



Use of a mHealth System to Improve Antenatal Care: A Literature Review

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Abstract

Antenatal care, often known as ANC, is the foundation of programs assisting reproductive health. It is particularly significant in the field of maternal and child health because it offers services to pregnant women from the time of conception until the delivery of the baby. These services are designed to ensure a safe pregnancy and delivery, hence preventing difficulties. The problem of pregnancy difficulties unquestionably has a bad influence on both the mother and her fetus. As a result, it is the reason for the high maternal mortality rate (MMR) in Indonesia. Some of the complications that contribute to this rate include bleeding, eclampsia, complications during abortion, sepsis, and extended partus. By providing routine prenatal care and examinations to medical professionals, it is possible to save the lives of pregnant women who experience problems. Distance is one of the numerous elements that can function as a barrier, and there are many others. During this digitalization era, technology makes it possible to disseminate information to pregnant women to enhance antenatal care. One example of this is using mobile phones in health services, referred to as m-Health. This is a promising option to improve the health outcomes of both mothers and children. This research was conducted to conduct a literature review to assess the advantages of mobile health in enhancing antenatal care. This literature study technique was selected from January 2019 to January 2024. The study approaches chosen are randomized trials, pseudo-experiments, and cluster randomization, designed to adhere to specific inclusion and exclusion criteria. This study utilizes the PRISMA protocol. A thorough electronic search across many databases yielded 683 articles, with 274 from PubMed and 409 from Google Scholar. After independently obtaining and rigorously filtering publications, 6 studies were included in the review. Final Thoughts Based on the findings of the six chosen publications, a critical analysis was carried





out, and the conclusion reached was that MHealth is highly significant and beneficial in pregnancy care.

Keywords: mHealth, Improvement, Antenatal Care

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1. Introduction

Neonatal mortality and stillbirth are significant concerns in the realm of global health, particularly in low and middle-income countries (LMICs). A report published by the World Health Organization (WHO) in 2021 indicates that preventable maternal fatalities associated with pregnancy and childbirth claim the lives of over 800 women daily (Rambliere *et al.*, 2023). According to data obtained from the Sampling Registration System (SRS) in 2018, the labor and post-partum period they exhibited the highest incidence of maternal mortality in Indonesia (76%). This was followed by the stages of pregnancy (24%), labor (36%), and delivery (40%) in that order (Sutjiati and Feva, 2022).

By providing services to pregnant women from the time of conception to the time of delivery, antenatal care (ANC) offers a significant potential to reduce mother and infant mortality. This is done as part of an attempt to enhance health by ensuring that pregnant women have a healthy pregnancy and delivery. It is recommended by the World Health Organization (WHO) that pregnant women receive prenatal care for a minimum of eight contacts. Prenatal care encompasses a variety of services, including physical examinations, laboratory tests, health education, and counseling (Rai, Barik and Chowdhury, 2022). Antenatal care, often known as ANC, is helpful in that it helps to promote full-term deliveries with average birth weights. According to the available evidence, antenatal care can enhance the health of both mothers and their infants by delivering health education and health promotion and avoiding and managing potential health problems that may arise during pregnancy. The World Health Organization (WHO) has established recommendations stipulating that comprehensive ANC should incorporate high-quality medical services. These services should include screening tests, proper treatment, and health education (Amponsah-Tabi *et al.*, 2022).





Several factors have contributed to achieving the Sustainable Development Goal (SDG) of reducing maternal mortality, which has yet to be as successful as anticipated. Several factors contribute to a lack of information obtained, which in turn contributes to maternal and infant mortality and morbidity. Some of these factors include inadequate quality of care, inadequate access, disparities in socioeconomic status and race/ethnicity, inadequate allocation of national resources, and inadequate health system infrastructure. Because of this, it is essential to implement creative and effective measures to improve the health of mothers and infants and increase their chances of survival (Souza *et al.*, 2024).

In recent years, the digital age in technology has made it possible to provide information to pregnant women to enhance antenatal care. One example of this is using mobile phones in health care, referred to as m-Health. This is a promising option to improve the health outcomes for both mothers and children. As a potentially fruitful strategy for enhancing the health outcomes of mothers and infants, numerous individuals have advocated for the development of mobile health interventions, also known as mHealth. The obstacles to accessing health services can be overcome through mHealth technologies, which provide a convenient and cost-effective option (Mishra *et al.*, 2023).

In addition to being advantageous for pregnant women living in remote and rural regions, mobile health services are becoming increasingly popular in urban areas. These services allow pregnant women to interact with community health workers through online or telephone consultations, referrals, and appointment scheduling. Furthermore, mobile health technologies can be of assistance in the process of data collecting and the maintenance of correct health records (Arnaert *et al.*, 2019). Several mHealth interventions have been created to provide prenatal care. These treatments enable pregnant women to receive reminders and education and monitor their health status. According to studies, programs based on mobile phones and text messaging have been beneficial in boosting access to antenatal care, improving maternal and neonatal health outcomes, and reducing the stillbirths and deaths that occur in new-born (Atukunda *et al.*, 2021).

Several mHealth interventions have been created to the use of mobile health (mHealth) initiatives, such as short message service (SMS), voice messaging, notification





alerts through mobile apps, and interactive voice response system (IVRS), has been suggested as a means of enhancing the accessibility and quality of antenatal care. The development of pregnant women's knowledge through mobile health technology has been the subject of several trials that have been carried out nationwide and internationally among pregnant women to enhance the quality of prenatal health services. These treatments enable pregnant women to receive reminders and education and monitor their health status. According to studies, programs based on mobile phones and text messaging have been beneficial in boosting access to antenatal care, improving maternal and neonatal health outcomes, and reducing the stillbirths and deaths that occur in new-born (Mishra *et al.*, 2023). In light of this, the purpose of this research is to carry out a literature analysis in order to assess the advantages of mobile health in terms of enhancing antenatal care.

2. Research Method

This study is a literature review. Articles were chosen based on the selected theme from January 2019 to January 2024. The selected study methodologies included randomized trials, pseudo-experiments, and cluster randomization. This study's inclusion criteria consist of peer-reviewed, English and Indonesian-language, full-text articles that are openly accessible. The exclusion criteria include research presented in abstract form, limited information on study methods and outcomes, unclear findings, observational studies, literature reviews, case reports, editorials, perspectives, conference abstracts, comments, meta-analyses, and systematic reviews.

The study included pregnant women from the first trimester till delivery who received standard care, mHealth interventions, and smartphone applications. Various mHealth applications include antenatal health interventions, SMS, voice calls, voice messages, notification alerts via mobile apps, and IVRS. The primary outcome indicators included knowledge, attitude, behavior, and ANC visits. The study employed the PRISMA procedure.

3. Results and Discussion

a. Result





Pencarian Elektronik komprehensif dari berbagai database didapatkan total 683 artikel, from databased PubMed 274, google scholar 409, Duplicate records removed (n = 193), Article excluded based on title and abstract screening (n = 348), Excluded based on sample (n= 86), Excluded based on the outcome of interest (n= 41), Previously discussed articles (n= 8), Full-text assessed for eligibility (n = 7), excluded Other study method (n = 1), Total Studies included in the review (n = 6).

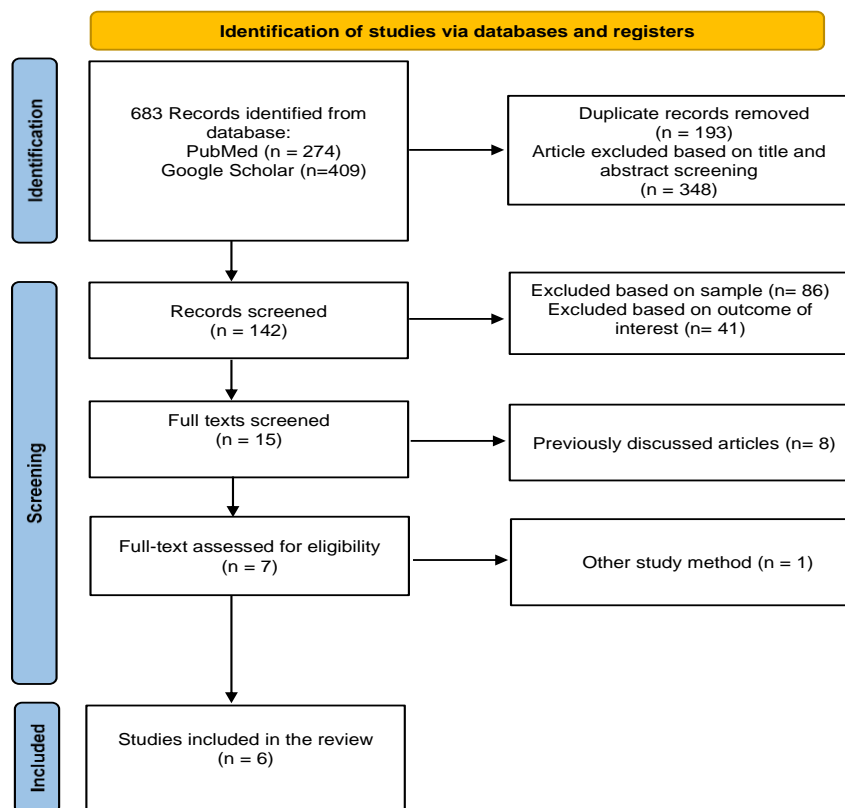


Figure 1. PRISMA Flowchart.

Table 1. Article Analysis





Author	Purpose	Population and sample	Intervention	Outcome	Study Design	Result
(Paduan <i>et al.</i> , 2022)	Carrying out research using the Panda system to investigate ANC visits among pregnant women	98 Pregnant Women	PANDA mHealth system.	Improving antenatal care	Non-randomized intervention trial	The PANDA system helps comprehend and remember the information presented, and the PANDA app has the potential to enhance the quality of ANC and positively influence the relationship between health personnel and pregnant women.
(Arnaert <i>et al.</i> , 2019)	Investigating women's experiences getting mobile health (mHealth) supported prenatal care.	19 Pregnant Women	Mhealth apps	Enhance services and enhance the understanding of pregnant women.	A qualitative study	The use of mobile health has the potential to improve women's understanding of their pregnancy and, as a result, encourage them to seek out additional antenatal care appointments.





(Sewpaul <i>et al.</i> , 2023)	An intervention using mobile health to increase attendance at prenatal appointments	412 Participant	Teen MomConnect	Utilizing mobile health technology to enhance health behaviors.	RCT	mHealth user satisfaction impacts behavior and adherence during prenatal visits.
(Osanyin <i>et al.</i> , 2022)	Evaluating the influence of a mobile phone-based voicemail strategy on antenatal care attendance	458 Pregnant Women	mHealth voice messaging	Increasing utilization of ANC services	experiment with a clustered randomization	The participants who were allocated the intervention were more likely to attend each of the eight ANC appointments.
(Zhang <i>et al.</i> , 2022)	To create a maternal early warning system to decrease avoidable maternal mortality throughout pregnancy and the postpartum period in high-risk women.	306 Pregnant Women	Maternal early warning system	To decrease maternal mortality during pregnancy and the postpartum period	Survei cross-sectional	The findings of this study can assist in the detection of deteriorating patient conditions, the prediction of morbidity in women who are at high risk, and the facilitation of prompt measures to safeguard against the possibility of severe disease.
(Afrizal, 2020)	This study aims to investigate	Seven participants	mHealth app	Prenatal care is prepared for the	Qualitative research	It has been determined through the





	<p>whether or not users involved in the antenatal care process are prepared to implement a pregnancy monitoring system based on mobile technology.</p>			<p>adoption of mobile health and the identification of potential obstacles to the introduction of mobile health.</p>	<p>analysis that pregnant women are prepared to use mobile health services. The preparedness of pregnant women to utilize mHealth is influenced by several elements, including social factors such as individual and environmental support and technical aspects.</p>
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b. Discussion

The provision of antenatal care is an essential component in ensuring that the pregnancy experience can be positive for every woman. Telemedicine and mobile health can play a significant part in enhancing the quality of care, and they are essential in determining the degree of quality that both patients and healthcare professionals perceive. Effective communication significantly boosts subject acceptance and satisfaction with maternity and newborn care. The provision of information that is both understandable and accessible is the initial step toward achieving mother satisfaction and awareness (Gamberini, Angeli and Ambrosino, 2022).

The findings revealed that four publications successfully met the inclusion criteria established beforehand. The article's findings shed light on the advantages of using mobile health in prenatal care. The PANDA mHealth system was found to help understand and remember the information provided. The PANDA application improved the quality of antenatal care. It positively influenced the relationship between health





workers and pregnant women, according to the findings of the first article, which was conducted by Paduano *et al* (2022), on 98 pregnant women. The trial was a non-randomized intervention trial to improve antenatal care.

ANC visits conducted using the PANDA system have been reported to have resulted in high levels of satisfaction among pregnant women. Women indicated that the health information they got during PANDA ANC visits was comprehensive and easy to comprehend. This was made possible by the graphical interface, which was both user-friendly and straightforward. This interface made it easier for health staff to communicate with patients, thereby addressing most of the language and literacy hurdles. Because of this, the PANDA emblem had a beneficial impact on their connection, which resulted in increased empathy between women and staff members in the healthcare industry (Paduano *et al.*, 2022).

Arnaert *et al* (2019) researched 19 pregnant women using a qualitative research approach, with the intervention of Mhealth apps as the study's outcome. The study's results on improving services and increasing the understanding of pregnant women showed that health can boost mothers' knowledge about their pregnancy and, as a result, drive them to attend more ANC visits. One of the benefits of mobile health is that it allows for digital communication to occur through many mediums. Through information technology, this system supports managing patient health remotely for medical personnel. Because its utilization does not necessitate direct interaction with medical workers, the availability of digital communication can potentially enhance patient satisfaction, particularly among pregnant women. The availability of applications that pregnant women can utilize is quite helpful when carrying their babies (Kusyanti *et al.*, 2022).

After doing research Sewpaul *et al* (2023) on 412 participants with the Teen MomConnect intervention, utilizing a randomized controlled trial study to improve health behavior, it was discovered that there was mHealth user satisfaction and that it improved behavior and compliance in antenatal visits. The use of mobile health (mHealth) therapies to deliver instructional, motivational, and behavioral content for





concerns such as quitting smoking, losing weight, and maintaining mental and sexual health is becoming increasingly common (Mahmood *et al.*, 2019). Short message service (SMS) text messaging has been demonstrated to favorably impact the number of prenatal appointments attended by pregnant women in low- and middle-income countries (LMICs) (Wagnew *et al.*, 2018).

The results of the study conducted by Osanyin *et al* (2022) on the impact of mobile phone-based voice messaging intervention on ANC use with mHealth voice messaging intervention in 458 women using a cluster-randomized experiment design were obtained. The results showed that participants who received the intervention were likelier to attend eight ANC visits. When it comes to providing care for pregnant women, MHealth is highly significant and necessary, yet it is unavoidable that some challenges must be overcome. One of them is the location of the geographical area (Kabongo *et al.*, 2021). Therefore, pregnant women who live in remote geographical locations and do not have access to transportation, as well as workers who have already given birth to children, have substantial obstacles when it comes to attending in-person appointments, which in turn affects their capacity to use these maternity services (Bekyieriya, Isang and Baguune, 2023).

The maternal early warning system can help detect deteriorating patient conditions, predict morbidity in high-risk women, and allow timely interventions to prevent the possibility of severe disease, according to a study that was conducted on 306 pregnant women with maternal early warning system interventions using a cross-sectional survey design (Zhang *et al.*, 2022). The program can help record the health information of pregnant mothers. Pregnant women can access antenatal care information, health personnel can handle examination data effectively, and consulting services can be provided through user-friendly software (Kusyanti *et al.*, 2022). There is a correlation between the quality of pregnancy services and the health status of pregnant women. These services aim to prevent difficulties and deaths during childbirth, as well as to promote the growth and health of the fetus (Souza *et al.*, 2024).





Afrizal (2020), stated that as a consequence of the intervention with the mHealth app, seven participants obtained results indicating that pregnant women were ready to use mHealth. Several elements influenced this readiness, including social factors such as individual and environmental support and technological considerations. It is becoming increasingly common for pregnant women to make use of mobile phone applications and social media platforms in order to have access to comprehensive health information and recognize potential hazards and warning signs during their pregnancy. Developing an application requires not only an analysis of the preparedness and requirements of users but also an analysis of the adoption of mobile health applications by users (Smith *et al.*, 2020). There is a correlation between the readiness of pregnant women to use information technology and their motivation to use a monitoring system based on information technology. In order to ensure that pregnant women are aware of the importance of utilizing mobile health applications to monitor service standards effectively and efficiently, it is necessary to promote awareness (Mohebi *et al.*, 2023).

An increasing amount of evidence shows that mHealth services are effective in enhancing traditional health services, especially in underserved communities. Mobile health technology (mHealth) can aid in quality data collection and enhance Antenatal Care (ANC) and Postnatal Care (PNC) services by offering a structured approach for health workers to carry out standardized visits following international and national protocols.

4. Conclusion

The conclusion that MHealth is highly significant and beneficial in pregnancy care was reached based on the findings of the critical evaluation carried out on the six chosen articles. However, it is indisputable that there will be several challenges that will be experienced. One of them is the location of the geographical area. Therefore, pregnant women who live in remote geographical locations and do not have access to transportation, have substantial obstacles when it comes to attending in-person appointments, which in turn affects their capacity to use these antenatal care services. Conversely, research indicates that telemedicine yields comparable results by enhancing patient contentment in





low-risk pregnancies and expanding the availability of specialized medical treatments for individuals in underserved regions. Knowledge and digital literacy will help successfully utilize mHealth in prenatal care. One issue with mHealth is that it is not universally accessible. Factors such as education level, inadequate infrastructure, and local government policies can hinder the implementation of mHealth in pregnancy care.

5. Compliance With Ethical Standards

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Disclosure of conflict of interest

There is no potential for any stakeholder to have a conflict of interest in this research.

Statement of informed consent

In our capacity as writers, every action we perform constitutes a joint agreement or consent.

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