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Digital Communication Algorithms Using Semi-automated Chatbot for Community-based Services on Posyandu Application in Indonesia: Model Development with Qualitative Approach

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Abstract

Purpose

The rapid development of information technology in the world has caused many countries, including Indonesia, to take advantage of this opportunity to increase effectiveness in the health sector. Technological advances in health services make it easier for health workers to communicate with people in remote conditions, one of which is due to limited access to primary healthcare centers/*Pusat Kesehatan Masyarakat* (*Puskesmas*) in Indonesia. This requires innovation to facilitate community-based health services, such as integrated health posts/*Pos Pelayanan Terpadu* (*Posyandu*) through digital communication with chatbot features. We developed a digital communication algorithm using a semi-automatic chatbot in the *Posyandu* application.

Methods

An exploratory qualitative approach was conducted to midwives, cadres, pregnant women, postpartum women, and mothers of toddlers in developing digital communication features in the application.

Results

The digital communication algorithm shows communication functions, including educational communication between midwives and patients, facilitation between midwives and cadres, advocacy between village midwives and *Puskesmas* midwives, and coordination between fellow midwives.

Conclusions

A digital communication development model is needed for the communication functions carried out and the expected goals. In this case, four communication algorithm functions were found: educational communication, facilitation communication, coordination, and advocacy communication.

1. Introduction

The rapid development of information technology in the world has caused all countries, including Indonesia, to compete to seize opportunities to improve the effectiveness of health services and to use these opportunities to increase efficiency in the health sector.[1],[2] This development also helps health workers improve the quality of health services and produce optimal health service outcomes.[2] The Internet and smartphones have become increasingly popular in the community to access health information and management tools.[1] The increase and expansion of smartphone ownership have changed the paradigm of health service delivery.[3] Statistical data records that as many as 67% of people in Indonesia own smartphones. This then causes the increase and expansion of smartphone

ownership to change the paradigm of health services.[4] As a supporting factor for the success of preventive efforts, health promotion has now penetrated the digital realm. Technological advances in health services make it easier for health workers to communicate with people in remote conditions, one of which is due to limited access to primary health care.[1]

The widespread adoption of digital health services aligns with the patient's need for consultation and decision-making media. The constraints of health workers in responding quickly make health workers innovate in making tools/media to provide services online by utilizing the sophistication of technology in the current era.[5] Several innovations have been made in applying technology in health services for mothers and babies, with digital communication between patients and health workers. One of the innovations in the application of technology in health services is digital communication. Communication is exchanging information between individuals using verbal and non-verbal symbols.[6] Mobile health (mHealth) is part of electronic health (eHealth), which is defined as the use of mobile phones to support the achievement of health goals or provide versatile and functional health services. The World Health Organization (WHO) defines eHealth as a health-related approach that utilizes information and communication technology.[7], [8]

The scope of use of health apps is now more specific, such as apps for implementing *Posyandu*, which targets the infant, toddler, adolescent, and elderly phases of life.[8]–[10] With widespread digital healthcare apps, mHealth services will be available to develop maternal and child health, primarily through community-based services. There is a need for innovations that address the latest data science developments, highlighting the benefits and slow exchange of traditional data, including time lags, high costs, and measurement complexity. They can transform data collection and processing speed, accuracy, and functionality.[11] To improve mHealth service interventions, it is necessary to characterize key features in data delivery agility, especially its ability to provide real-time and high-quality data.[9],[11] The performance of an application can be proven by increasing the number of features and modifying existing algorithmic techniques.[10] Automated and standardized application systems can significantly be utilized in various context-appropriate technologies, reducing the need to come directly to the field.[11] One form of automated application utilized in health care technology is chatbot features. A chatbot is a feature of digital communication that can provide automatic answers to user needs. However, in the application of automated chatbots, users are limited to the solutions already available by the chatbots, so to get more answers, users will be directed manually to health workers.[12] This finding highlights the perception that chatbot technology can help to respond immediately in a less complicated role.

Chatbot is a form of digital transformation, and one of its functions is to cause interaction between machines and humans.[13] Conversational agents are developed to support various health activities, including behavior change, care support, health monitoring, training, and screening support, developed through chatbots.[14] Research on digital innovation in public health should measure the impact of technology in health interventions, provide insight into the user experience, and work to ensure safety and improve user well-being.[15] Based on a review of previous literature, it has been shown that using chatbot technology to support information exchange and communication has significant positive effects

on clinical and behavioral outcomes such as knowledge, perceived social support, and health behaviors.[16] Chatbots can be a means to provide health consultation and education.[17] Recently, chatbots have also been utilized in health care to improve mental health, support patients with chronic diseases, and provide education.[18]–[20] This is because chatbots can help patients manage their health and assist health professionals in handling patient care, especially decision-making for their health.[21],[22] Although chatbots are designed to simulate human conversations in health education, they still have limitations.[22], [23] Education using chatbots is acceptable to patients, but many health professionals and experts have emphasized that fully automated chatbots are not mature enough to diagnose patient conditions or replace the judgment of health professionals.[18], [22], [24]–[26]

Public satisfaction with health services is starting to lead to access to health information anytime and anywhere. Digital communication is designed as a medium of interaction with a natural conversational style that forms a good relationship with all users. The advantages of digital communication that utilize the power of technological advances can open up more opportunities for health behavior change by providing personalized interventions.[7],[27] Health education provided by involving digital communication in the form of chatbots is expected to improve one's quality of life and become evidence of the success of health promotion by utilizing technology.[5] In one study, a semi-automated chatbot was used to provide health education and monitor maternal conditions, but cases that the chatbot could not handle had to have non-automated/manual communication with midwives. Health monitoring using an automated chatbot can only provide general health check results. Diagnosis using chatbot assistance is suitable for providing precise findings before the critical stage. The diagnostic process using technology includes preprocessing, segmentation, feature extraction, and classification.[10] However, issues of trust, confidentiality, and data protection in providing personal information to the application are debated barriers to its use.[8] Therefore, the practical feasibility of this approach is still an issue due to the complexity of the computational methods.[8],[10]

Related to community satisfaction and easy access to health services and digital communication facilities to facilitate health education to improve the quality of life of the general public, supporting technological innovation is needed. In this case, an application that is easy to access by the community or health workers named iPosyandu application has been created. iPosyandu is a data collection application that all stakeholders can access. It is known that an additional feature is needed to bridge communication between stakeholders.[28],[29] Digital communication features in chatbots are a new and innovative way of providing information digitally.[30] Chatbot conversations are considered meaningful and trustworthy when dealing with health problems compared to face-to-face, google searches, and telephone services. In addition, the cost of developing and implementing chatbots is also lower.[31] With these advantages, the implementation of chatbots has enormous potential in health promotion and the development of iPosyandu.[32] However, chatbots are required to adapt to stakeholders' needs.[33] This study aims to develop a digital communication algorithm using a semi-automated chatbot in the *Posyandu* application.

2. Methods

2.1 Study Design

An exploratory qualitative approach was used to explore the needs of midwives, cadres, pregnant women, postpartum women, and mothers under five in developing digital communication features on the iPosyandu application. Focus group discussions (FGDs) were conducted through semi-structured interviews, with a topic guide covering digital communication for online health services utilizing technological sophistication. Topic guide to explore participants' experiences, needs, expectations, and recommendations in greater depth. The topic guide is available in the Supplementary Material. Qualitative methods were used to develop digital communication algorithms in the iPosyandu application. The stages in this research process can be depicted in Fig. 1.

2.2 Participant Selection

Qualitative data collection was achieved through FGDs conducted with informants from midwives (n = 11), cadres (n = 13), pregnant women (n = 10), postpartum women (n = 9), and mothers of children under five (n = 15). The eligibility criteria for pregnant women informants consisted of women in all trimesters who could operate a smartphone and were willing to participate in the interview. Informant requirements were postpartum mothers and mothers of children under five who can operate smartphones and have participated in iPosyandu training. Other informants were midwives and cadres working in the *Puskesmas* area and attending iPosyandu training. Pregnant, postpartum women and mothers of children under five with complications and mental disorders were not included in this study. Excluded midwives were those known to have not performed their duties for over a month. This means these midwives were not actively working and did not follow the socialization and training on the iPosyandu application. None of the participants refused to be interviewed. For each participant, the first interview started with questions about their socio-demographic data. Characteristics of respondents are listed in Table 1, including age, education level, and participation in training on the use of the iPosyandu application. Characteristics of cadres are listed in Table 2, including age, education, and participation in iPosyandu training. Characteristics of pregnant women are listed in Table 3, which describes age, trimester, and parity, which is divided into the categories of primipara (women who have given birth once) versus multipara (more than once) and education level.

The characteristics of postpartum mothers are listed in Table 4, which includes age, occupation, and latest education. Characteristics of mothers under five are listed in Table 5, which provides for age, employment, and latest education.

Table 1
Characteristics of Midwife Respondents

Code	Age	Midwifery Education	Participated in iPosyandu
IB1	35	Diploma degree	Had attended training
IB2	34	Diploma degree	Had attended training
IB3	33	Diploma degree	Had attended training
IB4	32	Diploma degree	Had attended training
IB5	32	Bachelor degree	Had attended training
IB6	36	Diploma degree	Had attended training
IB7	32	Diploma degree	Had attended training
IB8	34	Diploma degree	Had attended training
IB9	33	Diploma degree	Had attended training
IB10	31	Diploma degree	Had attended training
IB11	33	Diploma degree	Had attended training

Table 2
Characteristics of Cader Respondents

Code	Age	Educational level	Participated in iPosyandu
IK1	41	Senior High School	Had attended training
IK2	38	Junior High School	Had attended training
IK3	50	Senior High School	Had attended training
IK4	47	Senior High School	Had attended training
IK5	50	Elementary School	Had attended training
IK6	48	Senior High School	Had attended training
IK7	45	Senior High School	Had attended training
IK8	36	Senior High School	Had attended training
IK9	33	Senior High School	Had attended training
IK10	39	Senior High School	Had attended training
IK11	35	Senior High School	Had attended training
IK12	38	Elementary School	Had attended training
IK13	37	Senior High School	Had attended training

Table 3
Characteristics of Pregnant Women Respondents

Code	Age	Trimester	Parity	Occupation	Educational level
IH1	30	2	Multiparous	Housewife	Senior High School
IH2	24	1	Primiparous	Housewife	Senior High School
IH3	27	2	Multiparous	Housewife	Senior High School
IH4	28	1	Multiparous	Housewife	Senior High School
IH5	30	3	Multiparous	Housewife	Elementary School
IH6	33	1	Multiparous	Housewife	Junior High School
IH7	23	2	Primiparous	Housewife	Senior High School
IH8	24	3	Primiparous	Housewife	Senior High School
IH9	27	3	Primiparous	Housewife	Senior High School
IH10	22	3	Multiparous	Housewife	Junior High School

Table 4
Characteristics of Postpartum Women Respondents

Code	Age	Occupation	Educational level
IN1	28	Housewife	Senior High School
IN2	29	Housewife	Senior High School
IN3	21	Housewife	Senior High School
IN4	23	Housewife	Senior High School
IN5	25	Housewife	Senior High School
IN6	30	Housewife	Senior High School
IN7	26	Housewife	Senior High School
IN8	31	Housewife	Senior High School
IN9	31	Housewife	Junior High School

Table 5
Characteristics of Respondents Mom of Toddlers

Code	Age	Occupation	Educational level
I1	20	Housewife	Senior High School
I2	34	Housewife	Senior High School
I3	25	Housewife	Senior High School
I4	31	Housewife	Senior High School
I5	28	Housewife	Junior High School
I6	24	Housewife	Junior High School
I7	25	Housewife	Senior High School
I8	29	Housewife	Senior High School
I9	32	Housewife	Senior High School
I10	31	Housewife	Senior High School
I11	27	Housewife	Senior High School
112	25	Housewife	Senior High School
I13	24	Housewife	Senior High School
I14	24	Housewife	Senior High School
I15	26	Housewife	Senior High School

2.3 Setting

This research was conducted in Purwakarta Regency, West Java Province, Indonesia. Purwakarta Regency has an area of 971.72 km2 consisting of 17 sub-districts, 183 villages and 9 villages with a total population of 997,869 people. The number of *Puskesmas* in Purwakarta Regency is 20 *Puskesmas*, of which 17 were used as research sites with the consideration that the *Puskesmas* was taken because it has been actively using the iPosyandu application with the division of areas with poor signal and good signal. Data was collected in September - November 2022.

3. Results

3.1 Educational Needs and Data

Some of the topics needed by respondents are material about pregnant women, material about postpartum women, material about mothers of infants and toddlers, and material about midwifery needed by midwives. Respondents expect chat that can be responded to quickly.

3.1.1 Pregnancy Materials

As we know, pregnant women experience complaints in each trimester. These complaints are usually about discomfort during pregnancy. Besides that, pregnant women need a reminder every month to do a direct pregnancy check. Information about pregnancy summarized from the results of the interview can be described as follows: pregnancy examination, complaints about discomfort, and information about gestational age.

“..when is the date to check pregnancy, labor, and gestational age.” (FGD pregnant women)

“..the app should remind about the Fe consumption schedule and how good fetal movement is.” (Midwife FGD).

The number of complaints of discomfort in pregnant women was conveyed by the subject directly with the hope of the availability of educational media that help pregnant women get answers quickly.

3.1.2 Postpartum Materials

When mothers enter the postpartum phase, they need education and knowledge about the health care of postpartum mothers and babies. In addition, postpartum mothers need education related to family planning. Information about postpartum mothers summarized from the interviews can be described as the subject's need for knowledge about maternal care for infants and toddlers during the postpartum period and family planning tools and screening.

"..... about birth control,...."

"Breastfeeding, pre-birth care is like having nipples in breast care." (Midwife FGD)

"... If you want to use birth control, you should use birth control like injections or implants. Can you consult with midwives through the application?" (FGD Postpartum Women).

The results of the interviews during the FGDs showed that postpartum women and midwives need media that can answer questions and complaints that they often experience so that treatment can be obtained more quickly.

3.1.3 Toddler Content

When entering the period of mothers caring for toddlers, of course, several things become obstacles and complaints mothers feel, including the need for information about massage in infants. In addition to constraints and complaints about the need for care for toddlers, cadres, as implementers, need information on nutritious food counseling for infants and toddlers when conducting *Posyandu* activities.

".... about newborns who are rich in care."

"immunization, growth and development, nutrition, complementary foods, and what type of nutrition we are."

"...Knowledge about SDIDTK (Stimulation, Detection, Early Intervention of Growth and Development) also for examination." (Midwife FGD)

"... Counseling on nutritious food for infants, nursing mothers and also children under five." (Cadre FGD)

“about baby massage .” (FGD Mom of Toddlers)

The results of interviews conducted with midwives, cadre mothers, and mothers of toddlers explained that information about care for newborn toddlers and nutritious food is needed in digital communication. The goal is that the handling and exposure of information about babies and toddlers can be appropriately conveyed to the subjects in need.

3.1.4 General Midwifery Material

The information midwives need is undoubtedly very useful in remembering the material. Information required by midwives is usually related to immunization, breast milk storage, family planning schedules, and the regulations if needed at any time.

"umbilical cord care, exclusive breastfeeding, immunization, breast milk storage, sunbathing, breastfeeding position, stunting, complementary feeding."

"Post-circumcision birth control schedule, sometimes we like to wait first and not immediately use birth control. Types of birth control as well as methods, side effects, benefits of birth control."

".... benefits and disadvantages and maybe what are the dangers (of using birth control) if for example it is not removed or replaced. Usually, if we tell them nicely about the dangers and they understand, they usually want it." "from Indonesian Midwifery Association and The Ministry of Health regulation. We changed the regulations, such as post- Sectio Caesaria (S.C). We do not serve post-SC intra-uterine device (IUD) placement. It is intended that the community knows what the midwife's authority is and why the action is not served. So it is not thought that we do not serve because we refer to the regulation."

In addition to the requirement for information, midwives need media to consult directly with doctors, the *Puskesmas*, health promotion, environmental health, dental consultations, and laboratory examinations.

3.2 Communication Service System

3.2.1 Chatbot Message System

"consultation with doctors, Puskesmas, health promotion, environmental health, dental consultation, laboratory."

"diagnose problems automatically" (Midwife FGD)

".... seems more convenient too because you can go far from home (remote consultation using chatbot)."

"That means that it can be answered immediately, ma'am. You don't have to wait for it to be replied to." (Pregnant Women FGD)

3.2.2 Manual Chatbot Messaging System

"…. It (the chatbot) can trusted mom but still have to go to a health worker for unanswered questions (direct consultation with a health worker)." (Pregnant Women FGD)

The communication system designed to be answered directly by the robot applies to general questions so that questions and answers are provided directly in the application, which can be implemented in the form of a chatbot so that the robot answers questions. Unanswered questions not yet available in the chatbot will be forwarded to the health worker concerned so that they can be answered manually because they are not available in an automated chatbot. This is called a semi-automated messaging system.

3.3 Semi-automated Chatbot Massaging System

"so the concept is like a WhatsApp bot or let's just consult directly if the bot can't answer..." (Midwife FGD).

3.3.1 Ease of Access

".... facilitates communication in pregnant women, childbirth and postpartum, makes it easier for midwives to make referrals, basically facilitates information to clients..."

".... is easy to use, not complicated, concise..." (Midwife FGD).

"...to facilitate communication between pregnant women and cadres." (Pregnant Women FGD)

3.3.2 Ease of Scheduling

"post-copy birth control schedule..."

"examination schedule."

"....vitamin A schedule...."

" Schedules such as Posyandu, immunization Puskesmas services etc. ...." (Midwife FGD)

"It could be a reminder of the Posyandu schedule. So that mothers remember the schedule of the Posyandu ...." (Cadre FGD)

"For me, it's more about immunization, scheduled routine. Made into one schedule, then made into an appointment."

".... which makes it easiest to schedule with the midwife." (Pregnant Women FGD)

Some conveniences that result from digital communication through chatbots are ease of access and scheduling. In this case, information can be easily accessed through the application, for example, information on questions that often arise in pregnant women. In addition, the use of digital communication also facilitates scheduling, such as prenatal check-ups.

3.4 Communication Benefits

3.4.1 Behaviour Change

".... behavior change ... yes, if, for example, the cadre says or reminds mothers to be diligent in checking so the mothers were given the information and aware of their behaviour." (Midwife FGD)

3.4.2 Improving Service

"Just call, but if it's an emergency (emergency service) ....."

"Hopefully, it can help, make it easier too..."

"The service is faster, efficient, and effective..."

"If we seem to have as much time as possible, we are able to reply to the chat (direct communication service.)" (Midwife FGD)

Digital communication is expected to have several benefits in terms of behavior change, for example, pregnant women who were initially constrained by coming to health services to check their pregnancy can be facilitated by the iPosyandu application, which includes digital communication facilities. Besides that, digital communication also increases services, such as education for patients.

3.5 Communication Channels

3.5.1 Advocacy Communication

"Maybe with area stakeholders such as sub-district heads, religious leaders, or the elders of the community, so they can coordinate well, and support.."

3.5.2 Facilitation Communication

"We can find out all the problems in the area by asking the cadres."

"oh, so you can consult with cadres...". (Midwife FGD)

3.5.3 Communication Coordination

"I wish I could streamline communication, especially concerning referrals..."

"oh, you can consult with a pediatrician..."

"..... hopefully obstetricians can enter too. (can communicate)"

"consultation with doctors, Puskesmas, health promotion, environmental health, dental consultation, laboratory." (Midwife FGD)

3.5.4 Educational Communication

"patient requests must be answered...."

"...facilitate communication to pregnant women, labor and postpartum..."

"....Education for pregnant women is often, about dizziness, taking blood tablets, how to consume them so that they don't get nauseous..." (Midwife FGD)

Communication can be divided into advocacy, facilitation, coordination, and educational communication related to different communication functions in different channels and roles. Each of these communications occurs by the function created by implementing the communication in the field.

Figure 2 shows that the concept map was obtained based on qualitative data. The researcher determined that the coding was given a blue round mark. This coding became the basis for categorization marked with an orange box shape. The categories were then grouped into significant themes marked with pink boxes as the main topics needed to form the digital communication model marked in yellow. Figure 3 illustrates the development of the menu on the iPosyandu application, which takes the form of a chatbot tailored to each user type. As depicted in the figure, the chatbot is divided into three distinct user roles: midwives, cadres, and families.

Notes:

A = Communication flow among application users between pregnant women, postpartum women, and mothers of toddlers in the midwife chatbot application, cadre chatbot, and patient/family chatbot.

This chatbot should exist in the iPosyandu application

B = Display of the chat feature on the iPosyandu main page

C = Example of a conversation contained in the iPosyandu application chatbot

Digital communication occurs between iPosyandu application users, including midwives, pregnant women, postpartum mothers, mothers of toddlers, and cadres, and is semiautomatically carried out to obtain information according to the needs of application users. Communication can occur between: (1a) pregnant women and midwives, (1b) pregnant women and their peers, (2a) postpartum women and midwives, (2b) postpartum women and their peers, (3a) mothers of toddlers and midwives, (3b) mothers of toddlers and their peers, (4a) cadre and midwives (4b) cadre and their peers, (5a) midwives and their peers, and (5b) midwives and *Puskesmas*. Figure 4 illustrates the flow of the communication algorithm.

chat can occur between them

4. Discussion

From the recent literature review, it is found that technological developments in the world of health are very diverse. This can be seen in research conducted in several developing countries, for example, Pakistan, the fifth biggest population after Indonesia, which analyzes the challenges of using mHealth in developing countries to expand and increase the effectiveness of mHealth use. The research focuses on education and awareness of clinical decision support systems, tracking epidemic outbreaks and natural disasters, training health workers, community resources for health, and remote monitoring.[34] Many smartphone medical applications have been developed and widely used by health professionals and patients. In current strategies, smartphones are getting more attention in healthcare daily. Medical applications make smartphones valuable tools in evidence-based medicine at the point of care and their use in mobile clinical communication. Also, smartphones can play a critical role in patient education, disease self-management, and remote patient monitoring.[35] In the existing review, digital communications between health workers and patients exist but do not specifically show several functions in one platform, as mentioned in our results. Our results depict several types of digital communication: educational communication (health workers and patients), coordination communication (between health workers), communication facilitation (between health workers and cadres), and advocacy communication (between health workers and policymakers). The urgency of the need for easy access between patients and health workers, in this case in community services, to facilitate patient communication with village midwives and community health center midwives is very much needed for health services, especially education. It is known from the country regulation that the rate of midwives to population is 1: 1000, but in Purwakarta, it is less (412: 997,869 people), and this number is not optimal to cover the needs for educational services required by patients in the area. [36–37] Digital communication services can help facilitate access to educational communication for patients assisted by robots (Chatbots).

Digital communication developed in this research includes: (1) coordination, (2) advocacy, (3), facilitation, and (4) education. Digital communication that occurs between village midwives and *Puskesmas* is coordination communication. It can be done through various coordination of health services. Coordination communication is the integration of organizational goals with other parties for the smooth and successful achievement of coordination goals, which has a binding nature of its function to make other parts unable to run without coordination.[38] Challenges in the coordination process usually include ineffective responses, coordination of data exchange, and commitment to facilitating service systems.[39] Coordination communication between health workers aims to achieve common goals in optimal health services. Fellow health workers with different fields of expertise are expected to work together with optimal coordination. This aligns with the WHO statement, which compiles a concept known as the "Building Blocks of Health Systems". This concept includes six central elements that form the basis of an effective health system. These six elements are health services, health workers, information systems, access to essential medicines, financing, and health governance.

[40] Coordination communication models have proven effective in improving communication between health and social services and in improving care for complex patients. Peer coordination interventions effectively improve access to appropriate treatment, reduce costs, improve clinical outcomes and quality of care, improve communication between health workers, and enhance patient safety.[41]

This application involves competent health workers so that health services can be carried out effectively. The application not only enables bidirectional information sharing among stakeholders but also organizes tasks based on each professional's area of expertise. This structured distribution of roles enhances interdisciplinary collaboration in resolving field-related problems. The communication network involves village midwives, other practicing midwives, nutrition personnel, and health promotion officers. [40] This type of communication is called coordination communication. Reports on the results of *Posyandu* services that require follow-up, in this case, are related to inter-professional coordination; for example, if midwives find cases of stunting, then handling midwives will coordinate with Nutrition officers and Health Promotion officers to solve the stunting problem found in the reports provided by cadres and recorded in the iPosyandu application. Coordination communication is semi-automatic.[43]

Communication between village midwives or Puskesmas and the district health office can be characterized as advocacy-oriented communication, as interactions related to health service delivery may contribute to informing and influencing policy decisions at the health authority level. In the context of strategic communication, advocacy plays an important role in shaping policies that govern the development and implementation of new health concepts and technologies intended to promote behavioral change. Advocacy communication encompasses efforts to mobilize public support for specific health-related objectives by engaging community groups and government stakeholders. This process is inherently strategic, involving dynamic interactions among social actors and policymakers to facilitate social change and ensure that communication initiatives are designed and implemented to advance public interests and broader community welfare.[44] Advocacy communication can facilitate coordination and collaboration between health workers in health services.[43] The mHealth application supports advocacy communication by facilitating the management of health information, including the collection, processing, analysis, and interpretation of data. This function is reflected in the communication established between village midwives and relevant stakeholders, such as Puskesmas, district health offices, and village administrations, to support coordination and decision-making processes.[45–47] This communication is carried out to influence stakeholders in making evidence-based policies or decisions. With this feature, mHealth provides a mindset change to provide more patient-centered services. Unlike the types of communication described previously, advocacy communication does not involve chatbots, so discussions will occur directly with the parties involved. [48]

Digital communication between midwives and cadres is called facilitates communication. It is aimed at stimulating each other. Midwives often rely on information collected by community health cadres to support service delivery. Therefore, effective communication between midwives and cadres is essential to overcome challenges related to information access and community outreach. The findings of this

study highlight the importance of a communication pattern that functions as a facilitative mechanism between these actors. In this role, cadres serve as community-level representatives who extend the reach of midwives in delivering health messages and services. As facilitators, midwives provide guidance and support during *Posyandu* activities, enabling cadres to perform their responsibilities effectively. They also encourage cadres to share their observations and experiences while fostering active participation and adherence to agreed procedures.[49],[50] Facilitative communication is essential in achieving change in individuals, organizations, or health systems and implementing effective interventions in a health service.[50] Facilitative communication between midwives and cadres in *Posyandu* services allows for achieving more effective health service goals. The existence of a more effective communication system refers to improving access to health services (Service Delivery). Limited access is one of the causes of high health problems related to maternal and child health.[51]

Digital communication in the community of pregnant women/postpartum women/mothers of young children is educational, where the community can consult about their problems or gain knowledge from the midwives. Educational communication is also from midwives to mothers of toddlers, postpartum mothers, and pregnant women. This communication aims to educate or provide counseling, so the information provider must be someone or a group in charge of *Posyandu* services, such as midwives.[52] The information shared in educational communication is all related to *Posyandu* services.[53] The Posyandu application should support semi-automated educational communication, allowing a chatbot to respond to public inquiries while ensuring that questions beyond its response capacity are referred to health workers for follow-up.[42] In clinical practice, educational communication influences patient behavior. This communication is essential in building relationships between health workers (midwives) and patients (pregnant women, postpartum mothers, mothers of toddlers). Communication skills include gathering information, formulating accurate diagnoses, providing therapeutic instructions and medical advice, communicating risks, and conveying health-related matters to patients.[54]

Limited access is one of the causes of high health problems related to maternal and child health.[51] In this context, it is vital to ensure that health services are easily accessible to all levels of society.[55] Based on this, a digital communication model is developed in a Posyandu service application. This communication model will be supported in the iPosyandu server, but users will access data through different platforms according to their respective roles.[49] Access to the iPosyandu system is tailored to the roles of its users. Village authorities (kelurahan), Puskesmas, and district or city health offices utilize the web platform, midwives access the iPosyandu for Midwives application, and families—including mothers of children under five, pregnant women, and postpartum women—use the iPosyandu for Family application. The integrated use of these platforms may contribute to greater efficiency in healthcare delivery and offer an affordable strategy for improving access to health information and services, especially in remote or underserved areas.[56] However, its development must also consider the readiness of the infrastructure to support this service. It is necessary to develop application development that is effective, easy to use, and more complex according to the needs of the field. This development can be in the form of iPosyandu Bidan and iPosyandu Keluarga that are in better design.[57] The limitations of this study are the constraints in operating digital communication applications,

which sometimes have signal interference in certain areas. In addition, because this application is a new application introduced to several groups of respondents, it requires adaptation for its operation. There are obstacles related to technical constraints in using applications using smartphones.[29], [58]

5. Conclusion

Information needed by pregnant women, postpartum women, mothers under five, cadres, and midwives from the semi-automated chatbot includes maternal health education, maternal health services, and health monitoring. In health monitoring, automated cunderserved areas.hatbots can provide general health checks. For health concerns that require individualized follow-up, users are directed to communicate directly with midwives via the manual messaging feature. The design of a semi-automated chatbot should incorporate user-centered principles, evidence from relevant literature, and expert consultation to ensure that the resulting digital communication algorithms are appropriate for Posyandu service delivery. Within this framework, digital communication can support multiple functions, namely educational communication between midwives and patients, coordination among healthcare personnel, advocacy communication with health authorities, and facilitative communication between midwives and community health cadres. With the digital communication listed in this semi-automatic chatbot feature, it is hoped that it can help achieve more effective health services and overcome limitations related to access and distance, which can ultimately help fulfill patient needs through this digital communication.

Abbreviations

AI
Artificial Intelligence
BPS
Badan Pusat Statistik (Statistics Indonesia)
eHealth
Electronic Health
FGD
Focus Group Discussion
IUD
Intra-Uterine Device
LPDP
Lembaga Pengelola Dana Pendidikan (Indonesian Endowment Fund for Education)
mHealth
Mobile Health
Puskesmas
Pusat Kesehatan Masyarakat (Primary Healthcare Center)
Posyandu
Pos Pelayanan Terpadu (Integrated Community Health Post)
SDIDTK

Stimulasi
Deteksi
dan Intervensi Dini Tumbuh Kembang (Stimulation
Detection
and Early Intervention of Growth and Development)
SC
Sectio Caesarea
WHO
World Health Organization

Declarations

Ethics approval and consent to participate

The study was approved by the Faculty of Medicine Ethics Committee of Universitas Padjadjaran Bandung, Indonesia (etic code 1412/UN6.KEP/EC/2023). Informed consent was obtained from all subjects involved in the study. All procedures involving human participants were performed in accordance with the relevant guidelines and regulations and with the ethical principles of the Declaration of Helsinki. The study was approved by the Faculty of Medicine Ethics Committee of Universitas Padjadjaran Bandung, Indonesia (etic code 1412/UN6.KEP/EC/2023). Informed consent was obtained from all subjects involved in the study.

Clinical trial number

Not applicable.

Consent for publication

Approvals for publication have been obtained.

Competing Interests

The authors declare that there are no conflicts of interest in the writing or publishing of this article.

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Author Contribution

Conceptualization, T.K., F.R.R., F.F.W., A.M .; writing—original draft, T.K., W.W, A.G.S. K.K., F.M. and H.W.; writing—review and editing, T.K., F.R.R., W.W., K.K., A.G.S. and H.W.; visualization; T.K., A.F., W.W, A.G.S. K.K., W.G.P., A.P.; supervision, F.F.W., F.R.R. A.M All authors have read and agreed to the published version of the manuscript.

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Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Figures

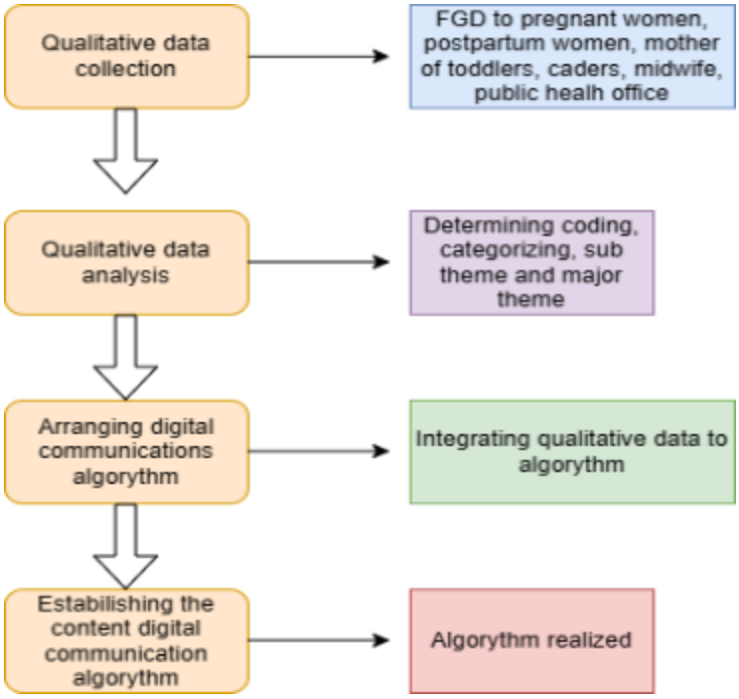


Figure 1

Stages of the Research Process

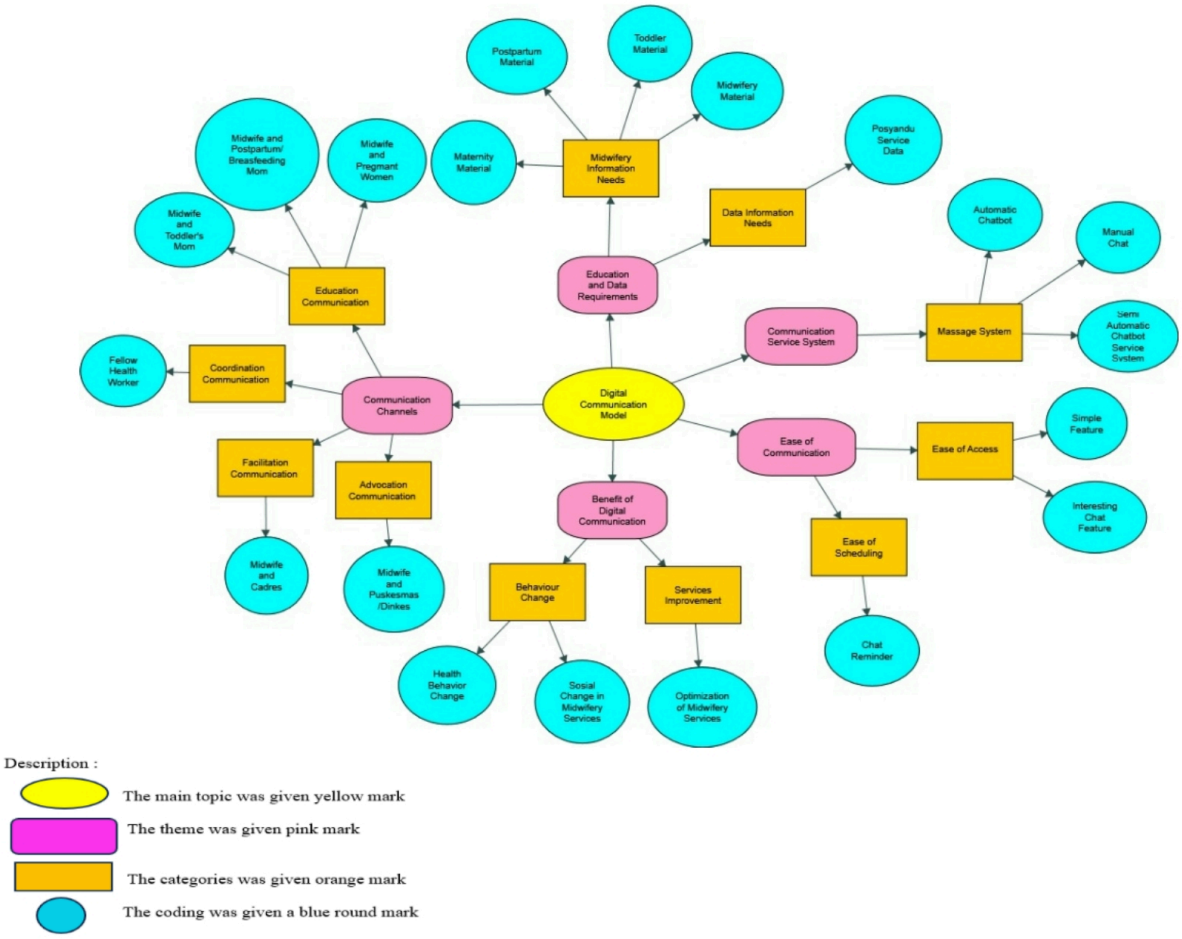


Figure 2

Concept Map

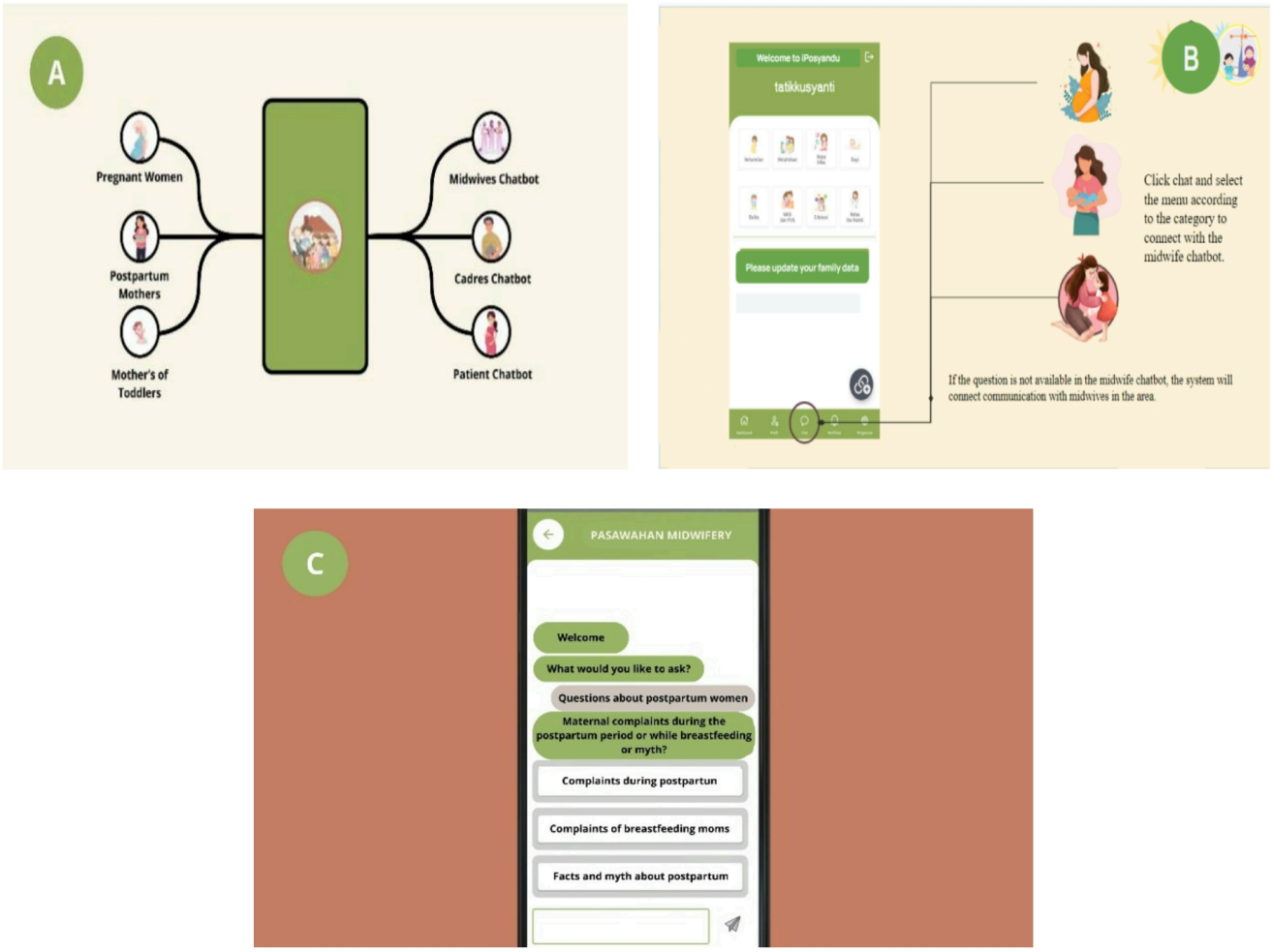


Figure 3

Development of The Chatbot and Algorithms

Notes:

A = Communication flow among application users between pregnant women, postpartum women, and mothers of toddlers in the midwife chatbot application, cadre chatbot, and patient/family chatbot.

This chatbot should existin the iPosyandu application

B = Display of the chat feature on the iPosyandu main page

C = Example of a conversation contained in the iPosyandu application chatbot

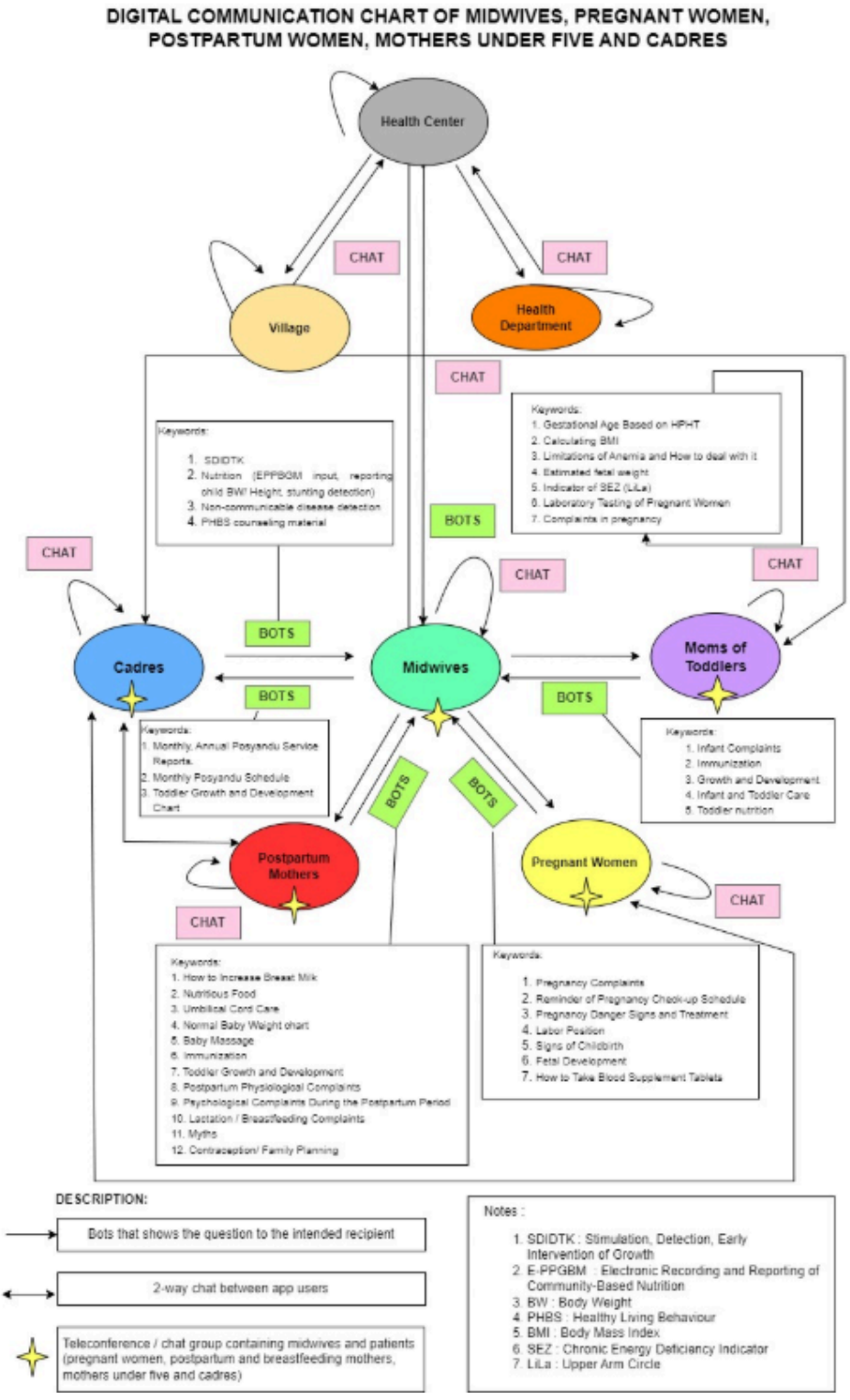


Figure 4

Digital Communication Algorithm

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