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Strengthening early identification of pregnant women 'at nutritional risk' attending primary health care facilities in a rural area of Haryana, India- A Quality Improvement initiative

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Abstract

Background

Maternal malnutrition leads to poor maternal and foetal outcomes. Early recognition of malnutrition and its risk factors, by the health care providers, is crucial for timely management and prevention of complications. Systematic identification of gaps in detecting maternal malnutrition, followed by targeted interventions - such as training and job aids, and skill strengthening of healthcare providers, can lead to improved maternal and child health outcomes. In this study we wanted to assess the effect of selected interventions on delivery of maternal nutrition services in primary health settings, by using a quality improvement approach.

Methods

A quality improvement initiative was implemented across five primary health care facilities in rural Haryana incorporating four Plan-Do-Study-Act (PDSA) cycles over a period of six months (August 2024 – January 2025). Baseline assessment and root cause analysis were done to identify gaps. Based on the gaps identified, interventions were planned, and 37 primary health care providers were trained in various components of facility-based maternal nutrition services. Job aids for counselling were also provided. Follow up was done to see for improvements. Change was expressed in proportions, using Fischer exact test.

Results

We assessed the proportionate coverage of various maternal nutrition services, during the first PDSA cycle (baseline), followed by endline assessments during third PDSA cycle (two weeks post-training) and fourth PDSA cycle (three months post-training). During the third PDSA cycle, different anthropometric assessments improved by 40–84% above the baseline. Similarly for various clinical examinations the improvements ranged up to 74%, and for counselling by 68–86%. Hemoglobin measurements were sustained at 100% coverage. By the fourth PDSA cycle, most indicators declined compared to the previous cycle (up to 44% for anthropometry), but remained 10% *i.e.* 72% higher than the baseline levels. Interviews with the health care providers identified key areas of challenges for providing maternal nutrition services, such as limited awareness, perceived need for training, lack of resources and cultural practices.

Conclusions

Implementation of a targeted intervention (capacity-strengthening and provision of job aids) significantly improved the nutritional service delivery in ante natal care facilities in a rural area of Haryana.

BACKGROUND

Maternal malnutrition includes a spectrum of conditions reflecting poor nutritional state of pregnant women. Some of them include, low body weight, overweight/obesity, short stature and severe anaemia. These conditions contribute to poor outcomes, and long-term adverse consequences, for both the mother and the child.(1–4) According to National Family Health Survey 5 (NFHS 5) (2019–2021), 52.2% of pregnant women between the age of 15–49 years were anaemic in India.(5) Secondary analysis of NFHS-4 data reported prevalence of 1.9% for severe thinness [Body Mass Index (BMI) < 16 kg/m2] and 12% for obesity (BMI > 25 kg/m2), among pregnant women (20–49 years) under 20 weeks of gestation(6,7). In addition, 11.5% (India) and 5.2% (Haryana) of women of 15–49 years had short stature (Height < 145 cm).(5)

Recognising this burden, World Health Organization's antenatal care guidelines (2016), emphasised on nutrition related assessments and interventions[8]. Services such as, anthropometry [measurement of height, weight, Mid Upper Arm Circumference (MUAC)], clinical examinations (measurement of blood pressure, pallor, jaundice, goitre, oedema)[9, 10, 11], biochemical examinations (Hemoglobin level, blood glucose level, urine protein and albumin levels) and counselling (dietary, breastfeeding and family planning) can aid in prevention, detection and management of malnutrition and its risk factors. In Indian primary health care settings, these services are provided through health care providers, such as Medical Offers, Female Health Supervisors and Health Worker (Female) [HW(F)] and Accredited Social Health Activist (ASHA). ASHAs are a band of community based health volunteers in India, they act as a bridge between the community and the health system. They are often the first point of contact for health related needs in the village – including maternal care. [12]

Studies have identified gaps in delivery of maternal nutrition services within primary health care facilities. Routine assessments of nutrition and counselling during antenatal care clinics, and monitoring of nutrition-related indicators through Hospital Management Information System (HMIS) are lacking(12,13,14). Inadequate infrastructure, socio-cultural barriers, shortage of skilled health workforce, irregular fund flow and supply chain interruptions[15], constrain the implementation of maternal health programs and initiatives[16, 17, 18, 19], leading to slow progress in reducing maternal malnutrition.[20]

A Quality improvement (QI) approach, utilizes specific techniques to bring about measurable improvements in healthcare settings.[21] Through ongoing scrutiny for gaps and efforts to address them, QI interventions, particularly training based interventions targeting health care providers

have shown to improve patient health seeking behaviour, service utilisation, and adoption of appropriate nutrition practices. Improved maternal nutritional outcomes following the strengthening of antenatal nutrition services have also been reported.(22,23) However, evidence on the use of QI approach to improve maternal nutrition service delivery in rural primary healthcare settings in India remain limited, with most existing studies conducted in well-resourced tertiary care facilities. Hence, this study was conducted to identify gaps in maternal health services in primary care facilities of rural Haryana, and address them through a QI approach, using iterative Plan-Do-Study-Act cycles.

METHODS

Study settings

The study was conducted at two Primary Health Centres (PHCs) in Ballabgarh block of district Faridabad, in Haryana state of India. The study setting is also an intensive field practice area of a tertiary care institute in New Delhi. Hence, this collaboration provides manpower and logistic support from both sides. Each PHC catered to a population of 50,000–55,000, well above the norms by Indian Public Health Standards (IPHS). Each of them have six sub-centres. Ante-Natal Clinics (ANC) were conducted weekly at sub-centres, with 20–30 pregnant women attending the clinic every week. Anthropometry (height, weight), blood pressure measurement, biochemical investigation (Hemoglobin levels, blood glucose levels, urine examination) were performed during the ANC visit. Attendees were offered counselling services and Tablet Folic acid, Tablet Iron plus Folic acid, and oral calcium supplementation.

Maternal services were delivered by a team consisting of Medical Officers (MOs), Female Health supervisors, Female health workers (HW-F) and Accredited Social Health Activists (ASHA). Both the PHCs had one MO each, and they led the QI team. Besides this, the PHCs were staffed by two female HSs, 27 HW-Fs and 88 ASHAs. ASHA is a volunteer health activist, responsible for conducting home visits, mobilising pregnant women to health care facilities, and maintaining records. In our study setting, they also aid the HW-F during the Antenatal OPDs, such as for anthropometry measurement, in cases of shortage other health care providers. The HW-F registers pregnant women for antenatal care, makes clinical assessments and orders relevant investigations. She is promoted to the role of female HS after at least ten years of experience. HS supervises the work of the HW-F and makes supervisory home visits. MO is responsible for overall supervision of the services provided and health care providers working under the PHCs, as well as for providing curative care. The MOs conduct maternal health trainings to Female HSs, HW-Fs and ASHAs at least quarterly. The nature and duration of the training is dependent on the MO, who gets posted for nine months to one year period. Predominantly they were lecture-based, using power point presentations. To ensure attendance these trainings are conducted along with monthly meetings, for which all the health care providers are required to be present. However, the content in these meetings have been limited to one or two conditions (namely, anemia and underweight pregnancy) and have not covered the entire spectrum and conditions included in maternal malnutrition.

We used a QI approach in our study, to improve maternal nutrition service delivery in selected health care facilities. The QI team were constituted by the health care providers and included (i) MOs, as team leaders with a mandate to train other team members, facilitate the QI initiative, and provide supportive supervision (ii) Female HSs, for supportive supervision of other staffs along with providing antenatal and postnatal counselling to beneficiaries, (iii) HW-Fs, for delivery of maternal nutrition services, and (iv) ASHAs for helping the HW-F in implementing the maternal nutrition algorithm[24]. The maternal nutrition algorithm and job aids developed by National Centre of Excellence and Advanced Research on Diets (NCEARD), at Lady Irwin College, New Delhi in collaboration with United Nations Children's Fund (UNICEF) and the Ministry of Health and Family Welfare, Government of India were used for the training. The algorithm has action plans for maternal nutrition provision in antenatal care (OPD). It includes a comprehensive list of nutrition services, such as Nutrition assessment (history taking, anthropometry, blood pressure measurement, clinical examination for pallor, jaundice, fluorosis and goitre), Provision of drugs and supplements (Folic Acid, Iron and Folic Acid, Calcium and Albendazole) and Counselling services (dietary, breastfeeding and family planning methods). It also assigns these roles according to the cadre of health care provider, who classify the pregnant women based on the nutrition assessment, and take appropriate actions as per nutritional risk.

Study Tools

(1) Objective structured clinical examination (OSCE) checklist: A OSCE checklist was prepared for measurement of height, weight and blood pressure, using standard guidelines[25]. Measurement of height and weight involves three steps each. Measurement of blood pressure involves five steps. Proportion of pregnant women whose anthropometry was measured following the right steps in the right order as the OSCE checklist were considered as service delivered. OSCE checklist for monitoring assessment for nutritional status, clinical examination, biochemical examinations and counselling services were also prepared. (These checklists are shown in tables 4–10 of Supplementary file). They were used in training the health care providers and for the pre-training and post-training assessments.

(2) Exit Interview : Findings from clinical examinations (pallor, jaundice, goitre, oedema) and provision of counselling services (dietary, breastfeeding and family planning methods) were not routinely documented in OPD cards or MCP books. To confirm their receipt, exit interviews using a semi-structured questionnaire was administered to pregnant women attending antenatal clinics. (see Supplementary File). The questionnaire contained items that could assess the services provided by the medical officer, HW-F and ASHA.

(3) Semi-structured interview guides for Focused Group Discussions (FGD) and Key informant Interviews (KII): Topic outline guides were developed before the study. We sought to explore the perception of the health care providers on barriers in delivering different maternal nutrition services and their suggestions on what can be improved. (see Supplementary File)

(4) Training needs assessment questionnaire: A semi-structured questionnaire, to assess confidence, frequency of services provision and the preferred areas for training. The Likert scale responses were categorised as “less confident” (if not confident or somewhat confident) and “more confident” (if moderately confident or very confident). Frequency of service provision (blood pressure, urine examination, blood glucose level measurement and documenting history) were assessed using predefined response options. For preferred topics and modes for training, participants could choose between multiple options. (see Supplementary File)

Baseline assessments

Baseline assessments were carried out over two weeks (August 15–30, 2024), to identify gaps in delivery of maternal nutrition services. Out of total twelve sub-centres, five were chosen randomly.

The activities performed during baseline assessment included:

(1) Direct observation of the antenatal services delivery was done by the MO. They visited one ANC clinic from each of the five sub-centres, (a) to understand the microprocesses from registration to dispensing of medications and (b) to assess if pregnant women received maternal nutrition services according to the OSCE checklist. The first ten pregnant women attending each sub-centre were observed. (Fig. 1);

(2) Exit interviews with the same fifty pregnant women to confirm the observations and assess receipt of clinical examinations and counselling;

(3) Record review: Anthropometry and biochemical assessments were confirmed from the MCP books, and their documentation was emphasised during the training.

(4) Four KIIs (MOs and female HSs) and Five FGDs (three groups of HW-Fs and two groups of ASHAs). The participants were chosen purposively, and included those with the maximum number of work experience in the PHC and to ensure representation from each sub-centre. Interviews were conducted at health facilities, and only the participants and the moderator were present at the location. Each interview lasted 45–60 minutes. KIIs and FGDs were audio recorded with consent, transcribed in the same language (Hindi) and then translated to English. Data was analysed manually with inductive approach to identify themes and domains. (see Supplementary File); and

(5) Separate training needs assessments of HW-Fs and ASHAs were conducted using the training needs assessment tool. It was designed according to their job responsibilities, to guide the design for training intervention.

The findings from the baseline assessment were incorporated in root-cause analysis. A fish-bone diagram was prepared to identify the gaps with respect to People, Place, Policy and Procedures. This is shown in detail in Supplementary file (see Fig. 1 of Supplementary File). The changes were planned and implemented over six months through four iterative Plan-Do-Study-Act (PDSA) cycles. During the “plan” phase, QI team brainstormed for possible interventions and indicators for monitoring, based on the gaps identified during baseline assessment and root-cause analysis. In the “do” phase, execution of the planned interventions were done. These interventions were:

(1) Development of a training package: The maternal nutrition algorithm developed by NCEARD, was adapted and translated in local language. The training package focused on services like, nutrition assessment, provision of drugs and supplements, counselling, classification of pregnant women as per nutritional risk with appropriate management. The algorithm is shown in the Supplementary file (see Fig. 2 of Supplementary File);

(2) Training of health care providers: Separate eight-hour training sessions for 27 HW-F and ten ASHAs (selected purposively) were held. The training was tailored according to their expected roles. Both the groups were trained to identify and measure nutritional risk factors and the counselling procedure. HW-F were additionally taught about the consequences of maternal malnutrition and importance of routine documentation of nutrition services in the MCP book.[26] These locally developed educational and record-keeping tools were pre-existing and already in use. Multimodal training process was adopted e.g., PowerPoint presentation, hands-on training, and role plays. Each health care provider was directly observed performing the skills, assisted and corrected when required.

(3) Introduction of two job aids for counselling viz. ‘By Gestational month cards’ and ‘At risk cards’. These job aids had details on dietary practices during pregnancy, as well as on breastfeeding practices and various methods of contraception for the post-partum period. These advices are to be provided to the pregnant woman according to her month of gestation and nutritional risk.

(4) Development of indicators to monitor process and outcomes: Most indicators had to be assessed at each visit, except - height (to be assessed once, ideally at first visit), Body Mass Index (at first trimester), hemoglobin and urine albumin and sugar levels (once every trimester), Oral Glucose Tolerance Test (OGTT) or Random blood sugar (RBS) level at first ANC contact and at 24–28 weeks of gestation.

In the “study” phase, improvements and sustainability of intervention were assessed using process indicators. These indicators were developed to assess the proportion of women who received selected anthropometric, clinical, biochemical examinations and counselling during their antenatal visit to the primary health care facility. Endline assessments were carried out at two points- at two weeks and at three months after the completion of training (third and fourth PDSA cycle, respectively). The assessment tools were same that were used at baseline assessment. Based on the findings from the “study” phase, the interventions were further adapted during each “act” phase. These included – excluding MUAC measurement from training material, fortnightly reminders on existing WhatsApp groups of healthcare providers and targeted correction of gaps found during first endline assessment. (see Fig. 3 of Supplementary File).

Statistical analysis

Results of the process and outcome indicators were expressed as change in proportion. P-value was calculated using Fischer Exact test. P value < 0.05 was considered significant.

RESULTS

Fishbone analysis

Challenges were categorized under four key headings, in a fishbone diagram. Under ‘policy’, absence of standard operating procedures for anthropometry, counselling and biochemical tests; and recurrent stock outs of supplies such as, strips for point of care blood glucose measurement and calcium supplements were noted. ‘People’ level barriers included limited training, low motivation and resistance to work amongst the HW-F and ASHAs. One sub-centre lacked a functional washroom, while another had no piped water supply, limiting urine examinations. Besides these, absence of private spaces for counselling across all sub-centres, posed challenges under ‘place’. ‘Practice’ such as, poorly organized clinic workflows, led to some women missing out on services.

Training needs assessment

Health care providers expressed a need for capacity-building. Commonly preferred topics were training on diet counselling, followed by skill strengthening for conducting antenatal clinics, anthropometry, and screening examinations. Printed materials and workshops were the preferred modes of training.

FGDs and KIIs

Barriers such as inadequate supply of consumables, irregular trainings, limited training contents, time constraints and lack of space at the health facilities emerged from the FGDs. In addition to this, the key informants also informed about resistance to work and a feeling of overburden with work among the HW-Fs and ASHAs.

Baseline and endline assessment

A summary of the changes in the proportion of service coverage is provided, where (i) represents baseline assessment (first PDSA cycle), (ii) two weeks post training (second PDSA cycle) and (iii) three months post training (third PDSA cycle). Weight measurement improved from (i) 30% to (ii) 86% and then dropped to (iii) 68%. Both these changes were significant compared to baseline. Height measurement increased from (i) 60% to (ii) 100%, which was significant, before declining to (iii) 72%. Blood pressure measurement, following correct steps, and BMI assessment, both (i) absent at baseline, rose significantly, to (ii) 60% and 84% respectively. Both dropped to (iii) 40% at the third month. Despite the decline, the improvements were significant compared to baseline levels. (Table 1). The step wise breakdown of height, weight and blood pressure measurement is provided in the Tables 1–3 of Supplementary File.

Table 1
Anthropometric and clinical measurement rate at baseline and endline (N = 50)

S. No	Indicator	Baseline assessment n (%)	Endline Assessment after two weeks n (%)	p-value	Endline assessment after three months n (%)	p-value
1	**Proportion of pregnant women whose height was measured following the steps as per the OSCE based checklist, in the right order**	30 (60%)	50 (100%)	**< 0.001**	36 (72%)	0.291
2	**Proportion of pregnant women whose weight was measured following the steps as per the OSCE based checklist, in the right order**	15 (30%)	43 (86%)	**< 0.001**	34 (68%)	**< 0.001**
3	**Proportion of pregnant women whose BMI was measured in the first trimester**	0 (0%)	42 (84%)	**< 0.001**	20 (40%)	**< 0.001**
4	**Proportion of pregnant women whose blood pressure was measured following the OSCE based checklist steps in the right order**	0 (0%)	30 (60%)	**< 0.001**	20 (40%)	**< 0.001**

Similarly, significant improvements were seen in pallor, goiter, fluorosis or pedal edema assessments, at both two weeks and three months post-training, despite a dip at the third month.

At (i) baseline, only pallor was measured, in 6% of participants. Pallor screening improved to (ii) 42% and remained at (iii) 42%. Assessment for goiter, pedal edema and fluorosis similarly increased (ii) 74%, eventually declining to (iii) 58%, 48% and 54%, respectively. (Table 2)

Among biochemical examinations, hemoglobin testing persisted at 100% at all the assessments. Urine testing showed a gradual improvement from (i) 50% to (ii) 56% and (iii) 60%. These improvements were not statistically significant. On the other hand, while OGTT/RBS testing was (i) absent at baseline, it improved to (ii) 4% and then to (iii) 52%. Among these tests, only the increase in OGTT/RBS testing at three months was of significant value. (Table 2)

Table 2
Clinical and biochemical examination rate at baseline and endline (N = 50)

S. No	Indicator	Pre-intervention n (%)	Two weeks post-intervention n (%)	P value	Three months post intervention n (%)	P value
1	**Proportion of pregnant women who were examined for Pallor**	3 (6%)	21 (42%)	**< 0.001**	21 (42%)	**< 0.001**
2	**Proportion of pregnant women who were examined for Goiter**	0 (0%)	37 (74%)	**< 0.001**	29 (58%)	**< 0.001**
3	**Proportion of pregnant women who were examined for Fluorosis**	0 (0%)	37 (74%)	**< 0.001**	24 (48%)	**< 0.001**
4	**Proportion of pregnant women who were examined for pedal edema**	0 (0%)	37 (74%)	**< 0.001**	27 (54%)	**< 0.001**
5	**Proportion of pregnant women whose hemoglobin level was measured within past 3 months**	50 (100%)	50 (100%)	-	50 (100%)	-
6	**Proportion of pregnant women whose urine examination was done to detect albumin and sugar within past 3 months**	25 (50%)	28 (56%)	0.69	30 (60%)	0.42
7	**Proportion of pregnant women whose Oral Glucose Tolerance test or random blood sugar was done at first and third trimester**	0 (0%)	2 (4%)	0.49	26 (52%)	**< 0.001**

Family planning counselling increase from (i) zero to (ii) 68%, then reduced to (iii) 46%. Diet counselling changed from (i) 8% to (ii) 92% and (iii) 80%. Breastfeeding counselling: (i) 4% (ii) 72% and (iii) 54%. Endline assessments [ii and iii] remained significantly higher to baseline findings, across all counselling services. (Table 3)

Table 3
Counselling service rate at baseline and endline (N = 50)

S. No	Indicator	Baseline assessment n (%)	Endline Assessment after two weeks n (%)	P value	Endline assessment after three months n (%)	P value
1	**Proportion of pregnant women who were counselled regarding family planning in the last trimester**	0 (0%)	34 (68%)	**< 0.001**	23 (46%)	**< 0.001**
2	**Proportion of pregnant women who were counselled regarding diet**	4 (8%)	46 (92%)	**< 0.001**	40 (80%)	**< 0.001**
3	**Proportion of pregnant women who were counselled regarding exclusive breast feeding in the last trimester**	2(4%)	36 (72%)	**< 0.001**	27(54%)	**< 0.001**

DISCUSSION

This QI initiative focused on strengthening delivery of maternal nutrition service in antenatal clinics of subcentres in a rural area of Haryana, through root cause analysis, followed by multiple PDSA cycles over 6 months. Use of multiple methods for baseline assessments (direct observations, FGDs, KIIs and training needs assessment), provided a comprehensive understanding of service delivery gaps, and also enabled in triangulation of data. The efforts of QI interventions led the improvement in the delivery of maternal nutrition services. Improvement was pronounced two-weeks post training, followed by a slight decrease at third month of endline assessment. However, the level of improvement remained higher than that at baseline. We believe that the observed maternal nutrition service in antenatal clinics was due to QI interventions.

The collaboration between the state government and a tertiary care institute ensured that the essential number [Indian Public Health Standards (IPHS)] or more healthcare providers were available – higher than many sub-centres in Haryana.[27, 28] It also provided dual channels for logistics and supplies. However, our study setting catered to population exceeding the IPHS norms. Besides, baseline assessment identified inadequate supply of consumables, poor infrastructure, low staff motivations as barriers to service delivery. Other studies, such as by Mugo N et al (2018, South Sudan), Singh S et al (2024, India), Sarfraz et al (2014, Pakistan), and Banchani E et al (2014, Ghana) have also reported similar barriers.[29–32] The absence of basic infrastructure, such as functional washrooms and piped water supply at two subcenters in our study, may have contributed to the lower rate of urine examination (56%). Similarly, stock-out of glucometer strips in two sub-centres, likely contributed to lower proportion (4%) of women receiving RBS testing in those subcenters. In contrast, consistent availability of functioning Hemocue-301 devices, microcuvettes and lancets played a role in the sustained provision of point of care hemoglobin estimation at all time points. Initiatives such as Anemia Mukt Barat, has strengthened routine testing for anemia among pregnant women. Such efforts by the government also plays major roles in ensuring sustained delivery of services.

Our study not only evaluated the coverage of anthropometry, but also their quality, assessed against a standardized OSCE checklist. Anthropometric measurements performed without adhering to all standardized steps in the correct sequence were not considered as service provision. Many prior studies on maternal services, predominantly focused on service coverage rate, without emphasizing on the procedural accuracy. By addressing this gap, we addressed the quality of services being rendered. Afterall, it is the quality and not merely the quantity that would determine the effectiveness of nutritional services being provided at ANC clinics.

Training regarding counselling services was identified as a key priority from baseline assessment. The training needs assessment and qualitative interviews also highlighted that the health care providers were open to using printed materials. Hence, we incorporated two job aids - ‘By gestational month cards’ and ‘At risk cards’ into the training program. Although, initially aimed to be used only for facility-based antenatal clinics, the feedback from the trainees and the beneficiaries (pregnant women) encouraged us to recommend its use in field conditions i.e., during domiciliary visit, as well.

During the “act” phase, we decided to exclude MUAC measurement from the maternal nutrition algorithm used in the training sessions, as it is not currently part of Indian guidelines for antenatal care. Similarly, WhatsApp reminders and correction sessions were other steps adopted to improve the sustainability of the interventions. Despite this, slight decline was observed over time. This pattern of sharp early improvement followed by slight decline is consistent with findings reported by Sharma et al. (2022, Uttar Pradesh)[33], and may reflect waning initial enthusiasm of novel things as the newness fades. Further, the interviews also brought forth the need for repeated training for a retained memory. Perceptions of being overburdened, as expressed by health care providers during the FGDs and a lack of motivation, as pointed out by the MOs and female HSs, during the KIIs, may also have contributed to the decline in performance. Further engagements with health care providers may bring more insight into this decline.

Our work has some limitations. Direct observation of service delivery may have introduced Hawthorne effect resulting in over-estimate of the improvement. We are unable to offer any credible or plausible reason(s) for observed decline at endline assessment at three months post-intervention. However, this pattern has been reported in other studies, and has been attributed to the decline in retention of information and lack of motivation. Regular reminders, doubt clearing and correction sessions are being continued to be held during monthly meetings in the PHCs by the MOs, to ensure sustainability of the interventions.

Using a QI approach in our study enabled us to bring significant changes in maternal nutrition service delivery. Involving the health care providers in both planning and implementing stages, helped us achieve this feat. Some of the strengths of our study was use of mixed-methods approach, Objective measures such as OSCE based checklists and semi-structured questionnaires were supplemented and supported by qualitative methods such as FGDs and KIIs. This approach added depth to the study and facilitated the identification of the factors hindering quality healthcare delivery in primary care settings.

CONCLUSIONS

Successful application of the QI approach led to improvement in coverage and quality of maternal service delivery. Such methods, as ours, can also be easily replicated in similar settings, aided by less requirement of resources for sustaining the intervention, hence can be especially beneficial in rural areas where higher medical centres aren't very accessible.

Abbreviations

ASHA
Accredited Social Health Activist
BMI
Body Mass Index
FGD
Focused Group Discussion
HS
Health supervisor
HW-F
Health Worker (Female)
IFPA
Intensive Field Practice Area
KII
Key informant Interview
MO
Medical officers
MUAC
Mid Upper Arm Circumference
NCEARD
National Centre of Excellence and Advanced Research on Diets
NFHS
National Family Health Survey
OGTT
Oral Glucose Tolerance test
OSCE
Observed Structured Clinical Examination
PDSA
Plan-Do-Study-Act
PHC
Primary Health Centre
QI
Quality improvement
RBS
Random Blood Sugar
UNICEF
United Nations Children's Fund

Declarations

Ethical approval and consent to participate:

Clearance from Institutional Ethics Committee, was obtained. Written informed consent was obtained from the participants. Permission/ concurrence from NCEARD and UNICEF regarding use of maternal nutrition algorithm and job aids were taken. Written informed consent was taken from all participants.

Consent for publication:

Written informed consent for publication of participant's clinical details and/or clinical images was obtained from the participant. A copy of the consent form is available for review by the Editor of this journal.

Competing interests:

The authors declare that they have no competing interests

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Authors' contributions:

S.N. performed the research. S.N. and R.K. designed the research study. R.K. and Rk.K. supported overall research procedure. S.N. and R.K. analysed the data. S.N., R.K., Rk.K., S.G. and S.K wrote the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials:

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Data availability statement:

All data supporting the findings of this study are available within the paper and its Supplementary Information.

References

1. London School of Hygiene & Tropical Medicine. Underweight women at greater risk of miscarriage [Internet]. London: LSHTM (2006) Dec 4 [cited 2025 May 28]. Available from: https://www.lshtm.ac.uk/newsevents/news/2006/miscarriage.html
2. Aviram A, Hod M, Yogev Y (2011) Maternal obesity: Implications for pregnancy outcome and long-term risks–a link to maternal nutrition. Int J Gynecol Obstet 115:S6–S10. https://doi.org/10.1016/S0020-7292(11)60004-0
3. Smith J, Doe A, Johnson L et al (2019) Maternal nutrition and birth outcomes: A systematic review and meta-analysis. J Maternal Health 15(3):123–130. 10.1016/j.jmh.2019.01.001
4. Haddow JE, Palomaki GE, Allan WC et al (1999) Maternal thyroid deficiency during pregnancy and subsequent neuropsychological development of the child. N Engl J Med 341:549–555
5. International Institute for Population Sciences (IIPS) and ICF. National Family Health Survey (NFHS-5), 2019–21: India. Mumbai: IIPS (2021) Available from: https://dhsprogram.com/pubs/pdf/FR375/FR375.pdfMedBox
6. Choedon T, Sethi V, Chowdhury R, Bhatia N, Dinachandra K, Murira Z et al (2021) Population estimates and determinants of severe maternal thinness in India. Int J Gynaecol Obstet 155(3):380–397. 10.1002/ijgo.13940

7. Chopra M, Kaur N, Singh KD, Jacob CM, Divakar H, Babu GR et al (2020) Population estimates, consequences, and risk factors of obesity among pregnant and postpartum women in India: Results from a national survey and policy recommendations. Int J Gynaecol Obstet 151(Suppl 1):57–67. 10.1002/ijgo.13319
8. World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience [Internet]. Geneva: World Health Organization (2016) [cited 2025 May 28]. Available from: https://www.who.int/publications/i/item/9789241549912
9. Kinshella MW, Omar S, Scherbinsky K, Vidler M, Magee LA, von Dadelszen P, Moore SE, Elango R (2021) Maternal Dietary Patterns and Pregnancy Hypertension in Low- and Middle-Income Countries: A Systematic Review and Meta-analysis. Adv Nutr 12(6):2387–2400. 10.1093/advances/nmab057. PMID: 34019634; PMCID: PMC8634459
10. Pornchai A, Kamalaporn P, Sriphrapradang C (2022 Winter) Jaundice Caused by Hyperemesis Gravidarum. Ochsner J 22(4):372–378. 10.31486/toj.22.0019. PMID: 36561106; PMCID: PMC9753955
11. Gómez-Cantarino S, Agulló-Ortuño MT, de Dios-Aguado M, Ugarte-Gurrutxaga MI, Bouzas-Mosquera C (2020) Prevalence of Hypoproteinemia and Hypoalbuminemia in Pregnant Women from Three Different Socioeconomic Populations. Int J Environ Res Public Health 17(17):6275. 10.3390/ijerph17176275. PMID: 32872263; PMCID: PMC7504065
12. National Health Mission (India) *Guidelines on Accredited Social Health Activist (ASHA)* [Internet]. New Delhi: Ministry of Health & Family Welfare; [cited 2025 Jul 2]. Availablefrom: https://nhm.gov.in/images/pdf/communitisation/task-groupreports/guidelines- on-asha.pdf
13. Nguyen PH, Kachwaha S, Avula R, Young M, Tran LM, Ghosh S et al (2019) Maternal nutrition practices in Uttar Pradesh, India: role of key influential demand and supply factors. Matern Child Nutr 15(4):e12839
14. DiMaria-Ghalili RA, Edwards M, Friedman G, Jaferi A, Kohlmeier M, Kris-Etherton P et al (2013) Capacity building in nutrition science: revisiting the curricula for medical professionals. Ann N Y Acad Sci 1306(1):21–40
15. Rajderkar S, Sohani S, Sohani A, Saale Y (2020) Preliminary evaluation of records of antenatal care at sub-centre in Western Maharashtra. Int J Community Med Public Health 7:756. 10.18203/2394-6040.ijcmph20200462
16. Garhwal P, Podder L, Bhardwaj G, Dora AK (2026) Health system barriers to effective implementation of maternal and child health programs. *Future Health*
17. Department of Women and Child Development |Pradhan Mantri Matru Vandana Yojana (PMMVY) [Internet]. [cited 2025 Jul 6]. Available from: https://wcd.delhi.gov.in/wcd/pradhan-mantri-matru-vandana-yojana-pmmvy
18. National Health Mission: Janani Shishu Suraksha Karyakaram (JSSK) [Internet]. [cited 2023 Jul 24]. Available from: https://www.nhm.gov.in/index4.php?lang=1&level=0&linkid=150&lid=171
19. IntensifiedNationalIronPlusInitiative OperationalGuidelinesforProgramManagers, Ministry of Health and Family Welfare, Government of India [Internet]2018
20. Ministry of Women and Child Development, Government of India. Mission SAKSHAM Anganwadi & POSHAN 2.0: Scheme Guidelines. New Delhi: MWCD (2022) Available from: https://wcd.gov.in/documents/uploaded/Mission%20Saksham%20Anganwadi%20and%20Poshan%202.0%20scheme%20guidelines.pdf
21. Victora CG, Christian P, Vidaletti LP, Gatica-Domínguez G, Menon P, Black RE (2021) Revisiting maternal and child undernutrition in low-income and middle-income countries: variable progress towards an unfinished agenda. Lancet 397(10282):1388–1399. 10.1016/S0140-6736(21)00394-9. Epub 2021 Mar 7. PMID: 33691094; PMCID: PMC7613170
22. Academy of Medical Royal Colleges (2016) Quality improvement - Training for better outcomes. AMRoC
23. Ballard M, Montgomery P (2017) Systematic review of interventions for improving the performance of community health care providers in low-income and middle-income countries. BMJ Open 7(10):1–14
24. Nguyen PH, Kachwaha S, Tran LM, Avula R, Young MF et al (2021) Strengthening Nutrition Interventions in Antenatal Care Services Affects Dietary Intake, Micronutrient Intake, Gestational Weight Gain, and Breastfeeding in Uttar Pradesh, India: Results of a Cluster- Randomized Program Evaluation. J Nutr 151(8):2282–2295. 10.1093/jn/nxab131. PMID: 34038529; PMCID: PMC8349122
25. National Centre of Excellence and Advanced Research on Diets (NCEARD) Maternal Nutrition Toolkit [Internet]. New Delhi: NCEARD; [cited 2025 May 29]. Available from: http://nceard.roshni-cwcsa.co.in/ToolkitFrame.aspx?flag=9
26. World Health Organization. Section 5: Collecting Step 2 data: Physical measurements. In: WHO STEPS Surveillance Manual. Geneva: World Health Organization (2017) https://cdn.who.int/media/docs/default-source/ncds/ncd-surveillance/steps/part3-section5.pdf. Accessed 25 May 2026
27. National Health Mission (India). Mother Child Protection (MCP) – Guide Book [Internet]. New Delhi: Ministry of Health & Family Welfare, Government of India (2018) [cited2025Jul2]. Availablefrom:https://nhm.gov.in/New_Updates_2018/NHM_Components/Immunization/Guildelines_for_immunization/MCP_Guide_Book.pdf
28. National Health Mission RMNCAH + N. https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=284&lid=154. Accessed 25 May 2026
29. Population Research Centre, Centre for Research in Rural and Industrial Development. Health and Wellness Centres in Haryana: An Assessment of Functioning and Efficiency. Chandigarh: Centre for Research in Rural and Industrial Development (2020)

https://share.google/VThG9b0uuDbJXx25W. Accessed 25 May 2026

30. Mugo NS, Dibley MJ, Damundu EY et al (2018) Barriers Faced by the Health Workers to Deliver Maternal Care Services and Their Perceptions of the Factors Preventing Their Clients from Receiving the Services: A Qualitative Study in South Sudan. Matern Child Health J 22:1598–1606. https://doi.org/10.1007/s10995-018-2555-5
31. Singh S, Rajak R (2024) Barriers in utilization and provisioning of obstetric care services (OCS) in India: a mixed-methods systematic review. BMC Pregnancy Childbirth 24:16. https://doi.org/10.1186/s12884-023-06189-x
32. Sarfraz M, Hamid S (2014) Challenges in delivery of skilled maternal care – experiences of community midwives in Pakistan. BMC Pregnancy Childbirth 14:59. https://doi.org/10.1186/1471-2393-14-59
33. Banchani E, Tenkorang EY (2014) Implementation challenges of maternal health care in Ghana: the case of health care providers in the Tamale Metropolis. BMC Health Serv Res 14:7. https://doi.org/10.1186/1472-6963-14-7
34. Sharma S, Bhardwaj A, Arora K, Akhtar F, Mehra S (2021) Health Workers' Perceptions about Maternal and Adolescent Health among Marginalized Populations in India: A Multi-Centric Qualitative Study. Women 1(4):238–251. https://doi.org/10.3390/women104002

Figures

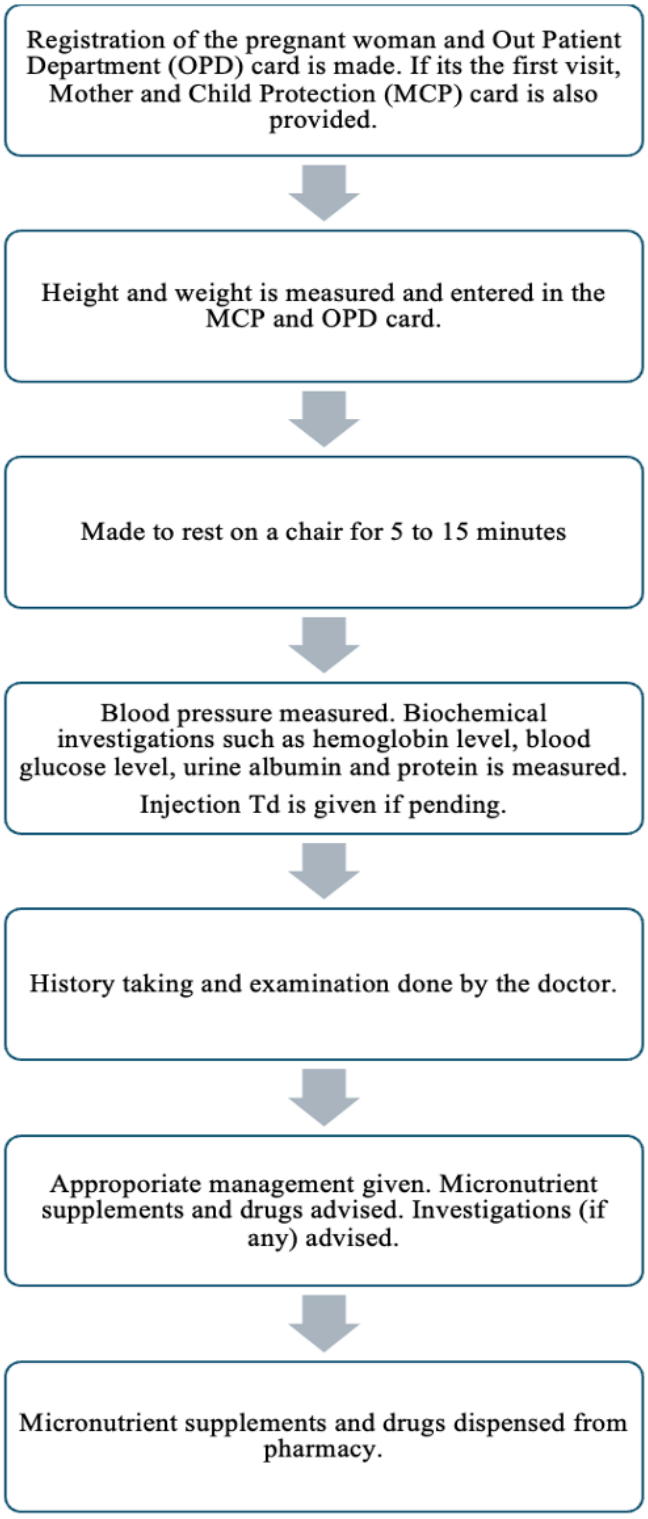


Figure 1

Process flow diagram for care of women attending antenatal clinics of selected subcentre

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