

The Effectiveness of ANC Care Monitoring as an Innovation in Nursing Assistance in Improving Antenatal Examination Compliance in Pregnant Women

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ABSTRACT

Compliance with antenatal care (ANC) examinations at least six times during pregnancy remains a challenge in the Ambacang Padang Health Center working area due to limited information, distance, and low awareness of the importance of pregnancy monitoring, increasing the risk of pregnancy and childbirth complications. This study aimed to determine the effectiveness of the application-based nursing assistance innovation "ANC Care Monitoring" in increasing ANC compliance among pregnant women. A quasi-experimental one-group pretest-posttest design was used. The population comprised all pregnant women in trimesters I–III in the Ambacang Padang Health Center working area. A total of 42 respondents were selected using purposive sampling according to inclusion criteria. Data were collected using an ANC compliance questionnaire and visit observation sheet before and after an eight-week intervention. Univariate analysis used frequency distributions, while bivariate analysis used the Wilcoxon Signed Rank Test. The average age was 28.3 years. Before the intervention, 38.1% (16 respondents) were categorized as compliant, increasing to 83.3% (35 respondents) after the intervention. The Wilcoxon test showed $p=0.000$ ($p<0.05$), indicating a significant difference in ANC compliance before and after intervention. ANC Care Monitoring effectively improved ANC compliance. Integration into the KIA Puskesmas program is recommended for reminders, education, and ANC reporting.

Keywords: ANC Care Monitoring, Antenatal Compliance, Nursing Assistance

INTRODUCTION

Pregnancy is a physiological period that is accompanied by the potential risk of complications for the mother and fetus, so that health monitoring on a scheduled and ongoing basis becomes an absolute necessity in reproductive health services. Antenatal Care (ANC) examination is organized as an effort to monitor the health condition of the mother and fetus, provide health education, and early detection of risk factors and pregnancy complications so that they can be handled in a timely manner. This service is mandatory for first-level health care facilities as part of national maternal and child health efforts. Non-compliance with the antenatal examination schedule that has been set has the potential to cause delays in handling pregnancy risks that should be prevented (Bella, S. S. T., Keb, M. et al, 2025).

Historically, the trend of Maternal Health rate (MMR) in Indonesia shows unstable fluctuations from time to time even though various maternal health programs have been run by the government. Improving the achievement of AKI requires strengthening the upstream aspect, namely monitoring pregnancy from the first trimester to before delivery consistently. The government through the Ministry of Health has established various maternal and child health policies as an effort to accelerate the decrease in AKI, but its success depends heavily on implementation at the level of basic health facilities. Strengthening quality antenatal screening is considered as one of the most effective and efficient interventions in the effort (Khotimah, S., Sari, E. N., Sepiana, A., & Daughter, C. Y. N, 2024).

Integrated antenatal service standards in Indonesia require every pregnant woman to get a minimum of six visits during pregnancy, which includes physical examination, laboratory, administration of blood tablets, tetanus immunization, and health counseling. These standards are designed to ensure that every antenatal contact provides a real clinical benefit, not just the fulfillment of administrative visit numbers. Compliance with the visit standard is the main indicator of the quality of maternal health services in a Puskesmas working area. The discrepancy between the number of real visits and the established standards indicates obstacles on the part of pregnant women, health workers, and the service system itself (regulation of the Minister of health of the Republic of Indonesia number 21 of 2021).

At the national level, the achievement of complete antenatal visit coverage (K4) is still below the target set by the government. Based on the 2024 Indonesian Health Profile, the coverage of K4 pregnant women's health services nationally reached 80.12%, while the 2024 RPJMN target was set at 95%, so there is still a gap of 14.88 percentage points. In addition, the results of the 2023 Indonesian Health Survey (SKI) showed a gap in K4 coverage based on residence, namely 63.9% in rural areas and 71.2% in urban areas, and based on socioeconomic status, namely 52.7% in the lowest socioeconomic group and 75.7% in the highest group. The gap between regions is also quite wide, with K4 coverage ranging from 13.9% to 90%. This condition shows that accessibility and awareness of pregnant women is still a challenge in the equitable distribution of quality antenatal services. Therefore, additional interventions beyond conventional services are needed to improve antenatal visit compliance more thoroughly (Bakri et al., 2026).



West Sumatra province, especially the city of Padang as the center of government and economic activity of the province, also faced challenges in achieving the target of health services for pregnant women. The total population of Padang city, which reached more than 954 thousand people, demanded the availability of adequate primary health facilities, while the ideal ratio of the number of Health Centers to the total population has not been fully met in all districts. The high population density and mobility of urban communities is one of the challenges in maintaining the regularity of the use of pregnant women's health services. This demographic condition places the city of Padang as a relevant area for further study related to the effectiveness of pregnancy assistance strategies based on service innovation (Padang City Government/Padang City Health Office, 2024).

Data on antenatal service coverage in Padang City showed low achievement in the last reporting period, with coverage of K1 at 20.6%, K4 at 16.4%, and K6 at 21%, far below the expected monthly achievement target. This low achievement indicates that there are obstacles both in the reporting side of the service network and in the compliance side of pregnant women in completing their antenatal visit schedules. Padang City Health Office needs to strengthen the socialization of target data achievement to the entire network of health facilities so that reporting and monitoring of visits can run more accurately. This finding is one of the empirical bases that reinforces the urgency of research on ANC compliance in the Padang City area (Khotimah, S., Sari, E. N., Sepiana, A., & Daughter, C. Y. N, 2024).

The working area of Ambacang Padang Health Center is one of the primary health service working areas in Padang city that also faces similar dynamics in monitoring ANC compliance for pregnant women. Based on initial observations in the field, some pregnant women in this region tend not to complete the antenatal visit schedule completely due to busy daily activities, limited time, and lack of structured reminders from health workers after the first visit. Recording visits that are still manual also makes it difficult for health workers to monitor pregnant women who are at risk of not returning for the next examination. These field conditions reinforce the need for a more structured, accessible, and sustainable assistance system at the Puskesmas level.

Various factors can affect the pattern of pregnant women's compliance in antenatal visits, including the level of knowledge, family support, distance or travel time to health facilities, and employment status. Analysis of national health data in Indonesia shows that education level, employment status, travel time to health facilities, service location, and region of residence are related to completion of antenatal visits. Education was also found to be one of the factors most strongly associated with the completeness of antenatal visits (Sari et al., 2023). In addition, research in Indonesia shows that family knowledge and support, especially husband support, are related to the utilization of antenatal services and maternal compliance in undergoing treatment during pregnancy (Irianti & Karlinah, 2021; Erviana et al., 2025). In the context of the Ambacang Puskesmas work area, previous studies have also reported that K4 achievement has not reached the target and identified knowledge, employment, family support, and access to health care facilities as factors that can affect antenatal visits. This condition shows the importance of a

proactive and ongoing mentoring approach to help pregnant women maintain adherence to antenatal visit schedules.

Non-compliance with antenatal screening has a direct impact on the delay in handling high-risk pregnancy, which is one of the main causes of maternal mortality in Indonesia through the phenomenon of "three late", namely late recognizing danger signs, late reaching health facilities, and late getting treatment. These factors can actually be prevented if the danger signs of pregnancy have been detected early through regular antenatal examinations and quality. An early assessment of the danger signs of pregnancy is crucial so that high-risk conditions can be immediately handled by health workers before they develop into obstetric emergencies. Therefore, the role of active and ongoing assistance largely determines the success of such early detection (Ayuni & Sjaaf, 2023).

Assistance by cadres and health workers has been empirically proven to increase awareness of pregnant women about the importance of regular pregnancy checks, especially in pregnant women with high-risk conditions. Research conducted at Puskesmas Mejuwet Bojonegoro shows a significant relationship between the role of escort cadres and compliance with pregnancy screening in high-risk pregnant women. The assistance includes home visits, direct education, and regular reminders of scheduled visits to pregnant women. This evidence confirms that the presence of an active Companion plays an important role in maintaining the regularity of antenatal visits (Ayuni & Sjaaf, 2023).

Similar findings were also reported in the cadre assistance study on antenatal care visits for high-risk pregnant women at the Jelakombo Jombang Health Center, which showed that the intensity of assistance was positively correlated with the regularity of pregnancy check-up visits. Assistance that is carried out consistently allows cadres and health workers to monitor the progress of the condition of pregnant women and remind the schedule of the next visit personally. This interpersonal relationship-based approach is considered effective in building pregnant women's confidence in the importance of routine pregnancy checks. However, the success of this kind of conventional assistance is highly dependent on the availability and intensity of cadre visits in the field (Rahayu, D. T., & Askabulaikhah, A, 2020).

The limitations of conventional assistance are increasingly seen when there are restrictions on the mobility of cadres and health workers, so that home visits cannot be carried out optimally. This condition causes some pregnant women to lose access to routine assistance, which was previously one of the driving factors for compliance in conducting pregnancy checks. This shows that the pregnancy assistance system needs to have an alternative that does not rely entirely on direct physical contact. Therefore, it is necessary to innovate media-based assistance that is more flexible and able to reach pregnant women whenever needed (Susanti, E., 2020).

Based on this series of issues, it takes a form of nursing assistance innovation that is able to combine the strength of interpersonal relationships with the efficiency of nurses monitoring system that is more structured and easily accessible to pregnant women and health workers in the working area of Ambacang Health Center. Innovation "ANC Care Monitoring" is designed as a



medium for nursing assistance that allows monitoring of visit schedules, pregnancy education, and reporting of examination results more systematically than conventional assistance. This approach is expected to reduce the risk of missed antenatal visits due to the busy schedule of pregnant women and the limited reach of cadres in the field. Through this innovation, the role of nurses as the main companion is expected to be more optimal in supporting the regularity of pregnancy checks for pregnant women in the Ambacang Health Center working area.

METHODS

This study aims to determine the effectiveness of application-based nursing assistance innovation "ANC Care Monitoring" to increase compliance antenatal screening in pregnant women. The research design used was quasi-experimental with one group pretest-posttest design, in which the group of respondents was given an intervention without a comparison group, then compared the ANC compliance level before and after the intervention was given. The study was conducted in the working area of Ambacang Padang Health Center for eight weeks. The study population is all pregnant women in the first trimester-III registered and antenatal visits in the Working Area of the Health Center Ambacang Padang. A sample of 42 respondents were selected using purposive sampling technique based on inclusion criteria, namely pregnant women who are willing to be respondents, have and are able to operate a smartphone (smartphone) based on Android, domiciled in the working area of Ambacang Health Center during the study period, and do not experience severe pregnancy complications that require immediate referral. The exclusion criteria included pregnant women who moved domicile or stopped checking pregnancy in the work area of the Ambacang Health Center during the study period, as well as respondents who did not fill out questionnaires or observation sheets in full.

The research instruments used consisted of ANC compliance questionnaires that had been tested for validity and reliability to measure the knowledge, attitudes, and behavior of pregnant women's compliance with the pregnancy examination schedule, as well as visit observation sheets used to record the realization of antenatal visits of respondents before and after the intervention. The data collection technique was carried out through two stages, namely filling out questionnaires and recording initial visits (pretest) before the intervention, followed by providing nursing assistance interventions through the "ANC Care Monitoring" application in the form of reminders of visit schedules, pregnancy education, and monitoring the achievement of visits periodically by accompanying nurses for eight weeks, then ending with Re-measurement (posttest) using the same instrument. Data analysis was conducted in a univariate manner using frequency distribution to describe respondent characteristics and ANC compliance levels before and after the intervention, and bivariate analysis using Wilcoxon Signed Rank Test to examine differences in ANC compliance levels before and after the implementation of innovation. This study has taken into account the ethical principles of research which include an explanation of the objectives and procedures of the study to prospective respondents, the provision of informed consent signed voluntarily by respondents before data collection, guarantees of confidentiality and

anonymity of respondent data, as well as the right of respondents to withdraw from the study at any time without any consequences for the health services they receive at the Ambacang Padang Health Center.

RESULTS

1. Characteristics of Respondents

Characteristics of respondents in this study include age, education level, gestational age (trimester), parity, and employment status of pregnant women in the working area of the Ambacang Padang Health Center. An overview of the characteristics of the respondents is presented in the following table.

Table 1. Characteristics of Respondents (n=42)

Characteristics	Categories	f	%
Age	< 20 years	3	7,1
	20-35 years old	32	76,2
	> 35 years old	7	16,7
Education	Elementary (SD / SMP)	9	21,4
	High school (SMA / equivalent)	24	57,1
	Higher (Diploma / Bachelor)	9	21,4
Gestational Age	Trimester I	8	19,0
	Trimester II	17	40,5
	Trimester III	17	40,5
Parity	Primigravida	18	42,9
	Multigravida	24	57,1
Jobs	Works	19	45,2
	Not working / IRT	23	54,8
Total	Categories	42	100

Table 1 shows that the majority of respondents are in the healthy reproductive age group of 20-35 years (76.2%), with the highest level of education at the secondary level (57.1%). Most of the respondents were in the II and III trimesters of pregnancy (40.5% each), which indicates that the respondents have passed through several phases of ANC visits so that it is relevant to assess their level of compliance. Respondents with multigravid status were more numerous than primigravids (57.1%), while more than half of the respondents were not working or were housewives (54.8%).



2. Frequency Distribution of ANC Compliance Before and After Intervention

Table 2. Frequency Distribution of ANC Compliance Before and After Intervention (n=42)

ANC compliance	Before The Intervention (f)	Percentage (%)	After The Intervention (f)	Percentage (%)
Obedient	16	38,1	35	83,3
Disobedient	26	61,9	7	16,7
Total	42	100	42	100

Table 2 shows that before the intervention, only 16 respondents (38.1%) were in the category of compliance with the antenatal examination schedule, while 26 respondents (61.9%) were in the category of non-compliance. After being given nursing assistance intervention based on "ANC Care Monitoring" application for eight weeks, the number of respondents with obedient category increased significantly to 35 respondents (83.3%), while non-compliant respondents decreased to 7 respondents (16.7%). This change in distribution descriptively indicates a considerable improvement in antenatal screening compliance behavior, with an increase in the proportion of compliance by 45.2 percentage points after the implementation of the innovation.

3. The Effectiveness of Application-Based Nursing Assistance Innovation "ANC Care Monitoring" to Increase Antenatal Examination Compliance in Pregnant Women

Table 3. Wilcoxon Signed Rank Test Results For ANC Compliance Before and After Intervention

Comparison	N	Mean Rank	Sum of Ranks	Z	p-value
Negative Ranks (After < Before)	0	0,00	0,00		
Positive Ranks (After > Before)	19	10,00	190,00		
Ties (After = Before)	23	–	–		
Total	42			-4,359	0,000

Table 3 shows that there is a significant difference between the level of ANC compliance before and after the implementation of "ANC Care Monitoring" ($p=0.000$; $p<0.05$). A total of 19 respondents experienced an increase in compliance, no one experienced a decrease, and 23 respondents did not experience changes. Thus, H_0 was rejected and H_a was accepted, so it can be concluded that "ANC Care Monitoring" effectively improves ANC examination compliance in pregnant women in the working area of Ambacang Padang Health Center

DISCUSSION

The results in Table 2 showed that before the intervention, only 16 respondents (38.1%) of 42 pregnant women were included in the category of compliance with the antenatal examination schedule, while the majority of respondents, namely 26 people (61.9%) were in the category of non-compliance. This condition illustrates that before the implementation of the "ANC Care

Monitoring" innovation, more than half of pregnant women in the Ambacang Padang Health Center working area had not carried out pregnancy examination visits according to the minimum standards set. The low adherence rate at this early stage is an important starting point to see the extent to which application-based nursing assistance interventions are able to change these behavior patterns. The findings in the pretest phase are consistent with the general picture that is often found in various other Puskesmas working areas in Indonesia, where ANC non-compliance is still a recurring problem even though the maternal health program has been running for a long time.

Low ANC compliance before intervention can be explained through the theoretical framework of the Health Belief Model, which states that a person's health behavior is strongly influenced by the perception of vulnerability (perceived susceptibility), perceived severity, and the presence or absence of triggers to action (cues to action) that encourage a person to behave healthily. Before getting structured mentoring, pregnant women tend not to have strong enough triggers for action to consistently schedule antenatal visits, so compliance tends to be low. In the absence of active media reminders or assistance, the risk perception of the dangers of pregnancy often only arises after pregnant women experience complaints, not as part of a scheduled preventive awareness. This is in line with research that shows that the regularity of antenatal examinations is strongly influenced by the extent to which pregnant women have confidence in the benefits and susceptibility to pregnancy risks according to the principles of the Health Belief Model (Fanggi, W. A. V., Haning, F. L. A., & Adam, O. T, 2025).

The finding of low ANC compliance in this study is also in line with research conducted at the Rijali Health Center, which shows that the level of knowledge and attitude of pregnant women is significantly related to antenatal care visit compliance. Pregnant women with less knowledge of the importance of ANC tend to consider visits only necessary when certain complaints appear, not as part of ongoing efforts to prevent pregnancy complications. The similarity in the pattern of these findings reinforces the assumption that the issue of ANC non-compliance is not merely a matter of accessibility to health facilities, but also concerns the understanding and awareness of pregnant women on the benefits of routine pregnancy checks. Thus, interventions that only focus on providing services without active education and mentoring are at risk of not being able to significantly change compliance patterns (Asmin, Mangosa, Kailola, & Tahitu, 2022).

The factor of knowledge about the danger signs of pregnancy has also been shown to contribute greatly to the low adherence of the ANC to the initial conditions of this study. A systematic review of various studies in Indonesia shows that the level of knowledge of pregnant women about the danger signs of pregnancy is closely related to their compliance in carrying out antenatal care examinations. Pregnant women who do not understand the danger signs of pregnancy tend not to feel the need to re-visit regularly as long as they do not feel disturbing physical complaints. This condition also explains why most of the respondents in this study are still in the category of non-compliance before getting education and assistance through the application "ANC Care Monitoring" (Sari, E., & Ediyono, S, 2025).

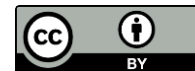


In addition to knowledge factors, pandemic conditions and changes in community activity patterns have also influenced the regularity of antenatal visits in various regions in Indonesia in recent years. Research on the determinants of behavior of pregnant women in conducting prenatal care shows that busy daily activities, time constraints, and concerns about risks in health facilities are the main inhibiting factors for the regularity of ANC visits. A similar pattern was also identified in this study, where some pregnant women admitted that they had difficulty managing the time for pregnancy check-up visits due to busy work and household affairs. The similarity of these conditions further confirms that the time and busyness factor remains a structural challenge that needs to be intervened through a more proactive and accessible reminder system (Bismihayati, S. K. M., et al, 2024).

Family support, especially husbands, is also one of the important determinants that affect ANC compliance as found in research related to the frequency of antenatal care visits during the pandemic. Pregnant women who do not get full support from their partner or family tend to have lower motivation to independently schedule routine pregnancy check-up visits. The low condition of compliance in the pretest phase of this study also indicates that social support factors have not been fully utilized as a driver of ANC compliance behavior in the Ambacang Puskesmas work area. This reinforces the importance of nursing assistance interventions that not only target pregnant women, but also involve families as part of the support system (Azizah, Ruslinawati, & Wulandatika, 2021).

After being given nursing assistance intervention based on "ANC Care Monitoring" application for eight weeks, the results showed a significant increase in the number of respondents with obedient category, from 16 respondents (38.1%) to 35 respondents (83.3%), while non-compliant respondents decreased from 26 people (61.9%) to only 7 people (16.7%). This 45.2 percentage point increase in the proportion of compliance showed a considerable change in behavior within eight weeks of the intervention. This change illustrates that the majority of respondents experienced a transition from non-compliant to compliant category after getting structured mentoring through the application. This overview of the results forms an important basis for further analyzing the mechanisms behind the success of such interventions.

This significant increase in postintervention ANC compliance can be explained through the cues to action principle in the Health Belief Model, where scheduled reminders, periodic education, and active monitoring from accompanying nurses serve as triggers for actions that encourage pregnant women to consistently meet antenatal visit schedules. Applications that provide notifications of scheduled visits regularly help pregnant women build new habits in monitoring the health of their own pregnancy. This change in behavior patterns is consistent with the finding that applying the principles of the Health Belief Model at a time that demands high alertness can significantly increase the regularity of K4 antenatal visits. The appropriateness of these findings reinforces that scheduled action trigger-based interventions are effective in changing ANC compliance behavior (Sartika, K. R, 2025).



The results of this study are also in line with the findings of a quasi-experimental study in the Special Region of Yogyakarta which showed that the use of pregnant women's health applications had a significant effect on increasing ANC knowledge and compliance in the intervention group compared to before the use of applications. The similarity in patterns of adherence improvement in both studies shows that digital application-based approaches are consistently able to improve the health behavior of pregnant women in different regional contexts. The educational and Reminder features in the application provide easier and more personalized access to information than conventional one-way counseling. This consistency of findings across regions reinforces the external validity that digital innovation deserves to be replicated in various other Puskesmas work areas with similar characteristics (Widyawati, Sumarah, & Pradjatmo, 2022).

The effectiveness of digital media as a means of pregnancy assistance was also confirmed by research on the effect of WhatsApp media use on pregnant women's knowledge and attitudes about pregnancy danger signs, which showed a significant increase after digital message-based interventions were given. Digital communication Media such as applications and instant messages provide easy access to information whenever needed without time and place restrictions, in contrast to conventional assistance that depends on the schedule of visits by cadres or health workers. This ease of access is one of the factors that supports the high level of compliance of respondents after the intervention in this study. This evidence reinforces the argument that digital transformation in maternity health services is not just a trend, but an evidence-based strategy that effectively improves health compliance behavior (Maulana, S., Nuraeni, A., & Saefulloh, M, (2022).

Research Lam et al. (2021) conducted a single disguised crossover randomized controlled trial on a community-based colorectal cancer screening program in Hong Kong, which compared groups that received reminders via WhatsApp with groups that did not receive reminders for faecal immunochemistry (FIT) test retrieval and return. The results of the study showed that the group that received the WhatsApp reminder had significantly increased compliance compared to the control group, with almost three times higher chances of compliance. The effectiveness of digital reminders in this international context has a common mechanism with the "ANC Care Monitoring" intervention in this study, which both utilize scheduled notifications through instant messaging applications to encourage adherence to health care schedules.

A systematic review of mobile health (mHealth) interventions in maternal and neonatal health services in Sub-Saharan Africa concluded that mobile technology-based interventions have consistently improved the coverage and quality of maternal health services, including the regularity of antenatal visits. The similarity of the results to studies in other developing countries provides strong scientific legitimacy that digital technology interventions are not only effective in a single research context, but have been consistently proven in a wide range of populations with diverse health accessibility challenges. The application of "ANC Care Monitoring" in this study can be viewed as a local adaptation of mHealth strategies that have been proven to be effective globally. This evidence reinforces the recommendation that the integration of digital technology



into Maternal and child health programs deserves to be expanded in various areas of Puskesmas work in Indonesia (Sartika, K. R, 2025).

The success of increasing ANC compliance in this study cannot be separated from the active role of nurses as companions who carry out regular monitoring through the application, in line with the findings that the role of companions both cadres and health workers is significantly related to compliance with antenatal care visits in pregnant women, especially in high risk groups. Personal and ongoing accompaniment allows a trusting relationship to be established between the pregnant woman and the companion, which in turn improves adherence to the health recommendations given. The digital mentoring Model in this study extends the range of nurse roles without having to rely entirely on physical home visits. Thus, this innovation can be viewed as an extension of the role of Community Nursing in a more efficient and affordable form (Ayuni & Sjaaf, 2023).

Although the majority of respondents showed an increase in compliance, there were still 7 respondents (16.7%) who remained in the non-compliance category after the intervention was given, indicating that digital applications alone are not fully able to overcome all ANC compliance barriers. Qualitative studies on facilitators and barriers to antenatal care attendance show that in addition to knowledge and reminder factors, structural barriers such as limited working time, domestic responsibilities, and certain geographical conditions remain barriers even though pregnant women have realized the importance of pregnancy screening. These structural barriers may also be experienced by a small percentage of respondents in this study who remained non-compliant despite receiving application intervention. These findings confirm that digital interventions need to be combined with other structural supports such as flexibility in service schedules and strengthening family support so that ANC compliance can be achieved more thoroughly

The results of this study are also relevant to the national regulation on integrated antenatal service standards, which stipulates that every pregnant woman is entitled to a minimum of six visits of pregnancy examination which includes physical examination, laboratory, administration of blood-addition tablets, immunization, and counseling. The improvement of ANC compliance through "ANC Care Monitoring" innovation in this study shows that the use of digital technology can be an operational strategy that supports the achievement of these standards at the primary service level. The alignment of the research findings with applicable policies reinforces the relevance and feasibility of this innovation to be adopted more widely by other Puskesmas facing similar challenges in achieving the ANC coverage targets. Thus, the results of this study are not only academically meaningful but also have applicative value for strengthening maternal and Child Health Service policies (regulation of the Minister of health of the Republic of Indonesia number 21 of 2021).

Researchers assume that a significant increase in ANC compliance in this study occurred because the "ANC Care Monitoring" application was able to overcome three main obstacles faced by pregnant women, namely limited information, lack of schedule reminders, and limited intensity

of health worker assistance due to high workload in Puskesmas. The combination of educational features, automatic reminders, and active monitoring by the accompanying nurse is believed to create a stronger synergistic effect than when only one component is applied separately. The researchers also assumed that the small number of respondents who remained noncompliant was most likely due to factors beyond the scope of the application, such as economic conditions, employment, or transportation barriers that are more structural and require cross-sector intervention. Therefore, the researcher views that the sustainability and replication of this innovation in the future needs to be integrated with the strengthening of referral systems and cross-program support at the Puskesmas level so that the benefits can be felt more evenly by all pregnant women in the Ambacang Padang Puskesmas working area.

The results of the Wilcoxon Signed Rank Test in Table 3 showed a Z value of -4.359 with a significance value of $p=0.000$ ($p<0.05$), which means that there is a statistically significant difference between the level of antenatal examination compliance before and after the application of the "ANC Care Monitoring" innovation. A total of 19 respondents experienced an increase in compliance status (positive ranks), no respondents experienced a decrease in compliance status (negative ranks = 0), while 23 respondents did not show a change in category (ties). The absence of respondents in the negative ranks group was an important finding that showed that this intervention did not cause negative effects or decreased compliance in any of the respondents during the study period. With a p value that is much smaller than the alpha value of 0.05, the null hypothesis (H_0) was rejected and the alternative hypothesis (H_a) was accepted, so it can be concluded that this application-based nursing assistance innovation is significantly effective in improving antenatal examination compliance in pregnant women in the working area of the Ambacang Padang Health Center.

The findings of statistical significance in this study are in line with Widyawati, et al (2022) who also used a pretest-posttest approach to examine the effect of the use of pregnant women's health applications on ANC compliance and found significant improvements after the intervention was given. The similarity in the pattern of results in these two studies, although conducted in different geographic regions and population characteristics, reinforces the external validity that digital application-based interventions are consistently able to change the behavior of pregnant women's adherence to the pregnancy examination schedule. The consistency of the results in these two different contexts also indicates that the mechanism of behavior change through digital applications is not coincidental, but rather reflects the effects of interventions that actually occur. This reinforces the belief that the results of research in the Ambacang Padang Puskesmas working area can be replicated in other Puskesmas working areas with similar characteristics (Widyawati, Sumarah, & Pradjatmo, 2022).

Similar results were also found in a study on the effectiveness of WhatsApp-based reminders on compliance with ANC visits for pregnant women in Bekasi regency, which showed a significant increase in compliance after administering the digital reminder intervention for several weeks. The similarity in the direction of the findings in these two studies confirms that the element



of scheduled reminders, both in the form of standalone applications and instant messaging, are equally effective in encouraging the regularity of antenatal visits. P values below 0.05 in both studies provide strong evidence that changes in postintervention ANC compliance are not due to chance factors, but the real result of the provision of stimulus reminders and structured education. The differences in the media used in these two studies also provide insight that the success of interventions is more determined by the consistency and regularity of monitoring, not just the type of technology platform used (Yuliani, F, 2025).

International evidence supports the findings of statistical significance in this study, as demonstrated by a randomized controlled study of the value of WhatsApp-based appointment reminders in improving attendance at community health screening, which resulted in significant differences between the group receiving reminders and the group not receiving reminders. This similarity in the direction of results across different international contexts of cultures and health systems suggests that the effectiveness of digital reminders on preventive health service compliance is universal and not limited to specific cultural contexts. Consistent statistical significance across multiple studies of similar design reinforces the generalization that scheduled reminder mechanisms are a strong determinant of Health Compliance behavior change. This is a solid scientific basis for the sustainability of the application of "ANC Care Monitoring" innovation as an evidence-based pregnancy assistance strategy (Yuliani, F, 2025).

The significance of changes in postintervention ANC compliance in this study can be explained through the cues to action principle in the Health Belief Model, which states that meaningful changes in health behavior occur when individuals receive consistent and sustained triggers for action. Notification reminders of scheduled visits received by respondents periodically through the application serve as an external stimulus that is statistically proven to be able to change the behavior of pregnant women from the category of disobedient to obedient. This action-triggering effect is consistent with research on the application of the Health Belief Model in adherence to ANC K4 visits during times of high alertness, which also found a significant relationship between the presence or absence of action triggers and the regularity of antenatal visits. The conformity between the statistical findings in this study with these theoretical principles reinforces the interpretation that the changes in compliance that occur are causal, not just correlations without a clear theoretical basis (Haning, Lada, Junias, Manafe, & Gero, 2022).

The significance value of $p=0.000$ in this study can also be interpreted through the Health Belief Model framework more broadly, where the regularity of antenatal examinations is strongly influenced by the perception of vulnerability, seriousness, benefits, and perceived obstacles of pregnant women to preventive health measures. Assistance through the "ANC Care Monitoring" application that provides regular education indirectly strengthens the perception of benefits and reduces the perception of obstacles that have been a barrier to ANC compliance. These perceptual changes are ultimately manifested in real, statistically measurable behavioral changes through the Wilcoxon test. The suitability of this change pattern with research on the application of the Health

Belief Model to the regularity of antenatal examinations of pregnant women also strengthens the theoretical validity of the bivariate test results in this study (Nisa & Rahmanindar, 2023).

The significance of the bivariate test results in this study is also reinforced by evidence from a systematic review of mobile health interventions in maternal and perinatal health services in low-and middle-income countries, which concluded that mHealth interventions consistently resulted in statistically significant improvements in maternal health outcomes in the various studies reviewed. The similarity of the findings in this global scale systematic review with the results of research in the Ambacang Padang Puskesmas work area shows that the effectiveness of digital technology-based interventions on ANC compliance is not an independent finding, but part of a larger and consistent pattern of scientific evidence in various developing countries. The consistency of the evidence across these studies gives additional scientific weight to the validity of the Wilcoxon test results obtained in this study. Thus, the results of this study can be viewed as a local contribution that strengthens the global body of evidence on the effectiveness of mHealth in pregnant women's health services (Jiang, Sun, & Li, 2023).

Additional evidence from a systematic review of mHealth interventions to improve maternal and neonatal care coverage and quality in Sub-Saharan Africa also showed a statistically significant pattern of improvement in various indicators of maternal health services after the implementation of interventions based on mobile technology. The similarity of the pattern of significance in other developing regions facing health accessibility challenges similar to Indonesia further reinforces the generalization that digital technology interventions are effectively applied in the context of limited resources. The significance of the results of the Wilcoxon test in this study is consistent with the pattern, showing that the limited resources of health workers can be overcome through the optimization of digital assistance technology. The appropriateness of this evidence in various developing country contexts reinforces the recommendation that the innovation of "ANC Care Monitoring" should be considered as a model of evidence-based intervention at a broader scale (Samosir, E., et al, 2024).

This significant change in bivariate test results can also be explained through self-efficacy theory, where increased knowledge and self-confidence of pregnant women through regular education in the application also contributes to statistically measurable increases in compliance. Pregnant women who have high self-efficacy tend to be more confident in their ability to independently organize and carry out the antenatal visit schedule as recommended. Research on the influence of maternal and Child Health Book media on the self-efficacy of pregnant women in the use of antenatal care also showed that increased self-efficacy contributed significantly to the improvement of behavior in the use of ANC services. The compatibility of this psychological mechanism with the Wilcoxon test results in this study reinforces the assumption that the "ANC Care Monitoring" application not only serves as a technical reminder, but also as a medium for strengthening pregnant women's self-confidence in maintaining their pregnancy health (Mandasari, Yusriani, & Patimah, 2021).



The significance of increasing ANC compliance in this study also reinforces the importance of the active role of Escorts, both in digital and personal forms, as found in research on the relationship of cadre roles to antenatal care visits in high-risk pregnant women which shows a significant relationship between the intensity of assistance and visit compliance. The application-based mentoring Model in this study can be viewed as a form of expanding the role of nursing assistants who are able to reach more pregnant women simultaneously without reducing the quality of personal interaction between nurses and pregnant women. The statistical significance obtained indicates that the hybrid mentoring model between digital technology and human interaction is more effective than conventional mentoring alone. These findings reinforce the urgency of developing the role of the community nurse as the main coordinator in the pregnancy digital assistance system at the primary service level (Ayuni & Sjaaf, 2023).

Although the results of the Wilcoxon test showed strong significance, the existence of 23 respondents in the ties category who did not experience changes in compliance status needs to be examined further, considering that part of this group is likely to be respondents who remain in the non-compliance category despite receiving intervention. Qualitative studies on facilitators and barriers to antenatal care attendance show that structural barriers such as limited working time and domestic responsibilities remain significant barriers even though pregnant women have received reminder-based and educational interventions. This condition indicates that statistical significance at the group level does not necessarily reflect success at the individual level as a whole, so the interpretation of the results needs to consider the variation of responses in each respondent. The implication is that digital interventions such as "ANC Care Monitoring" need to be supplemented with additional approaches that target structural barriers for groups of respondents who do not show changes (Nkurunziza, Merriel, Shamba, Pulford, Hamis, & Makene, 2023).

The significant bivariate test results in this study are also relevant to the mandate of the national regulation on integrated antenatal service standards, which emphasizes the importance of quality antenatal contacts as part of efforts to reduce maternal mortality. The statistical significance obtained shows that the innovation of "ANC Care Monitoring" can be one of the operational strategies that support the achievement of antenatal visit standards as mandated in the regulation. The alignment of the empirical evidence of the research results with the prevailing policy framework reinforces the feasibility of this innovation to be adopted more widely by other health centers that face the challenge of achieving similar ANC targets. Thus, the significance of the Wilcoxon test results in this study is not only statistically significant, but also has concrete policy relevance for strengthening maternal and Child Health Services (Regulation of the Minister of health of the Republic of Indonesia number 21 of 2021).

The significant findings in this study are also in line with quasi-experimental studies on the effectiveness of health education programs on the readiness of pregnant women to face childbirth, which used a similar pretest-posttest design and found significant differences after the provision of structured educational interventions. The similarity of the study design and the pattern of

significance of the results in both studies shows that educational interventions provided on a scheduled and ongoing basis are consistently able to produce statistically significant changes in the health behavior of pregnant women. The methodological consistency between this study and similar studies reinforces the reliability of the quasi-experimental one group pretest-posttest design as a valid approach for testing the effectiveness of nursing interventions in a population of pregnant women. This conformity also forms the basis for strengthening that the findings in this study have a solid methodological Foundation and can be scientifically accounted for (Astuti & Lestari, 2022).

Researchers assume that the significance of the results of the Wilcoxon test in this study indicates that the changes in ANC compliance that occur are not caused by chance or measurement bias, but are a real effect of providing application-based nursing assistance interventions consistently for eight weeks. The absence of respondents in the negative ranks Group reinforces the researchers' belief that the "ANC Care Monitoring" application is safe and does not have a counterproductive effect on the compliance behavior of any pregnant woman. The researchers also assume that the large number of respondents in the ties group likely reflects two different conditions, namely some respondents who have been compliant since the beginning so that they do not show additional changes, and another small number who remain non-compliant due to structural barriers outside the range of application. Therefore, the researchers view that the significant bivariate test results provide a strong foundation for the Ambacang Padang Health Center to adopt this innovation on an ongoing basis, noting the need for additional strengthening in the aspect of structural support for groups of pregnant women who have not shown changes in compliance.

CONCLUSIONS

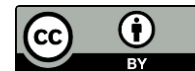
This study shows that ANC Care Monitoring innovation effectively increases antenatal screening compliance in pregnant women with an average age of 28.3 years. Before the intervention, the ANC compliance rate was recorded at 38.1% (16 people), and increased significantly to 83.3% (35 people) after the implementation of the intervention. The results of the bivariate test showed a value of $p=0.000$ ($p<0.05$), confirming the existence of a statistically significant difference between the level of ANC compliance before and after application use. The findings reinforce evidence that the use of digital technology based on reminders, education, and scheduled monitoring can be an effective strategy in encouraging the behavior of pregnant women's adherence to antenatal visit schedules, in line with evidence from various international studies on the effectiveness of digital reminders in preventive health services. Based on these findings, the integration of ANC Care Monitoring into the maternal and Child Health program (KIA) in Puskesmas is relevant to be considered as a media for schedule reminders, education, and reporting of routine ANC visits by cadres and health workers. Nevertheless, this study has a number of limitations that need to be a concern in interpreting the results as well as in further replication. Further studies suggest using experimental designs with control groups, larger and



more representative sample sizes, and longer monitoring periods, to strengthen external validity and ensure the effectiveness of ANC Care Monitoring more comprehensively before it is widely adopted in primary health care systems.

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