenon being analysed [19].

Thematic analysis was conducted based on the research by Braun and Clarke [20]. The codebook was developed based on initial reading and discussions among coders. There are six stages: (1) familiarization with the data, (2) initial coding, (3) development of initial themes, (4) review of themes, (5) definition and naming of themes, and (6) report writing. Two independent researchers completed the initial coding. This study did not calculate Cohen's Kappa, but agreement between coders was obtained through consensus discussion. All differences in code interpretation are collaboratively addressed and recorded in an audit log (audit trail).

In order to ensure the trustworthiness of the results, audit trail, data triangulation (informants from different groups), and translation validation were carried out. An audit trail was conducted by writing down coding decisions and compiling theme summaries. In this study, data sources were triangulated [18]. All recruited respondents agreed to sign a written informed consent form before data collection. The overall data transcription process was carried out verbatim in Bahasa by trained research assistants. Translations were performed by bilingual researchers and double-checked by independent linguists. This study also performed back-translations of the quotes used to ensure consistency of meaning. The confidentiality of the informants' data from the interviews was protected and used responsibly [21].

RESULTS

SURVEY

In this study, the majority of respondents were in the productive age range of 20-35 years (59.80%), had a secondary education (junior high school/high school) (34.12%), predominantly domestic workers (63.51%), most were married (73.99%), and the majority had more than one child/were multiparous (54.73%). Table 1 shows the characteristics of these respondents.

TABLE 1. CHARACTERISTICS OF RESPONDENTS

No	Characteristics	Category	Frequency (n)	Percentage (%)
1	Age	1) <20 years old	87	29.39
		2) 20 – 35 years	177	59.80
		3) >35 years	32	10.81
		Total	296	100.00
2	Education	1) Elementary School	84	28.38
		2) Middle school equivalent	101	34.12
		3) High school equivalent	85	28.72
		4) College	26	8.78
		Total	296	100.00
3	Job	1) Housewife	188	63.51
		2) Labour	5	1.69
		3) Private Officers	27	9.12
		4) Civil servants	2	0.68
		5) Students	51	17.23
		6) Other	23	7.77
		Total	296	100.00
4	Marital status	1) Yes/ Never	219	73.99
		2) Never	77	26.01
		Total	296	100.00
5	Parity	1) Nullipara	85	28.72
		2) Primiparous	49	16.55
		3) Multiparous	162	54.73
		Total	296	100.00

After analysing the characteristics of respondents based on age, education, occupation, marital status, and parity, the distribution of respondents' answers to the main variables of the study is presented in Appendix 2 (survey results). These variables include access and utilization of health services, ownership of supporting facilities such as insurance and health monitoring books, sources and exposure to health information, digital media usage, and perceptions of the benefits of electronic media in improving health status. This explanation aims to obtain a comprehensive overview of the level of need and readiness of respondents for integrated health applications.

Characteristics such as age, education, job, marital status, and parity were found to influence access, preferences, and utilization of health services and information. The type of health facility used, ownership of a maternal and child health book (*KIA* book), availability of recording media, and choice of health services showed a significant relationship with most of these factors. Conversely, *BPJS* (social insurance) membership was evenly distributed and was not influenced by sociodemographic background. Sources of information and the use of media for health recording are also influenced by social characteristics, particularly education. However, some aspects did not show a significant relationship, such as exposure to valid information and the habit of recording services digitally, which are still individual behaviours.

In terms of purpose and duration, the use of smartphones and electronic media is influenced by education, employment, and marital status. Therefore, integrated health applications need to be flexible, inclusive, and adaptive to the user's background. This application must be able to respond to specific needs at every stage of life, from adolescents, expectant mothers, pregnant women, to families with children. To facilitate the mapping of the integrated application design, Table 2 shows the implications of each sub-variable.

TABLE 2. SUMMARY OF VARIABLES AND THEIR IMPLICATIONS

No	Variable	Significant relationship	Applications implications
1	Healthcare facilities type	Age, marital status, and parity	Features must be customized by age, marital status, and number of children.
2	*BPJS* (social insurance) membership	None	*BPJS* integration must be made general and inclusive.
3	Ownership of *KIA* books	All characteristics	The digitalization of *KIA* books must be inclusive.
4	Availability of recording media	All characteristics	Digital recording features must be customized to user characteristics.
5	Health information sources	Age, education, marital status, and parity	The application must provide various information channels according to the usage background.
6	Exposure of valid information	None	Communication strategies can be general in content.
7	Media for information access	Education	Provide various formats of information media.
8	Digital recording (electronic media)	None	Encourage the use of digital recording with a simple design.
9	Access to information via the internet	Education	Provide content with various literacy levels.
10	Purpose of smartphone use	Education, job, and marital status	Multi-functional design according to social background.
11	Smartphone usage duration	All characteristics	Flexible and easy-to-access features.
12	Electronic media usage duration	Education, job, and marital status	Develop a desktop version for specific groups.
13	Purpose of using electronic media	Education and job	Desktop features are customized for users with more access.
14	Perspectives on electronic media for health	Education, marital status, and parity	Highlight the practical benefits of digital media.
15	Desired health services	All characteristics	Services are customized to the user's stage of life.

Multivariate test results can be seen in Appendix 3. In this multivariate analysis, the dependent variable used was the type of health services desired by respondents. This variable consisted of seven categories of services, ranging from adolescent and premarital services to services for infants and toddlers. This variable was analysed against ten relevant and significant independent variables based on bivariate tests. The independent variables consisted of the type of health facility used, ownership of *KIA* books, availability of recording media, access to health information, use of the internet for health information, purpose and duration of smartphone use, purpose and duration of use of electronic media other than smartphones, and perspective on electronic media for health. This analysis aims to identify the factors that most significantly influence health service needs, to design a more targeted and integrated health application that fits the characteristics of the users.

Multivariate analysis results show that no variable consistently and significantly influences the type of health service chosen compared to infant and toddler services as a reference. However, there are several practical trends that are worth considering. For example, hospital users tend to choose adolescent and premarital services less frequently, while

Puskesmas users are significantly less likely to choose newborn and postpartum services. Shorter smartphone usage durations (<5 and 5–10 hours per day) are also associated with a lower choice of maternity services. The existence of health records shows a lower tendency to choose services for middle-aged women and early detection of complications. Additionally, the use of non-smartphone electronic media for social networking is positively correlated with the selection of health services for middle-class women, and the use of smartphones for information access is related to the selection of newborn and postpartum services.

Overall, although not all statistically significant, these results show that the type of health facility and habits in using digital technology play a role in shaping service preferences. Therefore, the design of integrated health applications needs to consider access to formal services, the duration and purpose of digital device use, and the availability of health record media.

FOCUS GROUP DISCUSSIONS (FGDS)

Focus group discussions (FGDs) were conducted to explore the quantitative results and gain insights from the community and stakeholders regarding the development of a web-based integrated health application for adolescents, mothers, and children. Five main themes were identified from the thematic analysis. Table 3 shows the FGDs participants role.

TABLE 3. PARTICIPANTS OF FOCUS GROUP DISCUSSION

No.	Role	Frequency (n)	Percentage (%)
1	Stakeholder	5	34
2	Community Leader	3	20
3	Community Health Volunteer	5	33
4	Adolescent	2	13
	Total	15	100

Theme 1: The Need for Integrated and Easily Accessible Health Information

FGD participants assessed that the community is in high demand for integrated health information media that can be accessed via the internet and smartphones and covers all stages of women's lives. The application is expected to be usable anytime and anywhere.

"*The strategy for integrating health services must use a website application that can be accessed via smartphones and the internet. It must include education, information, and public health.*" (Participant 2)

"*I would prefer if this application adopts the contents of the KIA Book, but in an electronic version that can be accessed online*." (Participant 5)

"*Health services through websites make it easier to search for information and learn anytime without the need for direct consultation*." (Participant 8)

Theme 2: Digital Recording and Reporting is More Effective than Manual Media

Most participants stated that manual recording and reporting (using paper) was no longer effective. Digital applications were considered to be able to overcome data loss and facilitate the continuous tracking of health information.

"*Web-based applications are much better because manual data can be damaged or lost, and is difficult to recover.*" (Participant 3)

"*The recording and reporting functions of Puskesmas must be integrated and accessible to the Health Department and other relevant agencies.*" (Participant 1)

Negative cases/ different opinions:

One participant was concerned about whether village residents who are unfamiliar with digital applications would be able to access this system independently without training.

"*But what about people who are not familiar to using the apps? I'm worried they'll be confused and need guidance too.*" (Participant 6)

Theme 3: Content Validity and the Need for Interactive Educational Media

There are concerns about the validity of health information. Therefore, the content of the application must be validated by health professionals and presented in an attractive format, such as through videos or animations.

"*The information in the application must be validated. It would be better if there were a video to simplify the understanding*." (Participant 8)

"*That is why there must be a verifier from the health worker at the Puskesmas.*" (Participant 15)
"*I agree. Its use can be supervised by certain workers.*" (Participant 12)

Theme 4: The Application Must Improve Community Independence and Accessibility

Participants emphasized that the application should make it easy to monitor and maintain health independently, especially for people who have difficulty accessing health facilities or have limited time.

It is important for people who cannot travel so far to be still able to get health information via the internet." (Participant 2)
"*It is effective for busy people like me. I can access it anytime, and complications can be detected more quickly.*" (Participant 14)

"*To monitor people's health without medical assistance, just open the application.*" (Participant 4)

Theme 5: The Role and Responsibilities of Cadres and Health Professionals

Most participants stated that the application should involve cadres and health workers in management, training, and supervision. Village midwives are expected to be the primary coordinators for implementing the application in the community.

"*This application should be a platform for education and community empowerment, involving cadres and monitored by health professionals*." (Participant 7)

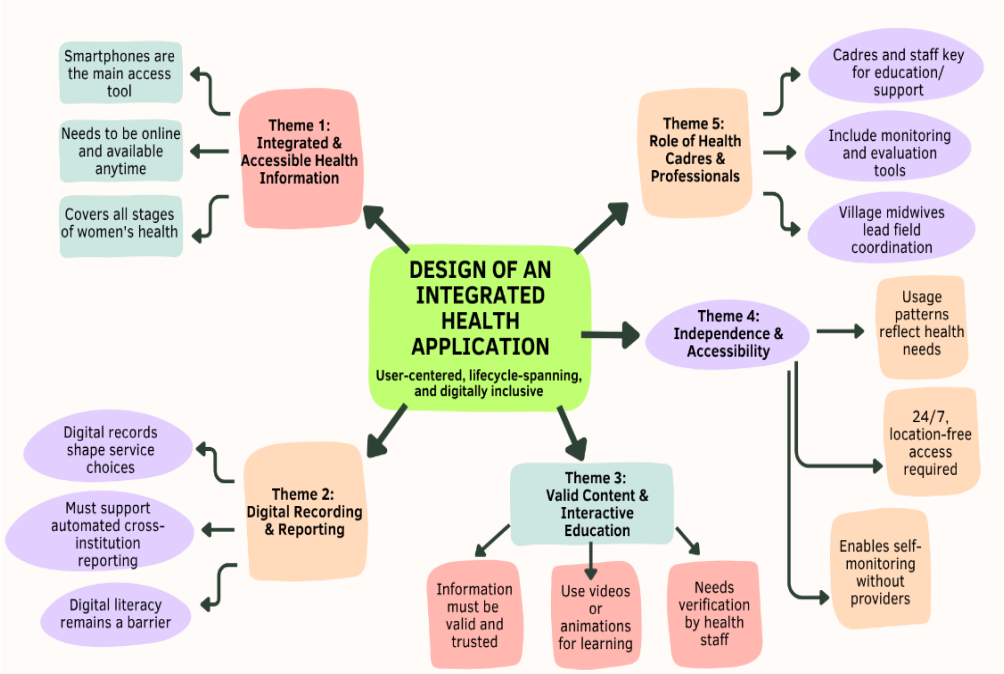
"*There must be a monitoring and evaluation system for Puskesmas activities, integrated with existing applications*." (Participant 8)

"*Village midwives can coordinate recording and reporting, assisted by cadres, so it can be an additional record besides the KIA book*." (Participant 2)

THEMATIC MAP OF SURVEY AND FGD RESULTS

The thematic map is shown in Figure 2. This figure illustrates the relationship between FGD themes, quantitative analysis (survey) results, and implications for application design.

FIGURE 2. THEMATIC MAP OF THE RELATIONSHIP BETWEEN QUANTITATIVE ANALYSIS (SURVEY) RESULTS AND FGD THEMES, AND IMPLICATIONS FOR APPLICATION DESIGN.



FGDs showed strong support for the development of integrated web-based health applications, with particular attention to accessibility, validity of information, involvement of health workers, and functionality of service recording. Although some participants highlighted potential barriers in digital literacy, the majority expressed readiness and a need for adaptive digital platforms. However, the general implication is that applications must be designed based on the real needs of users, across all stages of life, and be digitally inclusive.

DISCUSSION

The majority of respondents in this study were women in their reproductive age with primary education. Most of them worked as housewives, were married, and had children. The survey results showed that most respondents accessed health information independently through the internet and smartphones to obtain information and to record the health services they received. Their preferences for health services were also influenced by the type of facilities used, exposure to the media, and the availability of recording media. Although not all variables showed statistical significance in the multivariate analysis, important practical trends were found. Focus group discussions (FGDs) also confirmed that the community needs an integrated, web-based health information system that is easily accessible and can comprehensively cover health information for adolescents, mothers, and children.

These findings are in line with Goutam's research [22]. This study states that marital status, education, media exposure, and religion influence women's autonomy in health decision-making [22]. High internet exposure is also supported by data from the Ministry of Communication and Information Technology (Kominfo), which shows that 56% of Indonesians are active internet users, with 53% accessing the internet via smartphones [23].

Recently, the internet has been used in the health sector, especially in health information systems. This information is based on the recommendations of the Indonesian Ministry of Health (Kemenkes) as stipulated in Government Regulation No. 46 of 2014 concerning Health Information Systems. In this global era, health organizations have been connected to information technology networks worldwide through telecommunications technology, facilitated by the internet. The implementation of information and communication technology in the healthcare sector is known as e-health. E-health was developed to improve the quality of healthcare and develop effective and efficient work processes. In terms of the

implementation of electronic health information systems, e-health is a superset or suprasystem of electronically regulated health information systems [7] [24] [25].

Another study by Nursanti et al. [26] highlights the development of an innovative website based on an integrated health information system. This system offers a number of advantages, including simplicity, suitability, and complexity. The user-friendly interface makes navigation and easy to understand, ensuring accessibility and utility for all users. The use of websites for integrated health information systems is an innovation driven by several supporting factors, including the desire to enhance facility availability and the pressure to improve services [26].

In developing an integrated information system for adolescent, maternal, and child health, it is important to pay attention to the accessibility principle. This includes ease of access for all target groups, both in terms of website management, internet access availability, and smooth follow-up in the form of health services that can be obtained through the system. Improvements and refinements must continue to be made to ensure that this system is accessible to all parties who need it, thereby providing maximum benefits for the health of adolescents, mothers, and children [27, 28].

The results of research at *Puskesmas* of Peneleh show that the implementation of e-health services is considered quite effective and is in line with the principles of excellent public service in terms of simplicity, clarity, openness, economy, security, timeliness, and consistency. However, in terms of simplicity, not all people understand how to use e-health. In terms of transparency, there is still a need for more socialization regarding the e-health services provided by the *Puskesmas* to the community in its working area [29]. To develop an integrated health information system, which is part of the healthcare system at the *Puskesmas*, it must support the improvement of excellent service quality, implement program socialization to the user community, and supervise *Puskesmas* staff.

The use of smartphones as a platform for health promotion can reduce barriers to the use of other media. Additionally, it enhances the acceptance of electronic media-based health interventions by integrating health education and other forms of health promotion [30]. All health services, such as adolescent, premarital, maternal, and child health, can be facilitated at *Puskesmas* by utilizing e-health, which operates with health workers as facilitators [31, 32].

STRATEGIES FOR INTEGRATING ADOLESCENT, MATERNAL, AND CHILD HEALTH SERVICES

In the FGDs results, all informants agreed that the strategy was to use an integrated application for adolescent, maternal, and child health by adopting the website version of the *KIA* book. This system must include elements of education, information, and public health, which can be used to maximize the recording and reporting functions of *Puskesmas* staff to the Health Office.

Recent advances in digital technology are significantly impacting the healthcare sector. Many health applications, easily accessible via smartphones and tablets, have been launched to meet the public's need for health information. Patients are currently adapting to the growing trend of utilizing health technology. To receive valid health information that suits their needs, the public must know how to identify and search for credible health information. For this reason, monitoring the use of community-based integrated health systems by *Puskesmas* must be taken into consideration [16, 33].

THE IMPORTANCE OF INTEGRATED HEALTH SERVICES FOR ADOLESCENTS, MOTHERS, AND CHILDREN THROUGH A WEBSITE-BASED APPLICATION

All informants considered the use of a website-based integrated health information system for adolescents, mothers, and children to be necessary because it is a medium for information, recording, and reporting that uses minimal paper. A website-based system also allows for easy access to the community at any time, from anywhere. Developing an integrated information system for adolescent, maternal, and child health must consider the challenges of implementing health information systems in Indonesia. One of the challenges faced in implementing health information systems, or "*SIK*," is that the implementers themselves are still unfamiliar with SIK. It leads to inefficient implementation and poor-quality data. Another challenge is the low level of funding and utilization of *Posyandu* units. High maintenance costs sometimes cause the systems to malfunction. Therefore, specific strategies are necessary to effectively manage the system. *Puskesmas* can

utilize *Posyandu* community-based health units to monitor the system. Initially, this requires some effort, such as socialization and operational training. However, in the future, it will facilitate the performance of *Puskesmas* in terms of budget efficiency [6, 34].

Developing an integrated information system on adolescent, maternal, and child health requires the participation of all parties involved in public health services. All informants agreed that their responsibilities are based on their roles in the community. To improve access, community empowerment efforts are required through the involvement of health cadres as extensions of health workers at *Puskesmas* in monitoring and evaluating system-based health programs. It is expected that the integrated information system to be developed must meet the needs of the community and be in line with existing health unit programs. In public health services, there is no doubt that the work program at the *Puskesmas* must be followed. According to Government Regulation of the Republic of Indonesia Number 46 of 2014 concerning Health Information Systems, Article 58 (1), states that the development of Health Information Systems is carried out through system planning, system analysis, system design, software development, hardware provision, system testing, system implementation, and system maintenance and evaluation. All of these stages are carried out based on the results of assessments and research [7].

In addition, developing an integrated health information system for adolescents, mothers, and children must be in line with existing health programs. Health programs related to adolescent health include reproductive health, adolescent nutrition, sexual behaviour, and sexually transmitted infections. Maternal health is related to pregnancy, postpartum, breastfeeding, nutrition, and mental health. Child health includes newborn care, immunization, complementary feeding, growth and development monitoring, infant and toddler health services, childcare, daycare, environmental safety, and child protection [35].

The success of this system's development is highly dependent on data standardization and interoperability, which can be achieved through international frameworks such as FHIR (Fast Healthcare Interoperability Resources) or HL7 [36]. In this case, the system with existing information systems in primary health facilities such as *Puskesmas* [37]. This study is also relevant to various findings in low and middle-income countries (LMICs), where the successful adoption of mHealth is greatly influenced by community involvement, cultural fit, and institutional support [38]. Study by Lee et al. [39] has highlighted that the adoption of digital health technology in LMICs requires systems that are simple, accessible, yet secure and standardized. Therefore, the results of this study are not only relevant nationally but also have the potential to contribute to the global discourse on strengthening digital technology-based health systems in developing countries.

The main strength of this study lies in the use of a mixed method, namely a combination of quantitative surveys and qualitative FGDs, which provides a comprehensive representation of community needs. This approach allows for the integration of statistical data and field experience, thereby strengthening the validity of the findings in the context of health information system design. This study complements previous studies on the use of information systems in healthcare, particularly in the context of documentation, monitoring, and education, which were discussed separately. The findings of this study represent the first step in developing a truly integrated health information system for adolescents, mothers, and children, encompassing all aspects of information, service recording, and reporting. A needs analysis was conducted through a survey of a diverse target population, and the results were reinforced by FGDs to gain a more in-depth and contextual qualitative understanding. This combination of methods enables the design of a system that is not only responsive to user needs but also considers aspects of implementability, such as the involvement of cadres as facilitators and the need for a phased socialization strategy appropriate to the local context.

However, this study has several limitations. The study was conducted in a single village, so the results cannot be generalized to other areas with different sociodemographic characteristics, health infrastructure, or levels of technology access. In addition, although inferential analysis was performed using chi-square tests and logistic regression to assess relationships among variables, the overall design remained cross-sectional and based on a single community. This means that conclusions about community attitudes or readiness, including findings of high levels of agreement with the use of electronic media, must be interpreted with caution and limited to the local context. Furthermore, the study did not include

a pre-determined analysis plan, so the analysis was conducted retrospectively. Further studies with broader coverage and stronger analytical designs are needed to improve the external validity of the results of this study.

This study also did not involve non-service users, thus risking selection bias. The participation of adolescents in the FGDs in this study was very limited, which could potentially weaken the perspective of this important target group. The analysis did not systematically incorporate a SWOT approach. Therefore, it did not fully evaluate the strengths, weaknesses, opportunities, and threats associated with the system's implementation. The process of translating the FGD results from Bahasa to English also had the potential to distort the meaning. Based on these limitations, it is recommended that future studies involve a larger number of non-service users and adolescents. Future research should test the developed system prototype through usability testing, feasibility testing, and cost-effectiveness testing before it is widely implemented in the national health care system.

CONCLUSION

Based on an analysis of the needs of the community and stakeholders regarding an integrated information system for adolescent, maternal, and child health, it can be concluded that there is a need for more standardized health data recording and reporting. This is to ensure that community health data can be tracked and used as a basis for continued service management. This information must be easily accessible to health workers and patients' families anywhere and on time. Therefore, the information system developed in the future needs to prioritize these requirements to facilitate services for both health workers and patients and their families. In this way, the system has the potential to be implemented in the community health center (*Puskesmas*) service system. Policy makers can consider the results of this study to develop a system for future research. Further research can consider the design of health information systems for adolescents, mothers, and children as a basis for coding for programmers. This should focus on identifying user stories, analysing workflows, defining non-functional requirements (offline access, data security), and conducting risk analysis (use by cadres vs. the general public).

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APPENDIX 1: RESEARCH QUESTIONNAIRE: SURVEY OF PUBLIC NEEDS FOR INTEGRATED ADOLESCENT, MATERNAL AND CHILD HEALTH APPLICATIONS

CHART EXAMPLES

A. Respondent Identity

Instructions for Completing the Questionnaire for Points A and B

1. Read the questions carefully and thoroughly
2. Put a tick (V) on the answer that you think is correct.
3. Answer can be more than one item.

1. Name :
2. Home address :

3. Date of Birth / Age:
4. Gender:
   a. Women □ b. Male □
5. Education:
   a. Elementary School □ c. High School □
   b. Junior High school □ d. Higher Education Institution □
6. Work :
   a. Housewife □ c. Private Employees □ e. Students □
   b. Laborer □ d. Civil servants □ f. Others □
7. Marry:
   a. Yes / Never □ b. Never □
8. Pregnancy and Delivery Status
   a. Number of pregnancies:
   b. Number of childbirths:
   c. Number of living children:

B. Need will Integrated Health Application For Teenagers , Mothers and Children

Questionnaire Completion Instructions

1. Read the questions carefully and thoroughly
2. Put a circle (O) on the answer that you think is correct.
3. Answer can be more than one item.

A list of questions

No.	Question	Answer
1	Agency service health benefits (can be choose more from than one item)	a. Clinic Private b. Primary Clinic c. *Puskesmas* (community health center) d. Hospital e. Others
2	Ownership insurance health (BPJS and similar)	a. Yes

No.	Question	Answer
		b. Don't have any
3	Ownership book monitoring health (KIA books and the like)	a. Yes b. Don't have any
4	Availability service recording results service health that can monitored at home (book print / electronic media)	a. Available b. Unavailable
5	Access to information health (can be choose more from than one item)	a. From a health service professional b. From health cadres c. From the community d. From parents / closest people e. by myself
6	Exposure to accurate/valid health information for adolescents, mothers, and children.	a. Frequently b. Sometimes c. Never
7	Use of media to obtain health-related information.	a. Print media (books, newsletters, newspapers, magazines, etc.) b. Electronic books (E-Book) c. Television d. Radio e. Social media f. Internet (web browser)
8	The use of electronic media to record information related to health services.	a. Never b. Infrequent c. Sometimes d. Frequently e. Always
9	The use of internet to access health information.	a. Never b. Infrequent c. Sometimes d. Frequently e. Always
10	The purpose of using a smartphone.	a. Communication media b. Information access c. Social media d. Health services e. Other
11	How long do you use your smartphone per day?	a. < 5 hours/day b. 5 – 10 hours/day c. > 10 hours/day
12	How long do you use electronic media other than smartphones (computers/laptops) per day?	a. <5 hours/day b. >=6 hours/day c. Sometimes d. Never
13	The purpose of using electronic media other than smartphones (computers/laptops).	a. Communication media b. Information access c. Social media d. Health services

No.	Question	Answer
		e. Others
14	The use of electronic media as a source of information and a platform for recording health services can help improve health status.	a. Agree b. Disagree c. Do not know
15	The scope of health services desired.	• Service health teenagers and pre-marriage. • Health service for pregnant women. • Maternal care Services. • Services for newborns and postpartum mothers. • Service women's health during *masa antara.* • Early detection and treatment of risk factors for complications. • Health services for infants and toddlers.

*Description:
masa antara: the period between pregnancy and childbirth and the next pregnancy.

APPENDIX 2. SURVEY ON THE NEED FOR INTEGRATED HEALTH APPLICATIONS FOR ADOLESCENTS, MOTHERS, AND CHILDREN.

No.	Questions	Variations in Responses	Frequency (n)	Percentage (%)	Bivariate Test based on Characteristics
1.	Health service institution used.	Private doctor/midwife clinic	28	9.46	Age: p=0.001 < 0.05 Education: p=0.157 > 0.05 Job: p=0.443 > 0.05 Marital status: p=0.005 < 0.05 Parity: p=0.033 < 0.05
		Primary care clinic	11	3.72	
		Puskesmas	159	53.71	
		Hospital	55	18.58	
		Others	43	14.53	
		Total	296	100.00	
2.	Health insurance membership (BPJS and similar services).	Yes	140	47.30	Age: p= 0.154 > 0.05 Education: p=0.218 > 0.05 Job: p=0.082 > 0.05 Marital status: p=0.707 > 0.05 Parity: p=0.331 > 0.05
		Don't have any	156	52.70	
		Total	296	100.00	
3.	Ownership of health monitoring books (KIA books and others).	Yes	238	80.41	Age: p=0.001 < 0.05 Education: p=0.002< 0.05 Job: p=0.001< 0.05 Marital status: p=0.001< 0.05 Parity: p=0.001< 0.05
		Don't have any	58	19.59	
		Total	296	100.00	
4.	Availability of health service records that can be monitored at home (printed books/electronic media).	Available	183	61.82	Age: p=0.001< 0.05 Education: p=0.001< 0.05 Job: p=0.005< 0.05 Marital status: p=0.001< 0.05 Parity: p=0.001< 0.05
		Unavailable	113	38.18	
		Total	296	100.00	
5.	Access to health information.	From a health service professional	72	24.32	Age: p=0.039< 0.05 Education: p=0.001< 0.05 Job: p=0.296> 0.05 Marital status: p=0.005< 0.05 Parity: p=0.039< 0.05
		From health cadres	64	21.62	
		From community	29	9.80	
		From parents/ closest people	43	14.53	
		by themselves	88	29.73	
		Total	296	100.00	

No.	Questions	Variations in Responses	Frequency (n)	Percentage (%)	Bivariate Test based on Characteristics
6.	Exposure to accurate/valid health information for adolescents, mothers, and children.	Frequently	133	44.93	Age: p=0.161> 0.05 Education: p=0.119> 0.05 Job: p=0.485> 0.05 Marital status: p=0.054> 0.05 Parity: p=0.070> 0.05
		Sometimes	138	46.62	
		Never	25	8.45	
		Total	296	100.00	
7.	Use of media to obtain health-related information.	Printed media (books, newsletters, newspapers, magazines, etc.)	27	9.12	Age: p=0.362> 0.05 Education: p=0.013> 0.05 Job: p=0.911> 0.05 Marital status: p=0.093> 0.05 Parity: p=0.227> 0.05
		Electronic books (E-Books)	14	4.73	
		Television	46	15.54	
		Radio	4	1.35	
		Social media	61	20.61	
		Internet (web browser)	144	48.65	
		Total	296	100.00	
8.	The use of electronic media to record information related to health services.	Never	40	13.51	Age: p=0.385> 0.05 Education: p=0.363> 0.05 Job: p=0.256> 0.05 Marital status: p=0.102> 0.05 Parity: p=0.100> 0.05
		Infrequent	50	16.89	
		Sometimes	126	42.57	
		Frequently	74	25.00	
		Always	6	2.03	
		Total	296	100.00	
9	The use of internet to access health information.	Never	24	8.11	Age: p=0.090> 0.05 Education: p=0.001< 0.05 Job: p=0.270> 0.05 Marital status: p=0.516> 0.05 Parity: p=0.771> 0.05
		Infrequent	41	13.85	
		Sometimes	109	36.82	
		Frequently	98	33.11	
		Always	24	8.11	
		Total	296	100.00	
10	The purpose of using a smartphone.	Communication media	91	30.74	Age: p=0.124> 0.05 Education: p=0.001< 0.05 Job: p=0.001< 0.05 Marital status: p=0.043< 0.05 Parity: p=0.284> 0.05
		Information access	42	14.19	
		Social media	106	35.81	
		Health services	23	7.77	
		Others	34	11.49	
		Total	296	100.00	
11		<5 hours/day	162	54.73	Age: p=0.001< 0.05
		5 – 10 hours/day	95	32.09	

No.	Questions	Variations in Responses	Frequency (n)	Percentage (%)	Bivariate Test based on Characteristics
	Duration of smartphone use per day.	> 10 hours/day	39	13.18	Education: p=0.001< 0.05 Job: p=0.001< 0.05 Marital status: p=0.001< 0.05 Parity: p=0.001< 0.05
		Total	296	100.00	
12	Duration of using electronic media other than smartphones (computers/laptops) per day.	<5 hours/day	64	21.62	Age: p=0.062> 0.05 Education: p=0.001< 0.05 Job: p=0.004< 0.05 Marital status: p=0.005< 0.05 Parity: p=0.058> 0.05
		>=6 hours/day	39	13.18	
		Sometimes	78	26.35	
		Never	115	38.85	
		Total	296	100.00	
13	The purpose of using electronic media other than smartphones (computers/laptops) .	Communication media	57	19.26	Age: p=0.083> 0.05 Education: p=0.001< 0.05 Job: p=0.047< 0.05 Marital status: p=0.452> 0.05 Parity: p=0.622> 0.05
		Information access	74	25.00	
		Social media	12	4.05	
		Health services	6	2.03	
		Others	147	49.66	
		Total	296	100.00	
14	The use of electronic media as a source of information and a platform for recording health services can help improve health status.	Agree	283	95.61	Age: p=0.061> 0.05 Education: p=0.729> 0.05 Job: p=0.001< 0.05 Marital status: p=0.029< 0.05 Parity: p=0.008< 0.05
		Disagree	1	0.34	
		Do not know	12	4.05	
		Total	296	100.00	
15	The scope of health services desired.	Adolescent and premarital health services.	92	31.08	Age: p=0.001< 0.05 Education: p=0.024< 0.05 Job: p=0.005< 0.05 Marital status: p=0.001< 0.05 Parity: p=0.001< 0.05
		Health service for pregnant women.	11	3.72	
		Maternal Care Services.	5	1.69	
		Services for newborns and postpartum mothers.	18	6.08	
		Health services for middle-class women.	17	5.74	

No.	Questions	Variations in Responses	Frequency (n)	Percentage (%)	Bivariate Test based on Characteristics
		Early detection and treatment of risk factors for complications.	19	6.42	
		Health services for infants and toddlers.	134	45.27	
		Total	296	100.00	

APPENDIX 3. MULTIVARIATE TEST OF INTEGRATED HEALTH APPLICATION NEEDS FOR ADOLESCENTS, MOTHERS,

Code	Variable Initials	B	Sig.	Exp(B)
0	Healthcare facility: Private clinic	-0.165	0.821	0.848
1	Healthcare facility: Primary care clinic	0.375	0.994	1.454
2	Healthcare facility: *Puskesmas*	-0.709	0.152	0.492
3	Healthcare facility: Hospital	-1.038	0.085	0.354
5	Ownership of health monitoring books (KIA books): Yes	-0.489	0.384	0.613
7	[CatatanKesh=1]	-0.454	0.3	0.635
9	[AksesInfokes=1]	-0.952	0.1	0.386
10	[AksesInfokes=2]	0.122	0.816	1.13
11	[AksesInfokes=3]	0.73	0.188	2.074
12	[AksesInfokes=4]	-0.623	0.228	0.536
14	[TujuanSmartphone=1]	-0.386	0.519	0.68
15	[TujuanSmartphone=2]	0.207	0.789	1.231
16	[TujuanSmartphone=3]	-0.194	0.71	0.824
17	[TujuanSmartphone=4]	-0.415	0.623	0.66
19	[LamaPakaiHP=1]	-1.044	0.096	0.352
20	[LamaPakaiHP=2]	-0.414	0.49	0.661
22	[LamaPakainonHP=1]	0.427	0.358	1.532
23	[LamaPakainonHP=2]	0.51	0.384	1.665
24	[LamaPakainonHP=3]	-0.239	0.604	0.787
26	[TujuanPakaiMediaElnonHP=1]	0.267	0.595	1.306
27	[TujuanPakaiMediaElnonHP=2]	0.181	0.709	1.198
28	[TujuanPakaiMediaElnonHP=3]	0.43	0.744	1.538
29	[TujuanPakaiMediaElnonHP=4]	1.018	0.794	2.769
31	[MediaElupStatusKes=1]	-1.409	0.09	0.244
35	Healthcare facility: Private clinic	1.846	0.124	6.333
36	Healthcare facility: Primary care clinic	-0.446	0.999	0.64
37	Healthcare facility: *Puskesmas*	-0.054	0.96	0.947
38	Healthcare facility: Hospital	0.486	0.682	1.626
40	Ownership of health monitoring books (KIA books): Yes	-0.547	0.563	0.579
42	[CatatanKesh=1]	-0.292	0.699	0.747
44	[AksesInfokes=1]	0.908	0.391	2.479
45	[AksesInfokes=2]	1.47	0.152	4.35
46	[AksesInfokes=3]	0.904	0.48	2.471
47	[AksesInfokes=4]	-0.732	0.618	0.481
49	[TujuanSmartphone=1]	0.6	0.649	1.822
50	[TujuanSmartphone=2]	-0.547	0.795	0.579
51	[TujuanSmartphone=3]	1.071	0.394	2.919
52	[TujuanSmartphone=4]	1.985	0.205	7.278
54	[LamaPakaiHP=1]	0.803	0.619	2.233
55	[LamaPakaiHP=2]	0.794	0.624	2.212

57	[LamaPakainonHP=1]	-0.342	0.658	0.71
58	[LamaPakainonHP=2]	-1.572	0.282	0.208
59	[LamaPakainonHP=3]	-1.803	0.082	0.165
61	[TujuanPakaiMediaElnonHP=1]	0.839	0.367	2.314
62	[TujuanPakaiMediaElnonHP=2]	0.845	0.303	2.329
63	[TujuanPakaiMediaElnonHP=3]	1.625	0.369	5.08
64	[TujuanPakaiMediaElnonHP=4]	4.923	0.146	137.478

*Notes:
CatatanKesh: Health Service Records
AksesInfokes: Access to Health Information
TujuanSmartphone: Purpose of Smartphone use
LamaPakaiHP: Duration of Smartphone Use
LamaPakainonHP: Duration of (Non) Smartphone Use
TujuanPakaiMediaElnonHP: Purpose of Using Electronic Media (Non-smartphone)
MediaElupStatusKes: The use of health education media with health status