

Original Research Article

Evaluating the WhatsApp-based mMitra intervention: a hybrid tech-plus-touch approach for managing maternal anemia in Mumbai, India

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ABSTRACT

Background: Under the mMitra program, a pilot intervention was rolled out in Vasai Virar, Mumbai to understand the use of WhatsApp for delivering messages on anemia. It included health education videos, behavioral prompts, interactive quizzes, a helpline for support, and personal follow-up by community health workers (CHW). This study was a retrospective evaluation of the intervention to explore its potential role in supporting pregnant women with anemia.

Methods: Study included 287 pregnant women with hemoglobin (Hb) levels below 10 gm/dL, a gestational age of ≤ 30 weeks, and having received the eight-week intervention. The study descriptively measured message delivery and engagement rates, and changes in Hb levels. Feedback was collected from 64 women on recall of key messages, acceptability, and self-reported use of iron and folic acid (IFA). Institutional ethics review board approved the study.

Results: Approximately, 93.38% of women had high exposure to messages, 55.75% of the women had moderate anemia and 43.21% had mild to moderate anemia at enrollment. Total 244 women with follow-up Hb level data, 55.33% showed increase, but remained below 10 g/dL, 17.62% improved to 10-11 gm/dL, and 6.15% had anemia fully reversed. Having a personal phone was significantly associated with improved Hb levels ($p=0.030$). Feedback data showed 82.81% of women watched the entire videos and 73.43% made lifestyle changes related to diet and exercises.

Conclusions: The exploratory findings suggested the feasibility of a tech-plus-touch approach for managing maternal anemia, but larger studies are needed to prove its effectiveness.

Keywords: Maternal anemia, mMitra, Tech-plus-touch, WhatsApp

INTRODUCTION

The global prevalence of maternal anemia is estimated to be 38%, affecting approximately 32 million pregnant women worldwide.¹ As per the World Health Organization (WHO), India carries a disproportionate share of this burden. The prevalence is 49.7% among pregnant women compared to the global prevalence of 41.8% (WHO, 2008).^{2,3} The National Family Health Survey (NFHS-5, 2019-2021) reported a 55.3% prevalence of anemia among mothers.⁴ The WHO recommends a healthy diet to ensure a positive and healthy pregnancy experience.⁵

Despite sustained efforts from the public and private sector to improve maternal anemia, it remains a widespread nutritional issue.⁶ Conventional care methods often cannot offer quick interaction and assistance required for maternal anemia. The use of mobile health (mHealth) to enhance healthcare services, has emerged as important strategy for advancing maternal health including management of anemia.^{7,8} Due to its ease of use, WhatsApp in particular, has become a widely used tool for user-focused maternal health communication.⁹ Its multimedia features and nearly 2 billion active users have made it a popular tool for mHealth interventions globally.¹⁰⁻¹² WhatsApp based interventions have

demonstrated effectiveness in enhancing health-related knowledge.¹²

A study conducted in Chennai, India, found strong engagement with a text-based mHealth intervention for postnatal care. Most mothers read the messages regularly and found them useful for understanding their own and their newborn's health.¹³ The Noora Health Care Companion Program offered post-discharge assistance via WhatsApp and SMS to women who gave birth in tertiary healthcare facilities. This led to improvement in newborn care practices and a decrease in complications. Women who received advice through WhatsApp were more likely to adopt nutritional practices and adequate food intake, maintain their water intake, and avoid restriction of certain food.¹⁴ A separate evaluation of the mMitra mobile voice messaging among low-income women in Mumbai found improved behaviors such as the timely introduction of supplementary feeding, infant care practices, nutrition, and vaccination, and encouraging trends in infant birth weight.¹⁵

Few studies have examined the role of WhatsApp intervention for maternal anemia, but the role of CHWs in improving the user engagement and adherence to these platforms has not been thoroughly investigated.⁸ Closing these gaps would help build evidence for scalable, targeted digital interventions to address maternal anemia in India.

This retrospective study aimed to evaluate the feasibility, user engagement, and experience of women using WhatsApp for receiving maternal anemia messages. This study attempted to generate exploratory evidence to inform the scalable digital health solution for management of maternal anemia in India.

Intervention design

The mMitra core program

The mMitra, or mobile friend, a voice call program for MCH was launched in 2013 by ARMMAN to provide free voice call service. Targeted bi-weekly messages are sent directly to the phones of enrolled women in their chosen language (Hindi or Marathi) and time slot.¹⁶ Program has reached 2.47 million women across nine states through partnerships with 97 hospitals and 40 NGOs.¹⁷ Each 60 to 120 second call delivers standardized gestation-week wise health information on antenatal care, nutrition, danger signs, and childbirth preparation.

WhatsApp content and schedule for the pilot

Under the core program, a weekly WhatsApp message format was developed. Women who opted-in received six targeted multimedia messages a week on high-risk conditions. Failed messages were re-attempted for 28 days before being marked undelivered.

Home visits by CHWs

Women were identified and enrolled in the intervention by the CHWs with support from the Sanvi Foundation, Mumbai. The CHWs measured Hb using a hemoglobinometer at the time of enrollment. During the monthly follow-up visit, the CHWs remeasured Hb and repeated counseling messages. The details are shown in Figure 1.

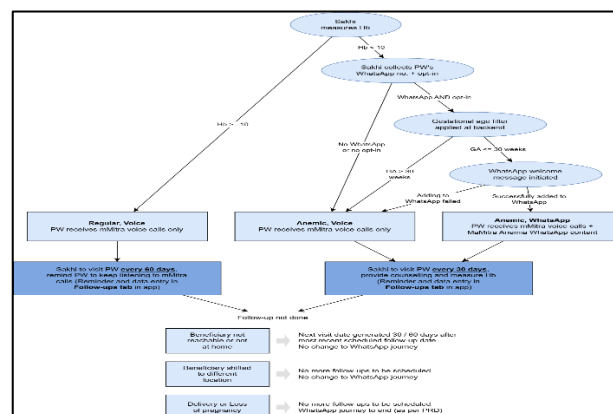


Figure 1: Detailed intervention design flow for sakhis.

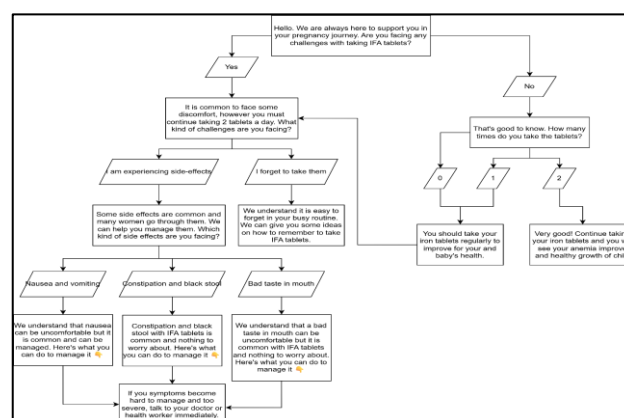


Figure 2: Nudgebot flow.

The intervention combined WhatsApp messaging (tech component) with in-person CHW support (touch component) to ensure consistent care. Multimedia content, behavioral prompts, and quizzes were disseminated via WhatsApp, complemented by in-person follow-up and counseling from CHWs. The design rationale draws on the premise that digital platforms deliver information quickly and at scale, while personal contact builds trust, adapts messages to local context, and sustains behavior change over time. Total 20 early user interviews were conducted to gather feedback. Anemia awareness, medication, danger signs, diet and lifestyle, mental health, and family environment emerged as gaps in understanding. Hence, content on these topics was prioritized for the WhatsApp pilot. Adherence to IFA was the most important factor; hence, two additional nudgebots were added, and the design was for 8 weeks.

Twice in the user's journey, at week 4 and week 8, a nudgebot, a chatbot flow to encourage IFA tablet consumption was sent. The detailed nudgebot flow is illustrated in Figure 2.

The content was validated by medical experts; quality was assured through CHW training and regular field visits. After enrollment, women received welcome messages and program offerings. The quizzes reinforced essential maternal health information through interactive learning. Each quiz covered subjects like anemia, medication compliance, warning signs, nutrition, mental health, and family setting. Questions were presented in Hindi and Marathi with multiple-choice answers, followed by concise explanations to clarify the correct responses. The messages provided actionable advice for behavior modification to achieve improved outcomes. A series of pre-set messages guiding users through interactive conversations to promote healthy behaviors were sent every other week to encourage specific actions such as adherence to IFA supplements.

Every 30 days, home visits were conducted by CHWs to ensure continued face-to-face engagement and health monitoring. A helpline number shared during onboarding and reinforced through nudges and automated WhatsApp replies gave women another channel for support. During the monthly follow-up visit, the CHWs measured Hb, provided counselling, and asked additional questions related to program feedback and engagement. The digital journey concluded with a closing message at the end of the eight-week intervention period.

METHODS

The purpose of this evaluation was to assess the feasibility, user experience, and engagement of the WhatsApp-based mMitra pilot. Feasibility was defined as women receiving the messages, having access to smartphones and internet, and willingness to participate if they use WhatsApp. The changes in Hb levels, self-reported lifestyle modifications, medication adherence, and uptake of advice communicated through WhatsApp messages were examined. Given the exploratory nature of the study, the analysis was not designed to establish causal relationships between the intervention and outcomes. The intent was to generate exploratory real-world evidence on feasibility and engagement patterns to inform larger, adequately powered studies.

Intervention site

The pilot was conducted in Vasai-Virar from September 2024 to March 2025 in a community that had small households with single-room units and basic amenities such as a kitchen, toilet, and essential appliances. The houses were generally accessible by foot from the main road, and the women were well integrated within the local community.

Sample size

All 287 women who were enrolled in the WhatsApp-based mMitra pilot program were part of retrospective study. Anemia readings were unavailable for 43 women. As a result, these women were excluded from analysis on anemia. For remaining 244 women, 3-4 follow-up visits were made to examine their Hb levels and adherence to IFA tablets. Data was collected through an app developed by ARMMAN on which the CHWs were trained.

In addition, feedback was collected from a convenience sample of 64 women, drawn from the cohort of 287 to assess how acceptable and useful they found the WhatsApp messages. These women were engaged during their regular appointments and were asked a set of standardized questions regarding their video viewing experiences, their ability to recall important topics, and their self-assessment.

Inclusion and exclusion criteria as per the intervention

Newly identified pregnant women with Hb<10 gm/dl, gestational age up to 30 weeks on the day of pilot enrollment, provided informed consent to participate in the pilot intervention, WhatsApp installed on their phone or secondary phone number, and provided opt-in permission to receive mMitra messages on WhatsApp were included. Women who did not provide consent and were >30 weeks pregnant were excluded from the pilot intervention as women nearing delivery would not benefit from the content of the intervention.

Ethical code of conduct

This was a retrospective study using secondary data from the mMitra program. The dataset was devoid of any personal identifiable information (PII) such as name, address, and phone numbers. Confidentiality was maintained throughout data collection from backend, storage, and analysis processes.

Prior to their inclusion in the program, informed consent was obtained from all women. They received comprehensive details in simple language about the mMitra program, its objectives, procedures, and the voluntary nature of their involvement. Women were informed that they are free to withdraw at any time and their healthcare services were not affected. They were also told their anonymized data would be used for evaluation and program improvement. All the information was confidential and maintained in accordance with public health reporting practices.

Analysis

Analysis was done in STATA, version 18.5. Descriptive statistics using frequency and percentages are reported. Fisher's exact test was used to analyze categorical associations for selected small groups.

RESULTS

Participant characteristics

Table 1 shows that the women were moderately educated, with 30.66% having completed standard 12. The sample primarily consisted of younger pregnant women, with 41.81% being in the age group of 21-25 years. Socioeconomic data revealed that 48.78% of the women came from lower income households earning between INR 15,001 to INR 20,000. Almost all participants (98.61%) had a phone. Most were Hindu i.e. 94.43%. Just over half (52.96%) were first-time mothers, and 63.76% were in their second trimester at enrollment.

Table 1. Participant characteristics (n=287).

Participant characteristics	Frequency (%)
Education	
9 th or lower	68 (23.69)
10	69 (24.04)
12	88 (30.66)
Graduation	62 (21.60)
Age in years	
19-20	18 (6.27)
21-25	120 (41.81)
26-30	101 (35.19)
31-35	39 (13.59)
35+	9 (3.14)
Income (INR)	
5001-10000	1 (0.34)
10001-15000	76 (26.48)
15001-20000	140 (48.78)
20001-25000	38 (13.24)
25001-30000	30 (10.5)
30000-999999	2 (0.69)
Phone ownership	
Husband	4 (1.39)
Woman	283 (98.61)
Religion	
Hindu	271 (94.43)
Muslim	15 (5.23)
Tribal	1 (0.35)
Parity	
0	152 (52.96)
1-2	128 (44.59)
3 or more	7 (2.44)
Trimester	
First	99 (34.49)
Second	183 (63.76)

Parity and age-wise engagement levels

The engagement was measured as women's responses to quizzes delivered via WhatsApp and calculated as quizzes

responded/quizzes received. As per the intervention, no engagement meant no interaction, low engagement meant less than 25% of the quizzes answered, medium engagement meant those who responded between 25-75% and high engagement as more than 75% of engagement. The level of engagement was an indirect measure of active involvement and did not account for activities like watching videos or reading messages without engaging in quizzes.

Engagement varied by parity. The study found that non-engagement (43.75%) was common among women who had one or two children and those with three or more children (42.86%). Medium engagement was similar across all parity groups, ranging from 25% to 29%.

Table 2 shows age-stratified analysis that revealed a declining trend in engagement with increasing age. Women in the age group of 19-20 years (55.56%) had medium engagement with the content.

Education-wise engagement levels

Engagement levels were comparable across education with similar proportions showing low and medium engagement category (Table 3). The findings did not show any clear pattern by education.

Given the modest sample size and pilot-stage nature of the analysis, this result is interpreted as preliminary rather than conclusive. A Monte Carlo estimate of the Fisher's exact test confirmed no statistically significant association between education level and engagement ($p=0.966$). This was consistent with the chi-square result ($\chi^2=4.89$, $df=12$, $p=0.961$).

Exposure and engagement

WhatsApp messages reached 93.38% of women indicating high exposure, defined as 80-100% of messages received (Table 4). Despite this, engagement levels varied. Approximately 36.24% of the women did not engage with the content, while 54.70% of women showed low to medium engagement.

Topic wise messages and quiz interactions

Quiz response rates reflected deeper engagement with content. Quizzes focusing on medication, diet, and danger signs had higher response rates of 27%, 26%, and 23%, respectively. Topics like mental health and family received lower response rates, approximately 15% to 16%. These patterns indicated that women prioritized immediate health risks over more general psychosocial issues.

Table 2: Age-wise engagement levels (n=287).

Engagement	Age in years				
	19-20 N (%)	21-25 N (%)	26-30 N (%)	31-35 N (%)	35+ N (%)
No engagement	3 (16.67)	38 (31.67)	41 (40.59)	17 (43.59)	5 (55.56)
Low (<25%)	4 (22.22)	35 (29.17)	31 (30.69)	9 (23.08)	1 (11.11)
Medium (25-75%)	10 (55.56)	33 (27.50)	24 (23.76)	8 (20.51)	2 (22.22)
High (75-100%)	0 (0.00)	7 (5.83)	3 (2.97)	4 (10.26)	0 (0.00)
N/A	1 (5.56)	7 (5.83)	2 (1.98)	1 (2.56)	1 (11.11)

Table 3: Education wise engagement level (n=287).

Engagement rate	Education			
	9 th grade or below, N (%)	10 th pass, N (%)	12 th pass, N (%)	Graduate or higher, N (%)
No engagement	23 (33.82)	27 (39.13)	35 (39.77)	19 (30.65)
Low (<25% engagement)	20 (29.41)	16 (23.19)	24 (27.27)	20 (32.26)
Medium (25-75% engagement)	19 (27.94)	18 (26.09)	24 (27.27)	16 (25.81)
High (75-100% engagement)	4 (5.88)	4 (5.80)	2 (2.27)	4 (6.45)
N/A	2 (2.94)	4 (5.80)	3 (3.41)	3 (4.84)

Table 4: Overall exposure rates (n=287).

Exposure	Frequency (%)
N/A	4 (1.39)
Low (0-50%)	11 (3.83)
Medium (50-80%)	4 (1.39)
High (80-100%)	268 (93.38)
Engagement	
N/A	12 (4.18)
No engagement	104 (36.24)
Low (<25%)	80 (27.87)
Medium (25-75%)	77 (26.83)
High (75-100%)	14 (4.88)

Table 5: Hb status at enrollment (n=287).

Hb Range (gm/dl)	Frequency (%)
Less than 7	3 (1.05)
7-8.9	160 (55.75)
9-10	124 (43.21)

Table 6: Trimester wise Hb status at enrollment.

Hb Range (gm/dl)	First Trimester (n=99)	Second Trimester (n=183)	Third Trimester (n=5)
Less than 7	2 (2.02)	1 (0.55)	0 (0.00)
7- 8.9	43 (43.43)	117 (63.93)	0 (0.00)
9- 10	54 (54.55)	65 (35.52)	5 (100.00)

Hb status at enrollment

Table 5 shows that most women (55.75%) had moderate anemia with Hb levels ranging from 7-8.9 gm/dl, and 43.21% had mild to moderate anemia with Hb levels

between 9 and 10 gm/dl. Only 1.05% of the participants were severely anemic (Hb<7 gm/dl). Hb level analysis stratified by trimester indicated that maternal anemia was present in all women regardless of trimester (Table 6).

Change in Hb levels (as per last available value)

Among the 244 women that could be followed up, overall, 79.09% showed improvement between enrollment and follow-up (Table 7). Of the 244 women, 20.90% showed no increase in Hb, 55.33% showed an increase but remained below 10 gm/dl, 17.62% improved to 10-11 gm/dl, and 6.15% had anemia fully reversed with Hb>11 gm/dl. The findings also showed about 66.80% (n=163) women consumed the recommended two tablets of IFA daily, and 27.86% (n=68) took one tablet daily. The combined tech-plus-touch approach of the pilot with nudges to take IFA tablets and the home visits by CHWs served as reminders for adherence and self-care.

Table 7: Change in Hb levels (n=244).

Hb outcome (mutually exclusive categories)	N (%)
No increase in Hb	51 (20.90)
Hb increased but remained below 10 gm/dl	135 (55.33)
Anemia improved, reached 10-11 gm/dl	43 (17.62)
Anemia reversed, Hb>11 gm/dl	15 (6.15)

Note: Categories are mutually exclusive. Percentages are calculated among women with last available Hb reading (n=244).

A total of 43 women were excluded from the above analysis because they could not be followed-up likely due to migration or their absence during follow-up visits by the CHWs. Most of these women had high exposure to

the intervention, with 90.70% reporting 80-100% exposure. However, 39.53% showed no engagement and 27.91% showed medium engagement. Most of them (69.76%) were between 21-30 years of age, and most were primigravida (67.44%). Educational status showed 27.91% had completed 10th standard, 25.58% had completed 12th standard, and 27.91% had a graduate degree. Most of the women were Hindu (95.3%). Regarding the pregnancy stage, over half of them were in the second trimester (51.16%), followed by the first trimester (44.19%). At registration, 55.81% women had Hb levels between 9 and 10 gm/dl and 44.19% had Hb levels between 7-8.9 gm/dl. A total of 74.42% consumed IFA tablets twice daily and 20.93% consumed them once daily.

Changes in Hb levels according to mobile phone ownership

Among the 240 women who personally owned the phone, 80.00% showed an increase in Hb. Fisher's exact test showed significant results ($p=0.030$). This suggests personal phone access supports more consistent, private exposure to health information. However, the retrospective design and lack of a control group rule out causal claims.

Table 8: Change in Hb by phone ownership (n=244).

Phone owner	Hb increased, N (%)	Hb not increased, N (%)	Total
Woman	192 (80.00)	48 (20.00)	240
Husband	1 (25.00)	3 (75.00)	4

Fisher's exact test, $p = 0.030$. Note: Analysis restricted to women with follow-up Hb data (n=244); Fisher's exact test was used due to small numbers in the husband-owned phone group (n=4).

Analysis on phone ownership and engagement level was also not statistically significant, fisher's exact test showed $p=0.58$. However, there were only four women who shared phone with their husband, so the results should not be read as evidence that no relationship exists. Larger studies with better representation of women who do not have personal phone are needed to clarify whether phone ownership affects engagement.

Feedback on WhatsApp

Among the 287 women, 64 women were purposively chosen to gather feedback on value of WhatsApp. It was observed that 98.43% (n=63) received anemia related videos and 82.81% (n=53) said they watched the entire content. Approximately 39.06% (n=25) remembered that the messages were delivered via the mMitra WhatsApp service, and 98.43% (n=63) of women recalled key topics such as signs and symptoms, danger signs, nutrition, the significance of IFA tablets, mental health, and family support.

Total of 71.87% (n=46) of women said they made lifestyle changes such as self-care and eating more iron rich foods. Common challenges were observed for non-adherence to IFA tablets and these included side effects, forgetfulness, or lack of awareness.

About 45.31% (n=29) and 53.12% (n=34) of women expressed that they 'always liked' and 'somewhat liked' the videos, respectively. A total of 32.81% (n=21) shared or discussed the videos with their husbands, and 68.75% (n=44) had participated in some quizzes on anemia.

Overall, women valued the WhatsApp messages and the videos on anemia as they were useful, easy understand and could be accessed at a convenient time. Some women emphasized the useful information on blood/anemia as it guided them on how to improve Hb suggesting that the content had direct perceived relevance.

DISCUSSION

This analysis drew on 287 women enrolled in a WhatsApp-based pilot intervention delivered within a community setting in Mumbai. The findings suggested that a WhatsApp-based tech-plus-touch model is feasible in a community setting and reaches young, moderately educated women effectively. More than 90% of participants had high exposure to the intervention suggesting strong technical delivery. Women found WhatsApp as a suitable and effective channel for raising awareness, driving engagement, and encouraging positive health behaviors.

Age and parity wise engagement data indicated that behavior, previous experience and life-stage aspects might have played a role in engagement than education alone. The study recommends that WhatsApp-based interventions in similar populations require content that is simple to understand. Engagement had declined with parity, but medium engagement was similar across parity groups (25-29%). This pattern further suggested that although active quiz participation was lower among multiparous women, a subset may still have engaged with the WhatsApp content in a more passive manner such as reading messages without completing quizzes.

This study showed that direct access to personal phones facilitated more convenient and timely receipt of messages and strengthen women's involvement in their health-related decisions. The findings also suggested that gender equity components may require consideration in future program design. Research from 15 countries indicated that phone ownership alone had significant impact on uptake of certain maternal and child health interventions.¹⁸

Overall, 79.09% showed improvement in Hb levels between enrollment and follow-up. Nearly 66.80% of participants reported taking two IFA tablets daily. These patterns were broadly consistent with findings from

comparable studies that showed increase in Hb levels, improvement in knowledge of anemia in pregnancy, improvement in dietary iron intake, and behavior towards adherence to iron supplementation ($p < 0.001$).¹⁹

The study observed that Hb level data for 43 women were not available. The study acknowledges that shorter duration of the assessment was insufficient to capture the women's journey, their nine months long lifestyle changes, sustained behavior changes, and assess full reversal of maternal anemia. A thorough nutritional assessment was not part of the program, so, we could not assess whether all women consumed iron-rich foods. This was a simple evaluation of the pilot intervention, and no control group was used to isolate the intervention's effects from other factors. The study targeted women with Hb < 10 gm/dl in a community setting in Mumbai, therefore, our findings may not be applicable to all pregnant women enrolled in hospital-based studies and those without smartphone access, limited familiarity with digital tools, and restricted personal phone use. External medical care or pre-existing co-morbidities could have impacted Hb results, but these were not part of the intervention. The intake of IFA was self-reported and not supervised by CHWs.

CONCLUSION

The evaluation pointed to several opportunities for improving future implementations. Multiparous women may need targeted strategies to boost interactivity. Engagement formats beyond quizzes, a longer support period, and more interactive content could also help.

Overall, the mMitra WhatsApp pilot reached most women effectively. It was linked to improved hemoglobin outcomes and strong IFA adherence among at-risk pregnant women in Mumbai. Personal phone ownership stood out as a factor that requires further investigation. Larger studies with a comparison group are needed to confirm causal effects before scaling WhatsApp-based anemia interventions in community.

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