International Journal of Medical and Health Research
www.medicalsciencejournal.com
ISSN: 2454-9142
Received: 29-07-2026, Accepted: 28-08-2026, Published: 12-09-2026
Volume 12, Issue 3, 2026, Page No. 89-94

Effectiveness of a QR-code-integrated self-instructional kit for improving birth-safety knowledge among antenatal mothers: A one-group pretest-post test study

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DOI: https://doi.org/10.66856/ijmhr.2026.12.3.12087

Abstract
Background: Birth preparedness, recognition of obstetric and newborn danger signs, and timely care-seeking are central to safe motherhood. Brief digital reinforcement may extend the reach and repeatability of routine antenatal education.
Objective: To evaluate the effectiveness of a QR-code-integrated self-instructional kit in improving knowledge regarding birth-safety measures among antenatal mothers attending an antenatal outpatient department.
Methods: A one-group pretest-posttest study included 60 antenatal mothers selected by purposive sampling at SVS Hospital, Mahabubnagar, and Telangana. Participants completed a structured 30-item knowledge questionnaire, received a printed self-instructional kit supplemented by a QR-linked educational video, and completed the same assessment one week later. Knowledge was classified as inadequate (<50%), moderately adequate (50-74%), or adequate (>=75%). Paired t testing evaluated change in continuous scores, an exact paired sign test assessed the categorical direction of change. Exploratory chi-square associations were re-evaluated with exact p values and Holm adjustment for multiple comparisons.
Results: Mean knowledge increased from 9.83 +/- 1.74 to 22.22 +/- 2.10. The reported paired mean difference was 12.38 points (95% CI 12.25-12.51), t(59)=195.64, p<0.001. All participants were in the inadequate category at pretest, at posttest, 34 (56.7%) were moderately adequate and 26 (43.3%) were adequate. The exact sign test confirmed a uniform direction of improvement (p<0.001). Education and gravida showed nominal unadjusted associations with posttest knowledge category, but neither remained significant after Holm correction. A favourable birth-safety classification was recorded for 52/60 participants (86.7%, 95% CI 75.8-93.1%).
Conclusion: The QR-code-integrated self-instructional kit was associated with a large immediate improvement in birth-safety knowledge. The format is a practical adjunct to nurse-led antenatal counselling, while controlled studies with prespecified clinical outcomes are required to determine effects beyond short-term knowledge acquisition.

Keywords: Antenatal education, birth preparedness, complication readiness, maternal health, QR code, mHealth, patient education

Introduction

Maternal and newborn safety depends not only on access to clinical services but also on timely recognition of risk and appropriate use of those services. The most recent global estimates indicate that maternal mortality remains heavily concentrated in low- and lower-middle-income settings, with preventable deaths continuing to occur during pregnancy, childbirth, and the postpartum period [1]. India has made substantial progress; the latest Sample Registration System bulletin for 2022-24 reports a national maternal mortality ratio of 87 per 100,000 live births, while important state-level differences persist [2]. The neonatal period remains similarly vulnerable, with prematurity, intrapartum complications, infection, and congenital conditions accounting for a large share of deaths in the first month of life [3].

Antenatal care provides a structured opportunity to identify maternal and fetal risks, provide preventive interventions, prepare families for childbirth, and strengthen care-seeking. The World Health Organization recommends a positive-pregnancy-experience model based on repeated contacts and person-centred counselling [4]. This continuum extends to respectful intrapartum care [5] and postnatal care that supports maternal recovery, breastfeeding, newborn assessment, and early recognition of complications [6]. Within this continuum, birth preparedness and complication readiness (BPCR) operationalizes practical planning for place of birth, skilled attendance, transportation, finances, emergency referral, blood-donor arrangements when relevant, and recognition of maternal and newborn danger signs.

Indian evidence demonstrates that knowledge and preparedness remain uneven. A 2024 systematic review and meta-analysis of 35 Indian studies estimated that approximately half of pregnant or recently delivered women were aware of BPCR components, with substantial heterogeneity and particularly important gaps in danger-sign knowledge [7]. Recent mixed-methods work from rural Gujarat also showed incomplete recall and comprehension of obstetric danger signs despite contact with maternity services, emphasizing the need for tailored counselling and family-centred health literacy [8]. A study from Rajasthan found that educational status, antenatal attendance, and gravida were associated with danger-sign knowledge [9], while community-based data from rural Delhi similarly identified incomplete implementation of birth-preparedness practices [10]. Earlier facility-based work in Delhi demonstrated that identification of a skilled attendant was

more common than recognition of danger signs or completion of transport and financial arrangements [11].

Routine verbal counselling is essential, but its effect may be constrained by limited consultation time, variable health literacy, information overload, and dependence on recall after the visit. Self-instructional material can standardize core messages and allow repeated review. A QR code adds a low-cost digital layer by linking printed material to video or other multimedia content without requiring a dedicated application. This hybrid approach may be especially suitable for antenatal education because the printed component remains available when connectivity is limited while the digital component can reinforce demonstrations and key warning signs.

The present study therefore evaluated a QR-code-integrated self-instructional kit on birth-safety measures among antenatal mothers attending the antenatal outpatient department of SVS Hospital, Mahabubnagar. The primary objective was to determine change in knowledge from pretest to one-week posttest. Secondary objectives were to describe post-intervention knowledge categories, explore associations between knowledge and selected maternal characteristics, and summarize the recorded birth-safety classification.

Methods

Study design and setting

A quantitative one-group pretest-posttest study was conducted in the antenatal outpatient department of SVS Hospital, Mahabubnagar, Telangana, India. The study report describes data collection from 29 November 2025 to 15 December 2025. A pilot study was conducted at Susrutha Hospital, Mahabubnagar, before the main study. The design can be represented as O1-X-O2, where O1 denotes baseline knowledge assessment, X the educational intervention, and O2 the one-week posttest.

Participants and sampling

Sixty antenatal mothers were selected using non-probability purposive sampling. The stated eligibility criterion specified antenatal mothers between 32 and 36 completed weeks of gestation attending the selected antenatal clinic, willing to participate, able to access the approved educational material, and available for both assessments. Women requiring immediate management for severe illness or obstetric emergency, those previously exposed to the same study intervention, and those unable to complete the protocol were excluded.

Intervention

After the pretest, participants received a structured self-instructional kit written in simple language. Content covered antenatal follow-up, birth preparedness and complication readiness, selection of place of birth and skilled birth attendance, transport and emergency planning, maternal danger signs, fetal and newborn danger signs, nutrition and prescribed supplements, preparation for labour, postpartum safety, breastfeeding, essential newborn care, and timely referral. The innovation component was a QR code linked to a short educational video reinforcing the same core messages. Participants could revisit the printed and digital content during the one-week interval before posttesting.

Study instruments and scoring

The data collection package comprised a demographic and obstetric proforma, a structured knowledge questionnaire, and a birth-outcome checklist. The knowledge questionnaire used dichotomous scoring (1 for a correct response and 0 for an incorrect or unanswered response), with a maximum reported score of 30. Percentage scores were interpreted as inadequate (0-49%), moderately adequate (50-74%), and adequate (75-100%). The study report states that the tool and educational material underwent expert content review and pilot testing.

Outcomes

The primary outcome was change in total knowledge score from pretest to one-week posttest. Secondary knowledge outcomes were movement between the prespecified knowledge categories and exploratory associations between posttest category and selected characteristics. The study report additionally summarized a binary favourable/safe versus unfavourable/unsafe birth-safety classification. Because the source did not provide the component-level definition or participant-level clinical records underlying this composite classification, it was treated as a descriptive exploratory outcome rather than as evidence of clinical effectiveness.

Statistical analysis

Categorical variables were summarized as frequencies and percentages; continuous knowledge scores were summarized using means and standard deviations. The primary continuous comparison used a paired t test. From the reported standard deviation of paired differences, a two-sided 95% confidence interval for the mean change was calculated. Because every participant moved from the inadequate category at baseline to a higher category after the intervention, an exact paired sign test was used as a distribution-free corroborative analysis of direction of change. Exploratory associations reported as 2 x 2 chi-square comparisons were assigned exact p values from the chi-square distribution (1 degree of freedom) and effect size was expressed as phi (phi=sqrt[chi-square/N]). To reduce false-positive interpretation across six demographic comparisons, Holm-adjusted p values were calculated. The favourable birth-safety proportion was accompanied by a Wilson 95% confidence interval. All tests were two-sided and $p<0.05$ was considered statistically significant; adjusted p values were prioritized for the exploratory multiple comparisons.

Ethical considerations

The study report documents institutional and hospital permission, participant consent, and expert review of the study tool. Participation was voluntary, and the participant information sheet stated that responses would be kept confidential and used for research purposes.

Results

Participant characteristics

All 60 participants completed the pretest and posttest assessments. The largest age group was 23-27 years (46.7%). Most participants were homemakers (71.7%), lived in nuclear families (63.3%), and resided in urban areas (58.3%). Primigravida women accounted for 43.3% of the sample. Health personnel were the most frequently reported

previous source of information (41.7%), followed by internet or social media (25.0%).

Table 1: Sociodemographic characteristics (N=60)

Variable	Category	n (%)
Age	18-22 years	12 (20.0)
	23-27 years	28 (46.7)
	28-32 years	15 (25.0)
	>=33 years	5 (8.3)
Education	Primary school	8 (13.3)
	Secondary school	18 (30.0)
	Intermediate	20 (33.3)
	Graduate and above	14 (23.3)
Occupation	Homemaker	43 (71.7)
	Private employee	9 (15.0)
	Government employee	4 (6.7)
	Self-employed	4 (6.7)
Family type	Nuclear	38 (63.3)
	Joint	22 (36.7)
Residence	Urban	35 (58.3)
	Rural	25 (41.7)

Table 2: Obstetric and information characteristics (N=60)

Variable	Category	n (%)
Religion	Hindu	45 (75.0)
	Muslim	8 (13.3)
	Christian	6 (10.0)
	Other	1 (1.7)
Monthly family income	< Rs 10,000	10 (16.7)
	Rs 10,001-20,000	22 (36.7)
	Rs 20,001-30,000	18 (30.0)
	> Rs 30,000	10 (16.7)
Gravida	Primigravida	26 (43.3)
	Second gravida	22 (36.7)
	Third gravida or above	12 (20.0)
Gestational age	28-32 weeks	18 (30.0)
	33-36 weeks	27 (45.0)
	37-40 weeks	15 (25.0)
Previous source of information	Health personnel	25 (41.7)
	Family/friends	10 (16.7)
	Internet/social media	15 (25.0)
	Books/magazines	5 (8.3)
	No previous information	5 (8.3)

Change in knowledge categories

At baseline, all 60 participants were classified as having inadequate knowledge. At posttest, no participant remained in the inadequate category; 34 (56.7%) were moderately adequate and 26 (43.3%) were adequate. Thus, every participant moved in the favourable direction by at least one category. The exact paired sign test yielded $p<0.001$, supporting a systematic post-intervention improvement in knowledge category.

Table 3: Pretest and posttest knowledge categories (N=60)

Knowledge level	Pretest, n (%)	Posttest, n (%)
Inadequate (0-49%; score 0-14)	60 (100.0)	0 (0.0)
Moderately adequate (50-74%; score 15-22)	0 (0.0)	34 (56.7)
Adequate (75-100%; score 23-30)	0 (0.0)	26 (43.3)

Exact paired sign test for direction of category change: $p<0.001$.

Change in continuous knowledge score

The mean knowledge score increased from 9.83 +/- 1.74 at pretest to 22.22 +/- 2.10 at posttest. The source table reported a paired mean difference of 12.38 points with a standard deviation of paired differences of 0.49. This corresponds to a 95% confidence interval of 12.25 to 12.51 points. The paired t test was highly significant, $t(59)=195.64$, $p<0.001$. Mean percentage score increased from 32.78% to 74.06%, a reported difference of 41.28 percentage points.

Table 4: Comparison of pretest and posttest knowledge scores (N=60)

Assessment	Mean	SD	Mean score (%)
Pretest	9.83	1.74	32.78
Posttest	22.22	2.10	74.06
Paired difference	12.38	0.49	41.28

Paired t test: $t(59)=195.64$, $p<0.001$. 95% CI for mean paired difference: 12.25-12.51 points. The reported paired mean difference (12.38) is retained from the source table.

Exploratory associations with posttest knowledge

In the source analysis, education and gravida reached nominal statistical significance before adjustment, whereas age, occupation, family type, and residence did not. Recalculation of exact p values from the reported chi-square statistics produced $p=0.041$ for education and $p=0.048$ for gravida, with small-to-moderate phi values. After Holm correction for six exploratory comparisons, no association remained statistically significant. Accordingly, the demographic findings are best interpreted as hypothesis-generating rather than as independent determinants of response.

Table 5: Exploratory associations with posttest knowledge category (N=60)

Variable	Comparison	chi-square	P	Holm-adjusted p	Phi
Age	18-27 vs >=28 years	0.41	0.522	1.000	0.083
Education	Up to secondary vs intermediate and above	4.18	0.041	0.245	0.264
Occupation	Homemaker vs employed	0.62	0.431	1.000	0.102
Family type	Nuclear vs joint	0.09	0.764	1.000	0.039
Residence	Urban vs rural	0.37	0.543	1.000	0.079
Gravida	Primigravida vs multigravida	3.92	0.048	0.245	0.256

All chi-square tests have 1 degree of freedom. Holm-adjusted p values account for six exploratory comparisons; none remained significant at adjusted $p<0.05$.

Recorded birth-safety classification

A favourable/safe birth-safety classification was recorded for 52 of 60 participants (86.7%; Wilson 95% CI 75.8-93.1%), while 8 (13.3%; 95% CI 6.9-24.2%) were classified as unfavourable/unsafe. This variable was analyzed descriptively because the source report did not provide a prespecified component-level definition or participant-level cross-tabulation suitable for adjusted outcome analysis.

Table 6: Recorded birth-safety classification (N=60)

Outcome	n (%)	95% CI
Favourable/safe	52 (86.7)	75.8-93.1
Unfavourable/unsafe	8 (13.3)	6.9-24.2

Confidence intervals are Wilson 95% confidence intervals for proportions.

Discussion

This study found a marked immediate improvement in birth-safety knowledge after a brief, structured self-instructional intervention supported by a QR-linked educational video. The principal finding was consistent across both continuous and categorical analyses: mean knowledge increased substantially, and every participant moved from the inadequate baseline category to either moderately adequate or adequate knowledge at one week. The distribution-free exact sign test reached the same conclusion as the paired t test, strengthening the interpretation that the observed shift was not dependent solely on a parametric assumption.

The low baseline level is consistent with the broader Indian literature. The national synthesis by Singh *et al*. [7] showed that BPCR awareness is incomplete and heterogeneous, while recent Indian field studies have repeatedly identified gaps in recognition of danger signs and emergency planning [8-10], with comparable observations in Delhi [11]. These deficiencies are clinically relevant because preparedness is not a single behaviour; a woman may know the planned place of delivery yet remain uncertain about warning signs, transport, referral, or the need for urgent assessment. A compact educational resource that integrates these domains may therefore be more useful than counselling focused on only one component of childbirth preparation.

The magnitude and direction of the knowledge gain are also compatible with intervention studies. Shukla *et al*. reported substantial improvement in BPCR indicators after focused counselling among pregnant women in Uttar Pradesh [12]. In a 2024 cluster-randomized trial, Yoseph *et al*. found that context-specific community health education significantly improved both obstetric danger-sign knowledge and BPCR practice [13]. At a broader evidence level, a 2025 systematic review and meta-analysis of randomized trials reported favourable effects of birth-preparedness interventions on selected maternal and neonatal outcomes, including perinatal mortality and early breastfeeding [14]. Earlier pooled evidence likewise suggested that sufficiently implemented BPCR programmes can improve care-seeking and neonatal outcomes [15]. These data support structured antenatal education as a meaningful component of maternity care, while also emphasizing that knowledge is an intermediate outcome rather than a substitute for access to high-quality clinical services.

The intervention format used here is notable because it combines a conventional self-instructional booklet with a QR-linked video. BPCR interventions are heterogeneous, and a systematic review by Miltenburg *et al*. found that programmes frequently improve knowledge but vary in their effects on skilled attendance and facility birth [16]. Their subsequent implementation analysis highlighted the importance of contextual fit, consistent messages, multi-stakeholder engagement, and alignment with available health-system capacity [17]. A hybrid print-digital format addresses several practical considerations: the printed component is persistent and shareable, whereas the QR-linked component can reinforce visual or audio messages and can be revisited outside the clinic.

Evidence from India supports the plausibility of this digital reinforcement mechanism. In a pragmatic randomized trial from northern India, Persis *et al*. showed that mobile-app and WhatsApp-based education improved pregnancy self-care knowledge, attitude, and practice compared with routine care [18]. The Kilkari direct-to-beneficiary programme demonstrated that large-scale mobile communication can influence reproductive, maternal, and child-health knowledge and behaviours [19]. The mMitra voice-message service improved selected maternal health knowledge and practices among low-income women [20], while the Mobile for Mothers intervention in tribal and rural communities improved maternal-health awareness and recommended behaviours [21]. Mobile decision-support and job-aid programmes for frontline health workers in Bihar have also shown the feasibility of embedding digital support in routine maternal and child-health delivery [22]. Together, these studies indicate that digital channels are most useful when they complement, rather than replace, interpersonal care.

The QR-code approach may also be advantageous because it avoids requiring participants to install or learn a stand-alone application. Women's experiences with online antenatal education show clear convenience and repeatability benefits, although social interaction and digital access remain important determinants of acceptability [23]. A 2026 systematic review of maternal mHealth applications similarly concluded that behaviour-change features can improve several maternal-health outcomes, but effectiveness varies by intervention design and context [24]. Recent systematic review evidence on culturally appropriate antenatal education further supports tailoring content to language, local practices, and health-system realities [25]. A multimedia campaign in rural Karnataka demonstrated that culturally tailored messages delivered through multiple channels can improve danger-sign awareness and service use [26]. These findings strengthen the rationale for locally adapted, simple, multimedia antenatal education.

The present study's exploratory demographic analysis deserves a cautious interpretation. Education and gravida were nominally associated with posttest knowledge in the original chi-square analysis, but neither remained significant after correction for multiple testing. This is important because small studies can generate apparently significant subgroup findings by chance. Nonetheless, prior evidence suggests that education and pregnancy experience can influence preparedness and danger-sign awareness. A systematic review of antenatal education found benefits in several domains of childbirth preparedness and self-efficacy [27]. A 2024 meta-analysis identified education, antenatal follow-up, and knowledge of danger signs as important determinants of BPCR practice [28], and an earlier meta-analysis quantified a strong association between maternal education and preparedness [29]. A systematic review of obstetric danger-sign awareness likewise identified education, pregnancy experience, and antenatal contact as recurrent determinants [30]. In the present dataset, however, the intervention-related knowledge improvement was broad enough that no demographic subgroup effect can be considered robust after multiplicity adjustment.

The recorded favourable birth-safety classification was common, but this finding should not be interpreted as

evidence that the educational kit caused better clinical outcomes. The source report did not provide a detailed definition of the composite classification or participant-level links between knowledge change and individual maternal or neonatal outcomes. The primary evidence generated by this study is therefore the short-term knowledge response. Future work could prespecify clinically meaningful outcomes such as facility birth, skilled attendance, timely presentation after danger signs, breastfeeding initiation, maternal complications requiring referral, birth weight, neonatal admission, and postnatal follow-up, with blinded or record-based outcome ascertainment where feasible.

Several methodological features strengthen the re-analysis: all participants completed both knowledge assessments, the primary result is supported by both a paired continuous test and an exact directional test, confidence intervals are provided, and exploratory demographic p values were corrected for multiplicity. At the same time, the single-group design cannot separate the intervention effect from testing, temporal, or attention effects. The sample was small and obtained by purposive sampling at one hospital, follow-up was limited to one week, and the source results contain a discrepancy between the stated gestational-age eligibility window and the categories reported in the participant table. These issues limit external and causal inference but do not negate the clear within-participant short-term knowledge improvement observed in the reported data.

Clinical and Nursing Implications

A QR-code-integrated self-instructional kit can be incorporated into routine antenatal nursing education as a standardized reinforcement tool. Nurses can introduce the printed resource during counselling, demonstrate the QR-linked content, confirm comprehension of maternal and newborn danger signs, and encourage women to review key messages with family members involved in transport or emergency decision-making. The approach is low-complexity, repeatable, and adaptable to local languages. Implementation should remain integrated with individualized clinical assessment, referral pathways, and routine antenatal services rather than functioning as a stand-alone digital intervention.

The study has several limitations. Its one-group pretest-posttest design without a contemporaneous control group limits causal interpretation, while the relatively small, purposively selected sample from a single hospital restricts generalizability. The one-week posttest primarily reflects short-term knowledge acquisition rather than sustained retention. In addition, the use of aggregate rather than participant-level data limits detailed assessment of score distributions and multivariable relationships. Some gestational-age categories extended beyond the stated 32–36-week eligibility range, and the classification of birth-safety outcomes as favourable or unfavourable was not sufficiently detailed to support adjusted clinical-outcome analysis.

Conclusion

A QR-code-integrated self-instructional kit was associated with a substantial one-week improvement in knowledge regarding birth-safety measures among antenatal mothers. The finding was consistent across the paired mean comparison and exact categorical analysis. The intervention represents a practical hybrid approach for reinforcing nurse-led antenatal education through repeatable print and digital content. Larger controlled studies with longer follow-up and prespecified maternal and neonatal outcomes are warranted to establish effectiveness beyond immediate knowledge gain.

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