Integrating User Acceptance Evaluation into District-Level Mobile Health System Design for Maternal Care

Arif Setia Sandi Ariyanto[1*], Purwono[2], Deny Nugroho Triwibowo[3]

[1,2,3]*Faculty of Science and Technology, Universitas Harapan Bangsa, Banyumas, Indonesia*

*corr-author: arifsetia@uhb.ac.id

Abstract - Many mobile health information systems are developed based primarily on technical requirements, while user acceptance is often assessed only after deployment and rarely integrated into the design process. This study addresses that gap by incorporating user acceptance evaluation as a design-informed feedback mechanism in the development of a district-level mobile health information system for maternal care. An applied research approach was used through system development, pilot deployment across five sub-districts, and post-use evaluation involving 74 active users. User acceptance was assessed using structured questionnaires covering perceived usefulness, perceived ease of use, consultation feature acceptance, and automated conversational support acceptance. The results showed high overall acceptance, with direct consultation with local midwives receiving the highest score (mean = 4.41; SD = 0.52), followed by consultation routing effectiveness (mean = 4.35; SD = 0.55). Perceived ease of use was positively associated with consultation feature acceptance ($\rho = 0.46$, $p < 0.01$). Automated conversational support was positively perceived but obtained lower scores (mean = 3.92) than human-based consultation features, indicating its complementary role. These findings demonstrate that user acceptance evaluation can provide actionable evidence for iterative system refinement and support the development of context-aware mobile health systems for maternal care.

Keywords: Mobile health information system, user acceptance evaluation, system design, maternal care, mobile application.

I. INTRODUCTION

The rapid advancement of mobile technologies has driven the widespread adoption of mobile health (mHealth) applications as digital tools to support healthcare services. These systems are increasingly used to deliver health information, facilitate communication, and extend access to care beyond conventional face-to-face interactions. In maternal care services, mHealth applications offer particular potential to address challenges related to geographical barriers, uneven distribution of healthcare providers, and time constraints that limit access to timely consultation for pregnant women, especially in community-based settings [1-3].

Despite their growing availability, many mHealth applications fail to achieve sustained use after deployment. Prior studies consistently report that technical functionality alone is insufficient to ensure long-term adoption, as user perceptions play a critical role in determining whether a system is accepted and continuously used. In maternal care contexts, where trust, clarity of interaction, and alignment with existing healthcare workflows are essential, systems that do not adequately consider user acceptance often experience low engagement or abandonment after initial use [4, 5].

Existing research on mHealth systems has predominantly focused on system development, feature implementation, or post-implementation performance evaluation [6, 7]. These prior studies can generally be grouped into three streams: technical system development, adoption-oriented acceptance studies, and post-deployment usability evaluations. Other studies have examined user acceptance using established evaluation models, such as the Technology Acceptance Model, to measure perceived usefulness and perceived ease of use. However, in most cases, user acceptance is positioned as an outcome evaluated after system deployment [8, 9], rather than as an integral component of the system design process itself. Consequently, acceptance findings are frequently reported as descriptive metrics without clear linkage to concrete design decisions or feature refinement. As a result, the practical role of user acceptance evidence in guiding iterative system improvement remains insufficiently demonstrated in the literature.

This separation between system design and user acceptance evaluation represents a critical gap in current mHealth research. Limited studies explicitly operationalize user acceptance constructs as design inputs that guide interaction design, feature prioritization, and system refinement during development and real-

world implementation. Furthermore, empirical evidence demonstrating how user acceptance findings can be operationalized as structured design feedback during real-world deployment in district-level, community-based maternal care settings remains limited, particularly in contexts where digital literacy and healthcare service structures vary across user groups [10, 11]. This limitation is particularly relevant in maternal care systems, where trust, accessibility, and continuity of communication strongly influence sustained user engagement.

Based on this research gap, this study aims to integrate user acceptance evaluation into the implementation and refinement of a mobile health information system developed to support maternal care services. The system is implemented as a mobile application and deployed in a district-level pilot involving multiple sub-districts. While user-centered and human-centered design approaches have long emphasized the importance of user feedback, empirical studies rarely demonstrate how user acceptance findings are explicitly translated into design refinement decisions during real-world deployment. Rather than proposing a new design methodology, this study demonstrates how Technology Acceptance Model (TAM) constructs can be operationalized as structured design feedback to support feature prioritization and system refinement. By explicitly linking acceptance findings to subsequent design actions, the study provides empirical evidence on the practical role of user acceptance data in improving maternal health information systems within community-based settings [12].

II. METHOD

A. *Type of Research*

This study adopts an applied research approach focusing on the development and evaluation of a mobile health information system. The research emphasizes the use of user acceptance evaluation as design-informed feedback to support system design refinement, rather than clinical assessment or health outcome measurement. The approach is suitable for examining how evaluation results can inform design decisions in the implementation of real-world systems.

B. *Research Object*

The research object of this study is a mobile health information system designed to support maternal care services, hereafter referred to as the developed system. The system is intended to function as an information and communication support platform rather than a clinical decision-making tool. Its primary purpose is to facilitate access to maternal health information and enable remote consultation between pregnant women and local midwives through mobile technology.

The developed system adopts a centralized client–server architecture. The overall operational workflow of the system is illustrated in Fig. 1. The mobile application serves as the primary interface for pregnant women, allowing users to access health information, submit consultation requests, and interact with the automated conversational support component. All user interactions are transmitted to the centralized application server for processing and data management.

The automated conversational support component was implemented using Dialogflow and configured with predefined intents covering frequently asked maternal health topics, including antenatal care, nutrition, pregnancy warning signs, and routine maternal health guidance. Responses were generated from a curated knowledge base developed from maternal health information resources and consultation materials used by local healthcare providers. The component was designed to provide preliminary informational support and assist users in obtaining basic guidance before engaging in direct consultation with village midwives. Consequently, the automated conversational support feature functions as a complementary information service rather than a replacement for professional healthcare consultation.

Fig. 1 illustrates the system architecture of the proposed maternal health information system based on a centralized client–server architecture. The mobile application functions as the client interface through which pregnant women access health information, submit consultation requests, and receive consultation responses. All communication between the mobile application and the centralized application server is performed through HTTP-based requests. The application server acts as the core processing component by managing user requests, coordinating consultation services, and controlling data exchange among the system modules.

When a consultation request is received, the server first classifies the request according to its type. General maternal health inquiries are forwarded to the Dialogflow-based conversational support component, which retrieves relevant information from the centralized knowledge base and generates automated responses for routine questions. Consultation requests requiring professional assistance are processed by the location-based routing mechanism, which identifies the user's registered administrative area and forwards the request

to the corresponding village midwife responsible for that service area.

The centralized database stores user profiles, consultation records, maternal health information, and routing data required for system operation. Responses generated either by the automated conversational support component or by village midwives are subsequently returned to the application server and delivered to users through the mobile application. This architecture enables centralized management of consultation services while supporting both automated information delivery and direct communication with healthcare providers.

C. Data Collection

The system was implemented and evaluated through a pilot deployment conducted at the district level involving five sub-districts. The pilot deployment was conducted over three months following system development and internal testing. During this period, users interacted with the system to access maternal health information, submit consultation requests, and utilize automated conversational support features. The evaluation was conducted after users had sufficient opportunity to interact with the system.

Data were collected using structured questionnaires administered to users after the pilot implementation. The questionnaire items were developed based on established user acceptance constructs, particularly perceived usefulness and perceived ease of use, and were adapted to the context of mobile health information systems for maternal care. Each item was designed to capture user perceptions related to system functionality, interaction clarity, and feature usefulness [13].

The questionnaires were distributed electronically to pregnant women who actively used the mobile application during the pilot period. Only respondents who had direct experience interacting with the system features were included in the evaluation to ensure that the collected data accurately reflected actual system usage rather than hypothetical perceptions. Table I presents the operational definition of each construct and the indicators used in this study.

D. Data Analysis Method

Before statistical analysis, all questionnaire responses were screened for completeness and consistency. Duplicate or incomplete submissions were excluded from the dataset. Only responses from active users who had directly interacted with the system during the pilot implementation were included in the final analysis.

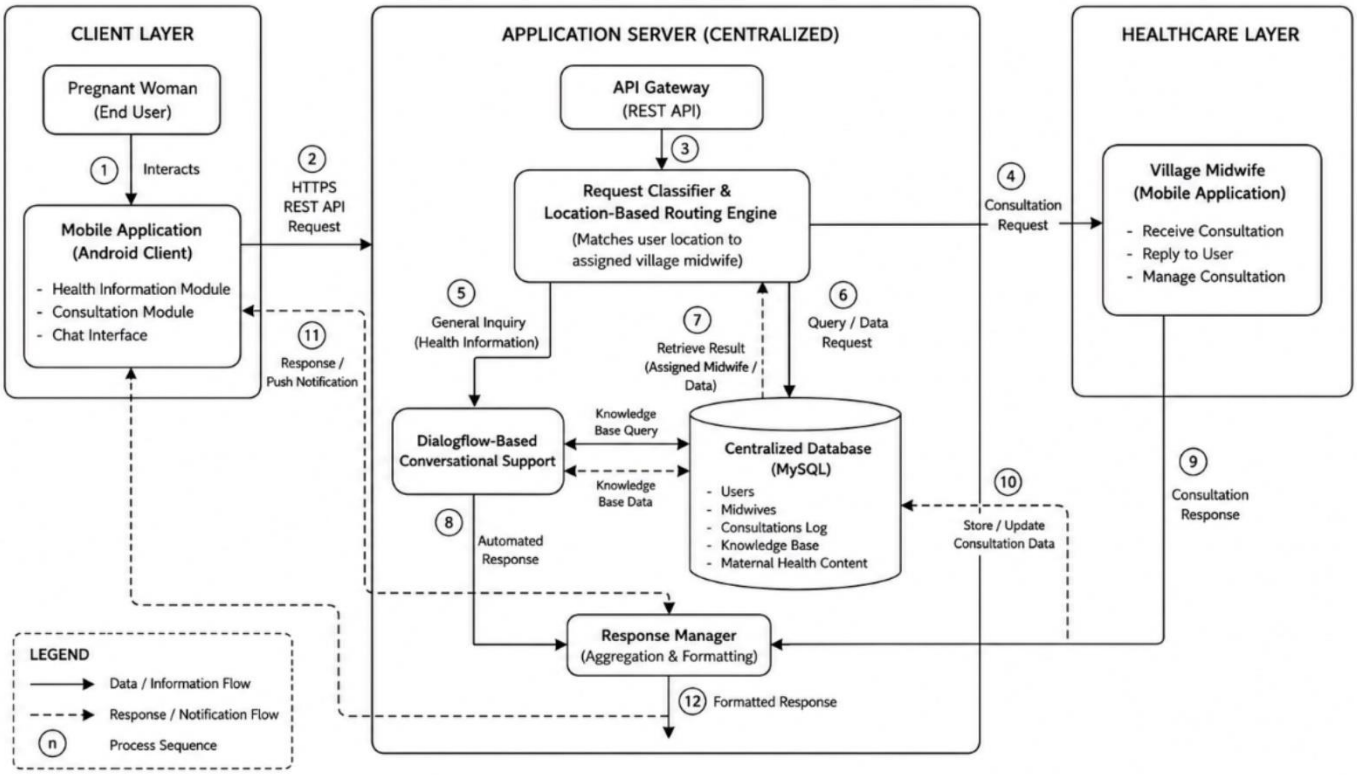

Fig. 1 System architecture of the proposed maternal health information system

TABLE I
OPERATIONAL DEFINITION OF USER ACCEPTANCE INSTRUMENTS

Construct	Item Code	Indicator Description	Source
Perceived Usefulness (PU)	PU1	The system helps users obtain maternal health information more efficiently	TAM (Davis, 1989)
	PU2	The system improves access to consultation services with midwives	
	PU3	The system is useful in supporting maternal care needs	
Perceived Ease of Use (PEOU)	PEOU1	The system is easy to learn and understand	TAM (Davis, 1989)
	PEOU2	Interaction with the system does not require much effort	
	PEOU3	The system interface is clear and easy to operate	
Consultation Feature Acceptance (CFA)	CFA1	The consultation feature effectively connects users to the appropriate midwife	Contextual adaptation
	CFA2	Direct consultation with midwives through the system is trusted and preferred	
Automated Conversational Support Acceptance (ACSA)	ACSA1	The automated conversational feature is useful for answering basic maternal health questions	Chatbot acceptance literature
	ACSA2	The automated conversational feature is helpful as preliminary support before human consultation	

Before analysis, the questionnaire instrument was evaluated to ensure measurement reliability. Internal consistency was assessed using Cronbach's alpha for each construct. Cronbach's alpha values above 0.70 were considered acceptable indicators of reliability. Content validity was established through adaptation of questionnaire items from the Technology Acceptance Model (TAM) and relevant mobile health acceptance literature. The instrument was further reviewed to ensure its suitability for the maternal health information system context before deployment.

Descriptive statistics were employed to summarize user perceptions of system usefulness, ease of use, and feature acceptance. Mean scores were interpreted using the following categories: 4.21–5.00 (Very High), 3.41–4.20 (High), 2.61–3.40 (Moderate), 1.81–2.60 (Low), and 1.00–1.80 (Very Low). Mean scores and standard deviations were calculated for each questionnaire item. In addition, an exploratory Spearman rank correlation analysis was conducted to examine the association between perceived ease of use and consultation feature acceptance.

An interpretive analysis was subsequently performed to relate the quantitative findings to specific system design elements and interaction mechanisms. Rather than aiming for population-level generalization, the analysis focused on understanding how acceptance results could inform design decisions and iterative system refinement within the context of a real-world pilot deployment. This approach is appropriate for applied system development research, where the primary objective is design improvement rather than predictive inference.

E. Research Flow

The research process is presented sequentially for clarity; however, the results of user acceptance data analysis function as a feedback mechanism that informs system design refinement, as in Fig. 2.

Fig. 2 illustrates the overall research workflow adopted in this study. The research began with the requirement analysis stage to identify user needs and define the functional requirements of the maternal health information system. These requirements guided the subsequent system design and development process, including the implementation of the mobile application, centralized server, location-based routing mechanism, and automated conversational support. After system development, a pilot deployment was conducted to evaluate the system in a real-world maternal healthcare setting. User feedback was then collected through structured questionnaires and analyzed to assess system performance and user perceptions. The findings from the evaluation were subsequently used to refine system features and improve usability through an iterative user acceptance feedback process.

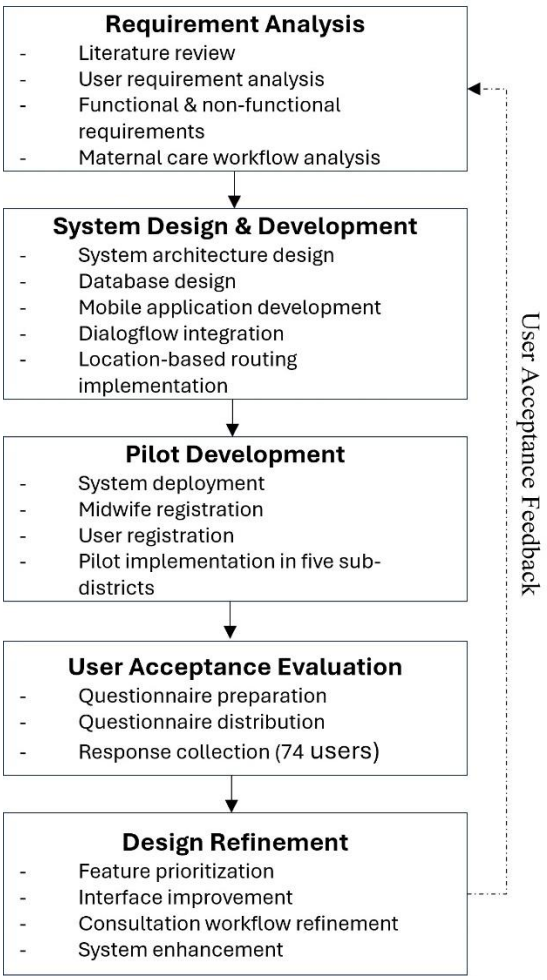

Fig. 2 Research flow of the study

III. RESULT AND DISCUSSION

This section presents the results of the user acceptance evaluation and discusses their implications for system design refinement.

A. Reliability Analysis

The reliability of the questionnaire instrument was assessed using Cronbach's alpha. The results indicate that all constructs achieved acceptable levels of internal consistency, suggesting that the measurement items were reliable for evaluating user acceptance of the developed system. The reliability results are presented in Table II. Cronbach's alpha values greater than 0.70 indicate acceptable internal consistency.

B. User Acceptance of Consultation Features

The high perceived usefulness of consultation features connected to local midwives indicates that users prioritize interaction models aligned with existing maternal care workflows, a pattern frequently reported in community-based mHealth studies [14]. Most users reported that this feature simplified access to consultation services by clearly directing communication to the appropriate village midwife based on the administrative area. This routing mechanism reduced uncertainty in initiating consultations and increased user confidence in using the system.

From a design perspective, this finding supports prior evidence that contextual alignment with existing healthcare service structures significantly enhances perceived usefulness and trust in maternal health applications. By mirroring the real-world organization of maternal care services, the system was perceived as more relevant and trustworthy. This suggests that mobile health information systems intended for community-based deployment should prioritize design elements that reflect local healthcare workflows to enhance perceived usefulness and adoption.

These findings are consistent with previous mobile health studies reporting that features closely aligned with existing healthcare workflows tend to achieve higher perceived usefulness and acceptance. Prior research has shown that contextual relevance and trust in service providers play a critical role in sustaining the use of maternal health applications, particularly in community-based settings. The results of this study extend these findings by demonstrating that such alignment can be intentionally reinforced through design decisions informed by user acceptance evaluation.

In this study, user acceptance was evaluated using four constructs: perceived usefulness (PU), perceived ease of use (PEOU), consultation feature acceptance (CFA), and automated conversational support acceptance (ACSA) (Table III). User acceptance data were collected from n = 74 pregnant women who actively used the mobile application during the pilot deployment. In addition to mean scores, the variability of user responses was examined to provide a more nuanced understanding of acceptance patterns across users. Table III reports both mean scores and standard deviations to reflect not only the central tendency but also the variability of user perceptions across acceptance indicators.

TABLE II
RELIABILITY ANALYSIS RESULTS

Construct	Number of Items	Cronbach's Alpha	Reliability Level
PU	3	0.80	Good
PEOU	3	0.78	Acceptable
CFA	2	0.74	Acceptable
ACSA	2	0.75	Acceptable

TABLE III
USER ACCEPTANCE EVALUATION RESULTS

Construct	Item Code	Mean Score	SD	Interpretation
Perceived Usefulness	PU1	4.28	0.61	Very High
	PU2	4.15	0.66	High
	PU3	4.32	0.58	Very High
Perceived Ease of Use	PEOU1	4.10	0.64	High
	PEOU2	3.98	0.71	High
	PEOU3	4.22	0.60	High
Consultation Feature Acceptance	CFA1	4.35	0.55	Very High
	CFA2	4.41	0.52	Very High
Automated Conversational Support Acceptance	ACSA1	3.92	0.74	High
	ACSA2	4.05	0.69	High

Overall, the evaluation results indicate positive user acceptance of the developed system, with consultation features connected to local midwives receiving the highest acceptance scores, while automated conversational support was perceived as complementary.

Among all evaluated indicators, direct consultation with midwives (CFA2 = 4.41; SD = 0.52) obtained the highest acceptance score, followed by consultation routing effectiveness (CFA1 = 4.35; SD = 0.55). These findings indicate that users strongly valued features that enabled access to known healthcare providers within their local service area. In contrast, automated conversational support for answering basic inquiries (ACSA1 = 3.92; SD = 0.74) received the lowest mean score, although it remained within the positive acceptance range. This pattern suggests that users perceived automation primarily as a supporting feature rather than a replacement for human consultation.

C. User Perception of System Ease of Use

The evaluation results also demonstrate that ease of use played a significant role in shaping overall user acceptance. Users generally reported that the system interface was easy to understand and operate, even among those with limited experience using mobile applications. Simple navigation structures and clear interaction feedback contributed positively to perceived ease of use.

This result supports existing evidence indicating that simplicity and clarity of interaction are key determinants of perceived ease of use in mobile health applications [15]. Previous studies have emphasized the importance of first-time user experience in shaping continued system use, particularly among users with limited digital literacy. The findings of this study reinforce this perspective by highlighting how early interaction barriers can influence overall acceptance, underscoring the need for design strategies that minimize cognitive and interactional load during initial system use.

However, the results indicate that initial interaction clarity influenced how quickly users became comfortable with the system. Users who experienced difficulty during early interactions tended to report lower ease-of-use perceptions. This finding emphasizes that first-time user experience is critical in mobile health system design. From a design standpoint, minimizing interaction complexity and providing clear guidance during initial use can significantly improve acceptance among diverse user groups.

In addition to descriptive findings, an exploratory Spearman rank correlation analysis identified a positive association between perceived ease of use and consultation feature acceptance ($\rho = 0.46$, $p < 0.01$). This result indicates that users who perceived the system as easier to learn and operate were more likely to engage positively with consultation services. From a design perspective, usability functions as an enabling factor that supports access to healthcare interaction features.

This result is consistent with previous usability studies showing that ease of use is a major determinant of continued engagement in mobile health applications, particularly among first-time or low-literacy users. The present findings reinforce the importance of minimizing cognitive and navigational barriers in community-based digital health systems.

D. Acceptance of Automated Conversational Support

The automated conversational component was positively perceived as a source of immediate assistance for basic maternal health inquiries. Users generally valued the feature for obtaining preliminary information before initiating direct consultation with midwives. However, the acceptance score for automated conversational support (ACSA1 = 3.92) was lower than that of direct human consultation (CFA2 = 4.41), indicating a clear preference for human-centered interaction.

This difference may be explained by higher levels of trust, empathy, and contextual understanding associated with healthcare professionals. In maternal care settings, users may seek reassurance and personalized responses when discussing sensitive or uncertain health concerns. Automated responses were therefore perceived as useful for general information needs, but less suitable for decision-critical consultation.

These findings are consistent with patterns commonly reported in international studies on chatbot-assisted health applications, where users tend to place higher trust in human healthcare providers for health-related decision-making, particularly in sensitive domains such as maternal care [16].

From a psychological perspective, the lower acceptance of chatbot-based interaction can also be attributed to reduced affective trust and perceived accountability, where users associate human midwives with moral responsibility and emotional presence that automated systems cannot yet convincingly replicate. Pregnant women may prefer reassurance and emotional support delivered by known healthcare professionals, especially when discussing personal or ambiguous health concerns [17].

Technical and interactional factors may also contribute to the observed difference. Automated conversational systems remain constrained by limitations in natural language understanding, contextual continuity, and domain-specific accuracy. Occasional mismatches between user intent and system responses, limited personalization, or insufficient localization of language and content can reduce perceived usefulness and reliability. Such limitations often result in chatbots being viewed as supportive tools rather than authoritative sources of healthcare advice [18].

While several international studies advocate hybrid human–AI models in healthcare, the findings of this study indicate that such models are highly context-dependent. In maternal care settings characterized by emotional vulnerability and perceived health risk, human-centered consultation remains the primary driver of user acceptance, positioning chatbot-based support as a secondary rather than equivalent interaction channel. By combining automated conversational support for immediate general information with direct access to healthcare providers for personalized consultation, mobile health systems can better balance efficiency with trust [19].

The observed acceptance patterns may be explained by the alignment between the system design and existing maternal healthcare service practices. Features that directly supported communication with village midwives received higher acceptance because they reinforced established trust relationships and reflected familiar consultation workflows. In contrast, automated conversational support received comparatively lower acceptance, likely because maternal healthcare consultations often involve contextual concerns that users prefer to discuss directly with healthcare providers. These findings suggest that perceived usefulness in maternal health systems is strongly influenced by the extent to which digital services complement, rather than replace, existing human-centered healthcare interactions.

E. Design Implications Derived from User Acceptance Evaluation

The integration of user acceptance evaluation into the system design process aligns with prior research advocating user-centered and context-aware approaches in mobile health system development. In this study, acceptance findings were not treated as evaluative endpoints, but as actionable inputs that directly informed design refinement and feature prioritization. Features associated with high perceived usefulness were prioritized for retention and enhancement, while usability-related concerns informed interface simplification efforts.

This approach demonstrates that user acceptance evaluation can function as a practical design feedback mechanism rather than merely an assessment tool. By interpreting acceptance results in relation to specific system features and interaction flows, the development process moved beyond functional implementation toward usability-oriented refinement. This finding addresses a limitation in previous studies that report acceptance levels without translating them into concrete design actions.

The findings further demonstrate that user acceptance scores should not be interpreted solely as numerical indicators. Differences across features provide actionable evidence regarding which interaction models are most trusted, most usable, and most appropriate for community-based maternal health services.

To provide explicit evidence of how user acceptance findings informed system refinement, Table IV presents the relationship between evaluation outcomes and the corresponding design actions undertaken during system refinement. The mapping demonstrates how acceptance results were translated into practical design decisions, thereby supporting the role of acceptance evaluation as a structured feedback mechanism within the development process.

A limitation of this study relates to respondent selection, as user acceptance data were collected only from users who actively interacted with the system during the pilot deployment. This may introduce survivorship bias, since users who experienced difficulties or discontinued use at an early stage were not captured in the evaluation. Consequently, the reported acceptance scores may reflect more favorable perceptions than those of the broader target population. However, this design choice aligns with the study objective of deriving design-oriented feedback from actual system use. Future studies should incorporate early-stage and inactive users, broader deployment settings, and longer-term evaluations to better understand adoption barriers and sustained engagement.

Another limitation relates to the scope of the acceptance evaluation. The study focused on perceived usefulness and perceived ease of use as design-oriented acceptance constructs because the primary objective was to generate actionable feedback for system refinement. Behavioral intention, continuance intention, and actual usage behavior were not included, as the study was conducted as a district-level pilot deployment. Future research may incorporate these constructs to provide a more comprehensive assessment of long-term adoption and sustained system use.

In addition, the study was conducted using a relatively small sample of active users from a single district-level deployment. Therefore, the findings should be interpreted as context-specific evidence derived from a pilot implementation rather than as indicators of population-wide adoption readiness. Future studies involving larger and more diverse populations are needed to improve the generalizability of the findings.

F. Contribution to Mobile Health System Design

The findings demonstrate that user acceptance evaluation can serve a broader role than merely measuring post-deployment satisfaction. In this study, acceptance results were systematically interpreted as design-oriented evidence to support feature prioritization and refinement decisions. Features associated with high perceived usefulness, such as consultation routing and direct midwife interaction, were retained as core components of the system, while lower-scoring features such as automated conversational support were positioned as complementary rather than primary interaction channels.

The contribution of this study lies in demonstrating how user acceptance findings can be systematically translated into design refinement decisions during real-world deployment of a maternal health information system. Rather than treating acceptance solely as an evaluation outcome, the study provides empirical evidence showing how acceptance data can support feature prioritization, usability improvement, and context-aware system refinement in community-based healthcare settings.

TABLE IV
ACCEPTANCE FINDINGS AND DESIGN REFINEMENT ACTIONS

Acceptance Finding	Evidence from Evaluation	Design Refinement Action
Direct consultation with village midwives received the highest acceptance score	CFA2 = 4.41; SD = 0.52	Human-centered consultation was retained as the primary interaction channel and prioritized over automated interaction mechanisms.
Location-based consultation routing was highly accepted by users	CFA1 = 4.35; SD = 0.55	The routing mechanism was maintained as a core system feature to ensure continuity with existing maternal healthcare service structures.
Users reported positive but lower acceptance of automated conversational support	ACSA1 = 3.92; SD = 0.74	Automated conversational support was positioned as a complementary feature limited to preliminary information delivery rather than primary consultation.
Ease-of-use scores indicated room for interface improvement during early interactions	PEOU2 = 3.98; SD = 0.71	Navigation flow and interaction steps were simplified to reduce cognitive effort and improve first-time user experience.
Positive acceptance of overall system simplicity	PEOU3 = 4.22; SD = 0.60	Minimalist interface principles were retained to accommodate users with varying levels of digital literacy.

From an Informatics perspective, the developed system employs a centralized client–server architecture with location-based consultation routing and integration of automated conversational support through Dialogflow. These technical components were designed to support scalability across multiple service areas and facilitate communication between users and healthcare providers. However, the present study focused on user acceptance evaluation rather than technical performance assessment. Future studies may complement the current findings by examining system performance, scalability, interoperability, and security aspects under broader deployment conditions.

IV. CONCLUSION

This study demonstrates that integrating user acceptance evaluation into the design process of a mobile health information system provides actionable insights for system development in community-based maternal care settings, rather than treating acceptance solely as a post-implementation assessment. Perceived usefulness and perceived ease of use were employed as design-oriented feedback to guide feature refinement during a real-world district-level implementation, with consultation routing to local midwives perceived as highly useful and interaction simplicity strongly influencing ease of use. Automated conversational support was accepted as a complementary feature, reinforcing hybrid interaction models that preserve human-centered consultation while improving system responsiveness. Scientifically, the findings provide empirical evidence that user acceptance evaluation can function as a structured source of design feedback during system deployment and refinement. The study demonstrates how acceptance findings can support feature prioritization and iterative improvement of community-based maternal health information systems.

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