Maternal & Child Nutrition

WILEY

Maternal & Child Nutrition

ORIGINAL ARTICLE OPEN ACCESS

Introducing Antenatal Multiple Micronutrient Supplements: Lessons Learned From Implementation Research in Bangladesh, Burkina Faso, Madagascar and Tanzania

Susan Thurstans-Fuller[1] | Philip James[1] | Rachael Menezes[1,2] | Alison Fleet[3] | Ireen Akhter Chowdhury[4] | Johanne Desormeaux[5] | Onjanarindra Jeannie Nadia Razafimalaza[6] | Patrick Codjia[7] | Vilma Tyler[2] | Alison Tumilowicz[8] | Zeina Sifri[8] | Emily Mates[2]

[1]Emergency Nutrition Network, Oxford, UK | [2]UNICEF, New York, USA | [3]UNICEF Supply Division, Copenhagen, Denmark | [4]UNICEF, Dhaka, Bangladesh | [5]UNICEF, Ouagadougou, Burkina Faso | [6]UNICEF, Antananarivo, Madagascar | [7]UNICEF, Dar es Salaam, Tanzania | [8]Gates Foundation, Seattle, Washington, USA

Correspondence: Susan Thurstans-Fuller (susan.fuller@ennonline.net)

Received: 21 January 2025 | **Revised:** 17 October 2025 | **Accepted:** 30 October 2025

ABSTRACT

Micronutrient deficiencies affect two-thirds of reproductive-age women globally, with pregnant women in low- and middle-income countries at higher risk due to greater nutritional needs and limited diets. Multiple micronutrient supplements (MMS) have shown greater benefits than iron-folic acid (IFA) during pregnancy, but WHO currently limits recommendations to humanitarian or research settings. This study synthesises experiences of implementation research designed to support and document the transition from IFA to MMS for pregnant women in Bangladesh, Burkina Faso, Madagascar and Tanzania, providing insights for scaling up MMS programming globally. This qualitative study used key informant interviews and reviews of key policies, proposals, and project materials. Purposive sampling identified 16 key informants involved in the project design, implementation, or funding at country, regional, or global levels. Semi-structured questionnaires guided discussions on themes including project planning, policy environment, community engagement, logistics, and monitoring. Qualitative descriptive analysis of interview transcripts and documents identified key themes and insights. Findings revealed context-specific successes and challenges in transitioning to MMS, highlighting the unique opportunity to strengthen antenatal care (ANC) systems. Key informants emphasised the importance of context specific situational analysis and tailored interventions, strong policy support, community engagement, robust supply chains, sustainable financing, effective monitoring systems, and collaboration among stakeholders. The experiences from this project contribute to the evidence base on MMS implementation. They demonstrate that the transition from IFA to MMS should be leveraged to enhance services and advocate for a health systems-wide approach, moving beyond isolated interventions, to foster more impactful and integrated improvements within ANC.

1 | Background

Within the framework of women's rights, ensuring access to adequate nutrition is considered essential for promoting women's health, well-being, and empowerment (UN General Assembly 1979, 1948). However, an estimated two thirds of women of reproductive age are affected by micronutrient deficiencies globally (Stevens et al. 2022). Increased nutritional needs during pregnancy mean that pregnant women in resource poor settings, where access to a varied and balanced diet is limited, are at further risk of micronutrient deficiencies (Gernand et al. 2016). While adequate food intake is the preferred means of meeting dietary requirements, some nutrient needs are challenging to meet during pregnancy,

Summary

- The introduction of MMS provides a strategic opportunity to strengthen maternal nutrition and health systems.
- Context-specific approaches grounded in implementation research allowed robust situational analysis and community engagement to inform programme design and has improved uptake and acceptability of MMS.
- Government leadership, integration into national policies and existing systems, and inclusion of MMS on essential medicines lists are critical for scale-up.
- Strengthening supply chains and identifying sustainable financing mechanisms remain priority areas for future investment.
- Continued implementation research and advocacy are needed to align global guidance and inform evidence-based scale up of MMS.

particularly in low- and middle-income countries (LMICs) (Arimond 2024; Lee et al. 2013).

The multiple micronutrient supplements (MMS) formulation for the United Nations International Multiple Micronutrient Antenatal Preparation (UNIMMAP) was developed in 1999 by UNICEF and WHO. This formulation was developed for the purpose of addressing dietary intake gaps to achieve the recommended dietary allowance of 15 essential vitamins and minerals for pregnant women (World Health Organization, United Nations University, United Nations Children's Fund 1999). Evidence indicates that taking MMS during pregnancy can lower the risk of low birthweight (LBW) and small-for-gestational age (SGA) infants (Ashorn et al. 2023), while also offering comparable benefits in preventing maternal anaemia compared with iron and folic acid (IFA) supplements (Gomes et al. 2023). Compared to IFA, MMS reduces LBW by 15%, stillbirth by 9%, pre-term birth by 4%, and SGA deliveries by 7% (Keats et al. 2021). The benefits of MMS are even stronger in women with anaemia or who are underweight: MMS have been shown to reduce LBW by 19% (vs. 9% in non-anaemic women), and to reduce SGA births by 8% and infant mortality by 29%, compared with no effect for either, in non-anaemic women. Pre-term birth was reduced by 16% for women who were underweight (BMI < 18.5 kg/m^2) compared with 6% in women who were not underweight (Keats et al. 2021; Smith et al. 2017) Finally, MMS have been shown to improve gestational weight gain over IFA alone (Liu et al. 2022).

MMS have been recommended for pregnant and breastfeeding women in humanitarian emergencies since 2007 (WHO, WFP, and UNICEF 2007). While repeated calls have been made to replace IFA with MMS in standard antenatal care (ANC) (Ashorn et al. 2023; Hofmeyr et al. 2023; UNICEF, Sight and Life, and Penn StateUniversity 2022), WHO currently only recommends MMS in the context of clinical or implementation research (WHO 2020).

1.1 | The Improving Project

In response to the WHO call for evidence generation on implementation in nonemergency settings, UNICEF, with support from the Gates Foundation (GF) and in partnership with national governments, conducted demonstration projects in Bangladesh, Burkina Faso, Madagascar and Tanzania, under the "Improving Maternal and Pregnancy Outcomes through Vital Interventions for Nutrition and Growth" (IMPROVING) project. A summary description of each country project can be found in Table 1. Guided by a theory of change (Figure 1), the aim was to document and share operational experiences on the use of MMS, as part of improved ANC services, among pregnant women. The project focused on identifying and addressing barriers to the provision of quality ANC services for pregnant women. This encompassed not only the immediate delivery environment but also broader systemic factors such as sustainable financing, supportive policies, resilient supply chains, effective monitoring and evaluation systems, and strong collaboration among stakeholders. In addition, the project aimed to elevate the integration of maternal nutrition interventions, particularly within ANC services, on the agendas of national governments. By combining country-specific strategies with coordinated global support, the initiative sought to strengthen the enabling environment for the scale-up of MMS.

This review documents and synthesises the successes and challenges from the IMPROVING project, which form both universal and context-specific learning for the scale up of MMS programming.

2 | Methods

2.1 | Study Design

This was a qualitative descriptive study bringing together lessons learnt from implementation research in Bangladesh, Burkina Faso, Madagascar and Tanzania.

2.2 | Data Sources

2.2.1 | Document Analysis

Project teams from all participating countries responded to a request to share relevant reports and project documents. We reviewed documents ranging from proposals, policies, standard operation procedures (SOPs), social behaviour change (SBC) materials, write ups from workshops and focus group discussions. We also obtained any additional documents referred to in interviews for review. Project documents provided were read by two reviewers (SF and RM) before the interviews, and key findings and themes highlighted.

2.2.2 | Semi-Structured Interviews

We used purposive sampling to identify key informants to participate in interviews. We interviewed individuals who were directly involved in the design, implementation, supervision or funding of the IMPROVING project at either country, regional or global levels.

Using semi-structured interview guides, we used key themes outlined in the theory of change (see Figure 1) to structure

questions about successes and challenges in the design and planning process of the project, the policy environment, project design and implementation, community engagement, supplies and logistics, finance, and monitoring and evaluation. Key informants were also asked about their ideas and recommendations for future scale up of the project, both in-country and for other countries wishing to follow in their footsteps. Interviews were conducted by two interviewers via videocalls between November 2023 and February 2024. Interviews typically lasted between 60 and 90 minutes. All interviews were conducted following consent and were recorded with permission for notetaking. To ensure the collection of rich and meaningful data, interviewers used open-ended questions, allowed ample time for responses, and used follow-up prompts to explore emerging themes in greater depth. As new themes emerged, minor modifications were made to the interview guide to further explore these areas with subsequent participants. We determined sample sufficiency by the concept of data saturation.

2.3 | Data Analysis

We used a qualitative descriptive (Sandelowski 2000; Doyle et al. 2020) approach to analyse the data collected allowing us to capture detailed insights and experiences from the projects. The approach selected is well-suited to exploratory studies seeking to capture a broad understanding of complex systems, practices, and stakeholder perspectives without imposing predefined theoretical frameworks. After each interview, using recordings and transcripts, the lead interviewer manually coded responses to themes and then two further co-authors assessed emerging themes to determine whether additional data were contributing new information. Following this, we summarised findings narratively combining information from both interviews and the review of project documents. Key themes initially centred around the broad components of the theory of change and were further sub-categorised to develop the key learning points for the purpose of this paper. The final selection of themes and write up of results were shared with key informants to ensure we had accurately captured their views.

2.4 | Ethical Considerations

This study did not require ethical approval as it used routine programme documentation. Consent was gained for all interviews that took place and all of those interviewed have reviewed and approved this manuscript. Ethical approval was granted for the original implementation research in all four countries.

3 | Results

3.1 | Description of Key Informants and Documents Reviewed

In total, seventeen individuals from UNICEF and the GF were interviewed, two were from Bangladesh, four from Tanzania, two from Madagascar, three from Burkina Faso, three from UNICEF headquarters, one from UNICEF's global Supply Division and two from the GF. All individuals worked at programme management level or above. We reviewed 72 files provided, including project proposals, monitoring frameworks, workshop reports, situation analyses, standard operating procedures, donor reports, and programme guidelines.

3.2 | MMS as an Opportunity to Strengthen ANC

The biggest strength of the project identified by all participants interviewed was the overarching approach taken to IMPROVING, which used the introduction of MMS as an opportunity to strengthen ANC more broadly, ensuring the focus was not solely on the provision of MMS as a product.

> *The whole issue was from the beginning to demonstrate how the antenatal care system will be improved if MMS will be introduced*
>
> Key informant Bangladesh

Rather than replace IFA with MMS in a like for like switch, the approach allowed countries to consider how to strengthen nutrition services within ANC, and what would be needed to ensure success in the integration of MMS into existing maternity services.

> *Our intention was for this not to be a project, but something embedded in ongoing antenatal care systems. How do you use IMPROVING to strengthen the system? It was intended to look at the bottlenecks for not just maternal micronutrient supplements but the counselling elements, the supply chain elements, the training of community health workers, the monitoring of supplements, essentially every single facet. The emphasis was different in different places.*
>
> Key informant, HQ

3.3 | Context Specific Situation Analyses Enable Responsive Programme Design

Throughout the course of the project, the approach to IMPROVING was grounded in implementation research (WHO/TDR 2014), resulting in adapted formative research guidelines for introducing MMS programming within ANC which are now widely available (UNICEF, PennState, and S.a. life 2022). Key informants all highlighted that an inception phase with allocated time and resources for extensive situational analyses was instrumental in the formulation of key questions and context specific programme design, and the overall success of the programme.

In all countries, there was engagement with national and subnational governments, and communities during the assessment and design phase, an approach identified as imperative to success by all informants. In country desk-based reviews of existing programmes, policies and health seeking behaviours that underpin the enabling environment for maternity care were conducted. The reviews (outlined in Table 1) helped define

TABLE 1 | Country summaries; project activities, advocacy and policy work, methodology of project implementation.

	Bangladesh	Burkina Faso	Madagascar	Tanzania
Summary of intervention	MMS delivered through ANC at health facility and community clinic level in two districts (Kurigram and Bhola). Programme also implemented in ready-made garment factories at community level. Nutrition counselling for pregnant women integrated into ANC. CHWs encouraged early identification of pregnancy and referral to ANC, educating families and husbands on benefits of early ANC attendance and early MMS supplementation.	MMS delivered through ANC at health centre level in two districts (Yako and Ziniaré). Nutrition counselling for pregnant women and anaemia screening integrated into ANC. CHWs conducted home visits to identify and register pregnant women with the ANC services at health facilities. Female CHWs facilitated to improve the trust & rapport between pregnant women and CHWs.	Two implementation arms: Soavinandriana district – Intervention 1: MMS supplementation at the health facility level during ANC visits. Ifanadiana district – Intervention 2: MMS supplementation at both the health facility level and community level. Integrated nutrition counselling for pregnant women at health centre level. Identification of pregnant women at community level by CHWs and traditional birth attendants and referral to health facilities. Pregnancy testing kits for CHWs to facilitate early identification.	Three implementation arms in three different districts: Kyela – Intervention 1: pregnant women transition from receiving IFA to MMS, including enhanced ANC services with community promotion through the delivery of comprehensive maternal nutrition care package. Chunya – Intervention 2: pregnant women receive IFA, including enhanced ANC services with community promotion through the delivery of comprehensive maternal nutrition care package. Mbarali - Control district - standard care (IFA) for pregnant women and other reproductive child health services. Hemocues purchased for health facilities so anaemia screening could be conducted during ANC. Integrated nutrition counselling for pregnant women at health centre level. CHWs identified pregnant women at community level, referring them to health facility.
Project start and end date	January 2020 – August 2024	June 2021 – June 2024	September 2021 – March 2024	August 2022 to March 2024
Initial assessments undertaken	Household survey. Health facility assessment survey. Quality of ANC service survey. Knowledge, Attitudes and Practice (KAP) survey of pregnant women and healthcare providers.	Analysis of Maternal Nutrition Status in Yako and Ziniaré districts. Qualitative study: barriers and facilitators to maternal health amongst pregnant women. Market assessment & analysis of production/procurement of MMS	Analysis of existing maternal health and nutrition. Analysis of enabling environment for maternal health and nutrition. Quantitative analysis of bottlenecks to maternal health and nutrition.	Analysis of Maternal Nutrition Status in Mbeya Region. Assessment of Nutrition Service Delivery and Utilization in Health Facilities in Mbeya. Analysis of production and procurement of MMS.

(Continues)

TABLE 1 | (Continued)

	Bangladesh	Burkina Faso	Madagascar	Tanzania
	Interviews conducted with healthcare providers and pregnant women. Market assessment & analysis of production/procurement of MMS (community workshops, focus groups and market observation).	(community workshops, focus groups and market observation). Interviews conducted with healthcare providers and pregnant women.	Quantitative analysis of barriers and facilitators to ANC and continued IFA supplementation throughout pregnancy. Supply chain assessment of IFA distribution platforms at community and health centre level. Market assessment (community workshops, focus groups and semi-structured interviews with pregnant women). Interviews conducted with health and community workers implementing the project under MOH.	Ethno-medical perspectives of nutrition and health marketing of MMS. Quantitative study of improving maternal and adolescent nutrition. Qualitative study: Barrier analysis for maternal and adolescent nutrition. Baseline biomarker assessment (including capacity-building of Tanzania Food and Nutrition Centre (TFNC) national laboratory which assesses food samples and biomarkers under the MOH).
Barriers to ANC identified during initial assessments				
Late/poor ANC attendance	✓	✓	✓	✓
Distance from health centre	✓		✓	✓
Unfavourable socio-cultural factors		✓	✓	✓
Lack of knowledge around the importance of ANC/nutrition	✓	✓	✓	✓
Lack of family/spousal support	✓	✓	✓	✓
Poor quality of services	✓	✓	✓	✓
Fears around health worker judgment, invasive procedures and quality of care		✓	✓	
Lack of availability of health practitioners	✓	✓		✓

(Continues)

TABLE 1 | (Continued)

	Bangladesh	Burkina Faso	Madagascar	Tanzania
Barriers to IFA uptake during initial assessments				
Side effects of IFA	✓		✓	✓
Low adherence to programme/ consumption of IFA	✓			✓
Stock outs	✓	✓	✓	✓
Cost			✓	
Advocacy undertaken	Development of an advocacy and brief for MOH to support MMS inclusion.	Development of an advocacy and brief for Minister of Health (MOH) to support MMS inclusion.	Upcoming advocacy meeting with MOH to discuss scale-up of MMS.	Continued advocacy efforts to scale-up MMS.
Policy change	Support to MOH for development of National Maternal Nutrition Guideline and National Maternal nutrition Operational Guideline, including updates in ANC guidelines and nutrition strategy.	Support to MOH for updates in reproductive health and national nutrition policy.	Support to MOH for updates in ANC guidelines and national nutrition action plan.	Support to MOH for updates in ANC guidelines and national multisectoral nutrition action plan.
Social and Behaviour Change	SBC/community sensitivity campaigns to educate on the differences between IFA & MMS, the benefits of MMS & ANC, and to encourage family/spousal support.	SBC/community sensitivity campaigns targeting mother-to-mother support groups for pregnant women and fathers/ spouse groups, with key messages around ANC/MMS.	SBC/community sensitivity campaigns to educate on the importance of ANC attendance. Education on the differences between IFA & MMS, the benefits of MMS & ANC, and targeting groups of influence, (e.g. fathers/ spouses, grandparents, traditional healers, religious leaders) with key messages.	SBC/community sensitivity campaigns & workshops held at VHNDs to educate on the importance of ANC attendance Education for local community leaders & traditional healers to reduce pregnant women's use of local healers.
Local production of MMS	Local production has been initiated.	Not suitable – needs regional strategy.	Not suitable – needs regional strategy.	Local production in discussion.
Is MMS Included in EML?	Currently not included.	Currently not included.	Includes MMS.	Currently not included.
Coordination and collaboration	MOH, country-level TAG established and leading on decision-making, inclusive of research partners.	MOH, country-level TAG established and leading on decision-making.	MOH, country-level TAG established and leading on decision-making.	MOH, country-level TAG established and leading on decision-making, inclusive of national research institutions.

(Continues)

TABLE 1 | (Continued)

	Bangladesh	Burkina Faso	Madagascar	Tanzania
Cost analysis	Costed implementation plan developed to support switch from IFA to MMS.	Costed implementation plan developed to support switch from IFA to MMS.	Ongoing discussions on mobilising resources to provide MMS for free at national level.	Ongoing discussions on the cost-comparison of IFA and MMS.
Health workforce	Efforts directed towards capacity-building of health providers, particularly increasing no. of female CHWs available. Linked with community support groups who directed funding for recruitment of volunteers to support CHWs.	Efforts directed towards capacity-building of health providers and the CHW workforce. Job aids for CHWs developed, with tools/solutions tailored to specific problems. Regular monitoring of health facilities to ensure protocol was being followed and to identify gaps/needs.	Training curriculum developed to improve CHWs' nutritional knowledge, counselling skills, weight gain monitoring skills, etc), and improve accurate reporting on the indicators. Certificates of recognition given to CHWs to incentivise them, which improved work ethic.	Efforts directed towards capacity-building of health providers and the CHW workforce. Training modules developed for CHWs to improve nutrition knowledge & counselling skills.

country-specific research questions. Further assessments then explored how and where women access prenatal supplements, the facilitators and barriers to accessing and adhering to supplements, assessment of uptake and quality of ANC services, and women's and community perspectives towards maternal and child health and nutrition. In Tanzania and Bangladesh this was done in collaboration with local research institutes.

Following these comprehensive assessments, key research questions were developed by each country to address the barriers and challenges identified, with common themes emerging across countries. For instance, access to ANC services emerged as a recurring theme, prompting each country to devise its own approach to address this (see Section 3.3 for examples). Both the document review and all key informants stressed how the in-depth situational analyses played a crucial role in project design, guiding prioritisation of strategies for overcoming specific challenges.

> *The early work with assessing acceptability and the enabling environment was key to scale up.*
>
> Key informant, Burkina Faso

Informants also highlighted the varied nature of assessments, considering all aspects of the programme as key. Examples that stood out included the analysis of local production and procurement mechanisms for MMS. IMPROVING adopted a market approach to understanding the supply of MMS and the potential impact on local manufacturers. This began with detailed assessments in each of the four countries to determine what was available in the market and to evaluate the feasibility of local procurement and/or production. Results of these assessments are covered in Section 3.6.

The assessment of women's preferences on packaging and labelling also stood out and was highlighted by key informants at all levels as a vital part of programming, addressing not only women's needs but also a step towards health equity in taking their preferences into consideration.

> *We designed the packaging so it was more attractive for women to feel like, oh, this is something nice. As a woman when I go into a pharmacy, something that is clearly labelled is attractive, and the odds are I'm going to take it. We shouldn't be saying that these women are too poor to have this.*
>
> Key informant, HQ

Formative research aimed to gain insights into preferred MMS packaging characteristics. Mock MMS boxes containing blister packs, with design options based on local contexts were used to prompt discussion with women on their preferred MMS design elements. Data was used to work with suppliers to tailor the packaging, with the aim of enhancing acceptability and uptake. Overall, women preferred white and pink colour palettes, citing reasons such as "*clean*", "*similar to paracetamol*" and "*soft and attractive*". Preferred logos included pictures of a pregnant or breastfeeding woman, or illustrations that depicted a healthy happy woman and child, possibly holding a supplement. Feedback from key informant interviews highlighted this work

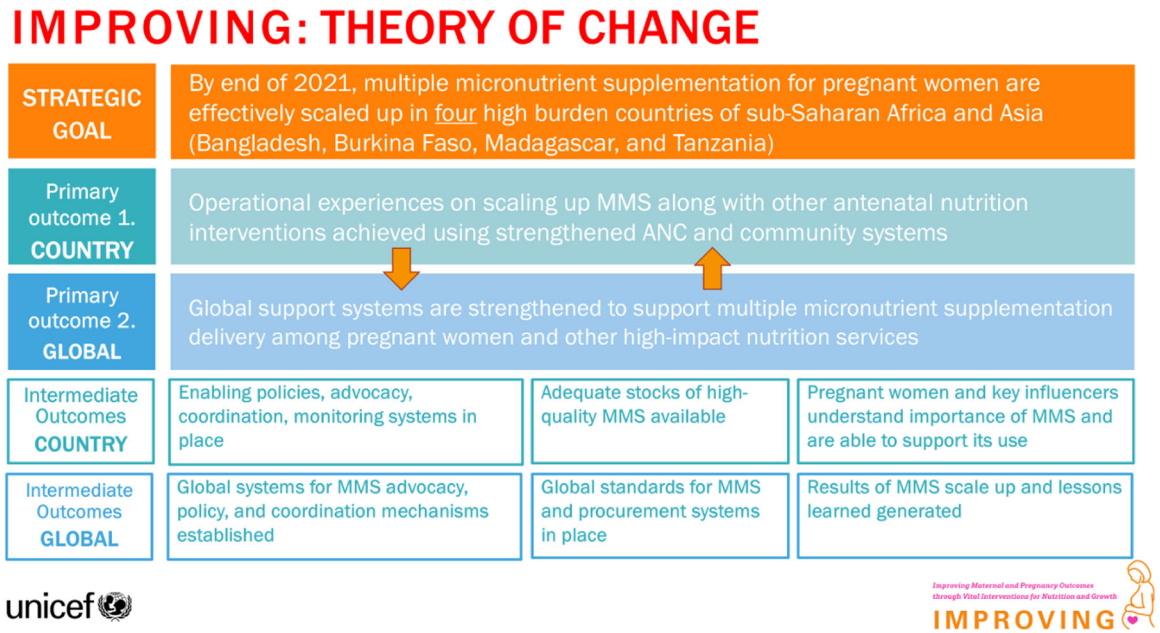

FIGURE 1 | The theory of change underpinning the IMPROVING Project.

as a critical part of promoting a positive pregnancy experience in line with WHO's ANC guidance. All Informants and relevant project documents reported that women valued this experience and the feeling of empowerment it gave them. Interviewees also indicated that they saw the involvement of women in these processes as a shift towards recognising that women deserve high quality and attractive products.

> *The work on the packaging design has been so successful that it is now used as the standard packaging from multiple suppliers, including use of the 'pink lady' logo.*
>
> Key informant, HQ

3.4 | Tailored Interventions to Address Context Specific Challenges

The formative assessments (as outlined in Table 1) identified various factors which might deter or prevent women from accessing ANC. Many of these were common across countries, whilst some were more specific to a given context. IMPROVING countries designed customised programmes to deliver a package of interventions which comprised weight monitoring, nutrition counselling, and MMS in contextually appropriate ways that were responsive to the barriers that mattered most in a given setting.

3.4.1 | Access to, and Quality of Care

Across all four countries, information from project documents and informants during interviews commonly cited distance to health centres and associated travel time as key barriers to accessing ANC. This challenge was especially the case in Madagascar, where difficult terrain and seasonal inaccessibility made travel difficult, particularly for women experiencing nausea and fatigue associated with early pregnancy.

To address these access barriers, countries adapted their approaches. In Madagascar, ANC services including MMS were provided at health centres, while community health workers (CHWs) conducted follow-up, counselling, and referrals. In one implementation arm, MMS was also distributed by CHWs directly, reducing the need for women to visit health centres for every contact and improving continuity of care. Key informants from Madagascar highlighted the success of the project was due to women's and CHW's preferences being taken into account with this approach.

In Bangladesh, the programme expanded to workplaces, specifically the ready-made garment (RMG) sector, where women make up over 60% of the workforce. Through the Mothers@-Work initiative, ANC services and MMS were made accessible at the workplace, helping to overcome barriers related to time constraints and competing household or job responsibilities:

> *Working in the factories we are promoting maternal nutrition, plus making sure that women's rights are protected in terms of maternity leave, plus exclusive breastfeeding, plus some early childhood development components.*
>
> Key informant, Bangladesh

The quality of care emerged as a consistent concern. Across countries, women reported that poor service quality deterred them from attending ANC. Key issues included lack of essential equipment, stock-outs of supplements, long wait times, and negative interactions with staff. In Madagascar, some women reported walking barefoot for hours to reach a clinic, only to find it closed or unstaffed. Women in Madagascar also expressed a preference for female health workers and were deterred by male health workers, especially where they believed vaginal examinations might be needed.

In all countries, CHWs played a pivotal role in improving both access and quality. Their trusted position in

communities made them effective in delivering services and health education. However, in Bangladesh, workforce gaps were significant, with key informants noting that nearly 45% of CHW posts were vacant. Across all countries, strengthening the health workforce through training, supervision, and clear task allocation, was identified by key informants as a prerequisite for scaling up MMS. Supportive supervision and motivation for CHWs were seen as critical. In Madagascar, a recognition system awarding certificates for successful referrals helped improve performance and morale. Capacity-building, mentoring, and high quality supervision were highlighted as essential strategies to enhance CHW effectiveness and ensure the sustainability of ANC and MMS delivery.

> *The use of CHWs in Madagascar was a creative solution for women, facilitating greater access to antenatal contact points throughout their pregnancy.*
>
> Key informant, HQ

3.4.2 | Low and Late Attendance

Late and low attendance at ANC were highlighted as a common challenge across countries, where most women attend their first ANC appointment in their second or third trimester, thus missing the benefits of supplementation in early pregnancy. In addition to some of the SBC efforts described in section 3.3.5, in Madagascar, pregnancy tests were used by CHWs to assist women in confirming pregnancy earlier and initiating the ANC pathway:

> *Something we learned was the use of pregnancy tests in the community helped to boost antenatal enrolment at the early stages of pregnancy.*
>
> Key informant, Madagascar

In Tanzania, informants highlighted how village health days and support from CHWs have been key to increasing early identification of pregnant women and facilitating their referral to health centres.

3.4.3 | Removing Barriers to Adherence

Acceptability of MMS over IFA was described as the most significant contributing factor towards improved adherence in all four countries. Reports from focus group discussions with women in Bangladesh and Tanzania, as well as key informants from all countries, all highlight fewer side effects from MMS compared with IFA.

> *We are hearing that pregnant women like MMS more, especially for those who were pregnant previously and had taken IFA, they seem to report fewer side effects from MMS.*

Key informant, Bangladesh Endline assessments in Bangladesh reported significant increases in both the coverage of MMS, and consumption of MMS in the intervention areas compared with coverage and consumption of IFA in non-intervention areas.

3.4.4 | Social Norms Around Health Seeking

The social behaviour change (SBC) component of the programme focused on changing behaviour with the aim of demand creation, rather than simply communicating messages. Engagement was designed around the barriers and social norms identified within the situational analysis. The importance of addressing healthy pregnancy, as opposed to just promoting a product and ensuring that all members of the community that influence care seeking behaviours are targeted, were reported as key to success. For example, one barrier analysis from Burkina Faso found that whilst a woman's parents and husband might support attendance at ANC, parents-in-law might think differently and exert more influence. In all countries, SBC efforts have focused on highlighting the importance of attending ANC, the benefits of early attendance and the importance of good nutrition in pregnancy (including MMS supplementation). This took different forms including village health days (Tanzania), radio campaigns (Tanzania, Madagascar, Burkina Faso), targeting of fathers/husbands (all countries) and grandparents (Madagascar), community leaders and traditional healers (Madagascar and Tanzania) and wider community members (all countries). In Tanzania and Burkina Faso, there was a strong drive to encourage husbands' attendance at ANC appointments.

Some aspects of SBC targeted context specific ideas and misconceptions. In Bangladesh for example, the fear of having a large(r) baby, was cited as a reason why women might make certain dietary and supplementation choices:

> *We know of mothers who believe eating extra food during pregnancy would result in giving birth to a larger baby and so they choose to eat less to avoid caesarean sections.*
>
> key informant Bangladesh

3.4.5 | Financial Barriers

Cost was identified as a potentially prohibitive barrier to care for many women, in terms of payment for care (Madagascar and private clinics in Bangladesh), payment for supplements (Madagascar) or transport to the health centres (Bangladesh, Madagascar and Tanzania). In Madagascar, the cost of IFA falls to women as these supplements are not provided free of charge. The free provision of MMS was seen as contributing to the positive uptake:

> *Women were really happy with MMS as opposed to IFA. We need to understand if removing the cost helped because the fact that it is free is definitely a kind of incentive.*
>
> Key informant, Madagascar

UNICEF country offices supported free provision of MMS and continue to work with governments to facilitate longer-term solutions.

3.5 | Advocacy and Policy as a Driver of Change

Advocacy played an important role in the IMPROVING project and has been a continuous process at all levels of intervention.

To complement an advocacy package highlighting global evidence, findings from the cost-effectiveness and situational analyses in each country were used to formulate country specific advocacy packages. These were used to aid discussions with national and subnational governments and community leaders. A key focus of the advocacy initiatives related to the incorporation of MMS onto the essential medicines list (EML). At global level, MMS has been included on the EML, paving the way for governments to include MMS in national EMLs. This has so far been achieved in Madagascar and Burkina Faso, with efforts ongoing in other countries:

> *We did a lot of work on advocacy for MMS in the global essential medicines list and as that happened and got approved, countries started advocacating for that too, with each country moving at its own pace.*
>
> Key informant, HQ

Advocacy also played a role in the revision and strengthening of policies, particularly where cross-sector collaboration was necessary to ensure that nutrition was reflected within policy and guidance that is under the remit of reproductive health departments. The process of policy revision and collaboration between relevant sectors served as a mechanism for fostering national ownership and creating an enabling environment for the programme, as well as future scale up, for example, the addition of MMS into the national multisectoral policy in Burkina Faso, the nutrition action plan in Madagascar, and the maternal nutrition operational guidelines in Bangladesh.

Although these policy changes laid the groundwork for improved implementation and national ownership, challenges do persist for scale up, in particular regarding the alignment with WHO guidelines. Inconsistencies in global guidance hinder the scalability of MMS interventions, as highlighted in interviews conducted in Madagascar, emphasising the need for clearer policy directives.

3.6 | The Importance of Partnerships and Coordination

Throughout the interviews, partnership was identified as crucial to the success of the programme, with emphasis on the importance of placing government at the centre of decision-making. This partnership approach promoted ownership, supported the enabling environment, and continues to drive further scale-up. Coordination was also key between different departments within governments and organisations, such as nutrition and reproductive health teams. This was highlighted as a success of IMPROVING in both global level and country level discussions where the importance of ensuring representation from all relevant sectors was emphasised. An example of this can be seen in Bangladesh, where before IMPROVING, the ANC card did not have a box for IFA distribution. Collaboration between government departments (such as nutrition, child health, reproductive health) paved the way for changes to ANC forms and the development of guidelines for nutrition in maternity care.

In addition to government partnership, in all four countries a technical advisory group (TAG) comprising experts was established to provide guidance. In Tanzania and Bangladesh, further partnerships were formed with national research bodies to support the design and implementation of assessments, analysis of results, development of research questions, design of the implementation research and endline evaluations. These partnerships have contributed to the overall success and sense of national ownership of the project.

> *Partnerships were key to success – not only through ensuring good communication and coordination with all relevant government departments, but also through national coordination mechanisms such as technical advisory groups.*
>
> Key informant, HQ

3.7 | The Challenge of Supply

In the majority of interviews, sustaining a consistent supply of MMS was identified as one of the most challenging aspects of the IMPROVING programme. As described in Section 3.2, in-depth market research was conducted in each country, mapping out existing and potential suppliers to determine contextually appropriate solutions for sourcing MMS, and the feasibility of local production. Local production was highlighted as a possibility in two countries, Bangladesh and Tanzania and efforts to move this forward are ongoing. Local production was not deemed appropriate in Burkina Faso and Madagascar, where regional or global solutions have been considered more feasible.

Effective supply chain management was also highlighted as an area needing improvement in all countries. IFA is often locally produced and easily available, but still subject to challenges such as stock outs. Improvement in management is needed to address issues such as poor storage conditions and improved forecasting (accounting for inaccessible roads during rainy seasons) to prevent stockouts. Integration of MMS into the national supply chain and associated stock management systems and its inclusion on the national EML were identified as important steps towards effective management of MMS in Burkina Faso and Madagascar.

> *We need to make sure that supplies go in a coordinated way to the district and that they manage things, as opposed to multiple partners sending supplies in an uncoordinated way That helps with the monitoring of stock outs and supporting government-led supply chain management.*
>
> Key informant HQ

In Tanzania steps have been made toward this and MMS is now included in the electronic Logistics Management Information System (e-LMIS system) allowing districts to request MMS and be held accountable for (MMS) logistics and reporting in the national supply system, similar to IFA. The need for strengthening of capacity at all levels in supply chain management to improve long term planning and forward thinking was identified in all countries as vital to ensure a secure supply chain.

3.8 | Integration of Data Collection Tools Into Existing Systems

The approach taken to integrate MMS into ANC meant that data collection was primarily integrated into existing DHIS-2 in all four countries:

> *We didn't want to create a parallel system. Within the national health information system there were some indicators that were not included, so we added some of the indicators. The indicators that were added, were also put in the routine information system.*
>
> Key informant Burkina Faso

Most country level informants highlighted this integration as key to success, however, several challenges persist in fully capturing all components of the programme. While existing systems accurately capture the number of women reached, they may not comprehensively reflect the extent of coverage or the quality and effectiveness of interventions. Similarly, the initial situation analyses provided insights into women's and communities' perceptions of ANC and IFA supplementation. However, there is no formal system for ongoing monitoring and response of indicators, such as adherence. While capturing data on coverage, quality and effectiveness of interventions may not be a practical reality for programming at scale, interviewees suggest that practitioners should consider periodic assessment of more qualitative measures of ANC performance.

3.9 | Sustainable Financing

The MMS used in the four country programmes, and other programme components were funded within the IMPROVING project. While the additional 13 micronutrients compared to IFA, along with quality assurance requirements, makes it a more expensive commodity than IFA, which has been identified as a challenge, the additional benefit from more micronutrients must be factored into conversations about cost. Many, but not all, government budgets include allocated funds for IFA, but this will not cover the additional cost for MMS. In the short term, key informants outlined initiatives such as UNICEF's Improving Maternal Nutrition Acceleration Plan, and the Child Nutrition Fund (using match funding mechanisms), along with other similar sources of funding can help to cover these costs. In Bangladesh, the government has agreed to the redistribution of budget lines to contribute towards the cost of scaling up maternal nutrition interventions nationally. Long term, predictable funding sources need to be identified for countries intending to scale-up to national level over the longer term.

> *Since the end of this project two countries (Bangladesh and Madagascar) have successfully applied for multi-year funding from the UNICEF-led Child Nutrition Fund, which includes commitments of domestic resources from the respective governments.*
>
> Key informant HQ

4 | Discussion

The IMPROVING project has generated a substantial amount of implementation evidence from which to draw lessons for future scale up of MMS. Learning is ongoing, but our findings already show that the provision of MMS within ANC is not only possible but is beneficial to both women's nutrition and the quality and accessibility of services. In Figure 2, we outline ten key lessons for future scale up of MMS programming that stand out from the synthesis of learning presented above.

Ensuring leadership from national and subnational governments, alongside strong multisector coordination from the outset was identified as fundamental to successful scale up of MMS. Likewise, national policies that include MMS as a component of integrated health and nutrition interventions for maternity care are necessary to transition from IFA to MMS, and to bolster the case for integrating MMS into routine maternal health programmes. At global level, updating of the current WHO guidelines would help to facilitate this process. Continuous advocacy is vital, with the sharing of evidence and documentation with decision makers.

Perhaps the most important learning is that MMS should not be considered as a product-driven solution to improving maternal nutrition, nor as something that should be simply swapped for IFA, but rather the provision of free MMS should be seen as an opportunity for strengthening ANC in a way that addresses the barriers and challenges to timely uptake and continuity of services. As the interest in scaling up MMS grows among donors, governments, and partners, advocating for the importance of viewing MMS as an opportunity to support system-strengthening must be emphasised.

The approach to IMPROVING, grounded in implementation research, resulted in a systematic introduction of MMS as part of strengthened ANC services. This included an inception phase comprising comprehensive situational analyses to identify challenges specific to each context and allowed the design of responsive MMS programming. Likewise, the formative research empowered women via consultations and helped to build ownership. This approach also allowed the generation and documentation of evidence around scaling up MMS, contributing towards research priorities laid out in the global Child Health and Nutrition Research Initiative (CHNRI) exercise that was conducted in 2020 on research priorities for MMS supplementation in pregnancy (Gomes et al. 2020).

In addition to strengthening systems, the decision to focus on demand creation has contributed to the buy-in from communities but also addresses issues of equity. Personalised quality care is an incentive to attend ANC and to adhere to MMS. By identifying the key barriers to ANC, IMPROVING addressed these in a way that considered the whole system. The work conducted around packaging was noted as a particular strength, addressing not only women's preferences, but also considering MMS as a social equaliser, whereby women in LMICs have the same access to high-quality and visually appealing products as women in high-income countries. This also contributes to the overall approach of demand creation and indirectly improves

Ten key successes and/or lessons learned from IMPROVING for future scale up

1. Scale up of MMS should be led by national and sub-national governments alongside strong multisector coordination from the outset.
2. Inclusion of MMS into national and global policy is an opportunity to strengthen policy and ensure cross sector engagement.
3. MMS should not be seen as a product driven approach, but rather an opportunity for strengthening ANC provision.
4. The demonstration project process allows the identification of barriers to MMS and facilitates context specific programming to address these.
5. The inclusion of MMS in a national EML supports the enabling environment for scale up.
6. Monitoring and evaluation of MMS programming should be integrated within existing health information systems rather than parallel systems.
7. Continuous supply and effective supply chain management is key to support scale up.
8. Community engagement and demand creation contributes to improved ownership, uptake and acceptance of antenatal services, and access to MMS.
9. Adequate financing should be secured for supply, distribution and programming.
10. Continued influencing, evidence generation and advocacy at both national and global level is key to achieving success in all aspects of MMS programming scale up.

FIGURE 2 | Ten key successes and/or lessons learned from IMPROVING for future scale up.

adherence. The project has shown that strengthened community components, with strong links to health centres and enhanced support and supervision systems, have the potential to increase coverage and continuity for rural and remote communities and those with restricted access, along with the earlier identification of pregnancy.

Despite interventions to support an enabling environment, the supply of MMS proved to be challenging during the IMPROVING project, posing a threat to viability and success. A focus on ensuring consistent supply and effective supply chain management should be a key component of future scale up efforts.

4.1 | Limitations

The IMPROVING project was not designed to assess the impact of MMS, rather it addressed the practical question of how to integrate MMS into ANC in a way that comprehensively strengthens the enabling systems, from policy through to delivery of care. Endline evaluations are ongoing for the different methods implemented in each country and will offer more insight into topics such as coverage, cost benefits and adherence. This synthesis of learning complements the evaluations by looking at project teams' perceptions of successes and challenges encountered during the design and implementation of the IMPROVING project. Whilst implementation research cannot necessarily meet a certain level of rigour required for some research questions, it does offer critical insight into understanding programming realities, women's perspectives, and the processes, planning and implementation required. It can therefore contribute vital learning for shaping future interventions and supporting countries wanting to integrate MMS into ANC care and future scale up. It should also work as a reminder to practitioners to document their own learning in the same way that IMPROVING has, to continue building the evidence base on how to implement and sustain the programme.

5 | Conclusion

Evidence exists on the efficacy and additional benefits of MMS over IFA in pregnant women. The IMPROVING project makes a significant contribution to the implementation evidence base and highlights that the move to MMS from IFA should be seen as an opportunity to improve services and advocate for a health systems-wide approach rather than isolated interventions.

Author Contributions

S.F., P.J., E.M., and R.M. designed the study methodology. All authors reviewed and agreed to the methodological approach. S.F. and R.M. conducted all interviews, reviewed supporting documents, and prepared the initial manuscript drafts. P.J. and E.M. reviewed and provided feedback on the initial drafts. All authors reviewed, edited, and approved the final manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

Arimond, M., D. Wiesmann, L. M. Grummer-Strawn, E. L. Ferguson. 2024. "Food Pattern Modeling to Inform Global Guidance on Complementary Feeding of Infants." *Maternal & Child Nutrition*: e13590.

Ashorn, P., U. Ashorn, Y. Muthiani, et al. 2023. "Small Vulnerable Newborns-Big Potential for Impact." *Lancet* 401, no. 10389: 1692–1706.

UN General Assembly. 1979. "Convention on the Elimination of All Forms of Discrimination Against Women." *United Nations, Treaty Series* 1249: 13.

UN General Assembly. 1948. *Resolution 217A (III),* Universal Declaration of Human Rights (UDHR). https://www.un.org/en/about-us/universal-declaration-of-human-rights.

Doyle, L., C. McCabe, B. Keogh, A. Brady, and M. McCann. 2020. "An Overview of the Qualitative Descriptive Design Within Nursing Research." *Journal of Research in Nursing* 25, no. 5: 443–455.

Gernand, A. D., K. J. Schulze, C. P. Stewart, K. P. West, and P. Christian. 2016. "Micronutrient Deficiencies in Pregnancy Worldwide: Health Effects and Prevention." *Nature Reviews Endocrinology* 12, no. 5: 274–289.

Gomes, F., S. Askari, R. E. Black, et al. 2023. "Antenatal Multiple Micronutrient Supplements Versus Iron-Folic Acid Supplements and Birth Outcomes: Analysis by Gestational Age Assessment Method." *Maternal & Child Nutrition* 19, no. 3: e13509.

Gomes, F., M. W. Bourassa, S. Adu-Afarwuah, et al. 2020. "Setting Research Priorities on Multiple Micronutrient Supplementation in Pregnancy." *Annals of the New York Academy of Sciences* 1465, no. 1: 76–88.

Hofmeyr, G. J., R. E. Black, E. Rogozińska, et al. 2023. "Evidence-Based Antenatal Interventions to Reduce the Incidence of Small Vulnerable Newborns and Their Associated Poor Outcomes." *Lancet* 401, no. 10389: 1733–1744.

Keats, E. C., J. K. Das, R. A. Salam, et al. 2021. "Effective Interventions to Address Maternal and Child Malnutrition: An Update of the Evidence." *Lancet Child & Adolescent Health* 5, no. 5: 367–384.

Lee, S. E., S. A. Talegawkar, M. Merialdi, and L. E. Caulfield. 2013. "Dietary Intakes of Women During Pregnancy in Low- and Middle-Income Countries." *Public Health Nutrition* 16, no. 8: 1340–1353.

UNICEF, Sight and Life, and Penn StateUniversity. 2022. *Formative Research Guidance: IntroducingMultiple Micronutrients Supplements (MMS).* UNICEF andSight and Life.

Liu, E., D. Wang, A. M. Darling, et al. 2022. "Effects of Prenatal Nutritional Supplements on Gestational Weight Gain in Low- and Middle-Income Countries: A Meta-Analysis of Individual Participant Data." *American Journal of Clinical Nutrition* 116, no. 6: 1864–1876.

Sandelowski, M. 2000. "Whatever Happened to Qualitative Description?" *Research in Nursing & Health* 23, no. 4: 334–340.

Smith, E. R., A. H. Shankar, L. S. F. Wu, et al. 2017. "Modifiers of the Effect of Maternal Multiple Micronutrient Supplementation on Stillbirth, Birth Outcomes, and Infant Mortality: A Meta-Analysis of Individual Patient Data From 17 Randomised Trials in Low-Income and Middle-Income Countries." *Lancet Global Health* 5, no. 11: e1090–e1100.

Stevens, G. A., T. Beal, M. N. N. Mbuya, et al. 2022. "Micronutrient Deficiencies Among Preschool-Aged Children and Women of Reproductive Age Worldwide: A Pooled Analysis of Individual-Level Data From Population-Representative Surveys." *Lancet Global Health* 10, no. 11: e1590–e1599.

UNICEF, PennState, and S.a. life. Formative Research Guidance: Introducing Multiple Micronutrient Supplements (MMS). 2022.

World Health Organization, United Nations University, United Nations Children's Fund. 1999. *Composition of a Multi-Micronutrient Supplement to be Used in Pilot Programmes Among Pregnant Women in Developing Countries: Report of a United Nations Children's Fund (UNICEF), World Health Organization (WHO) and United Nations University Workshop*. UNICEF. http://apps.who.int/iris/handle/10665/75358.

WHO/TDR. *Implementation research toolkit*. 2014. TDR/World Health Organization.

WHO. *WHO Antenatal Care Recommendations for a Positive Pregnancy Experience: Nutritional Interventions Update: Multiple Micronutrient Supplements During Pregnancy [Internet]. Available from*: https://www.ncbi.nlm.nih.gov/books/NBK560384/. Geneva: World Health Organization, 2020.

WHO, WFP, and UNICEF. *Preventing and Controlling Micronutrient Deficiencies in Populations Affected by an Emergency Multiple Vitamin and Mineral Supplements for Pregnant and Lactating Women, and for Children Aged 6 to 59 Months: Joint Statement by the World Health Organization, the World Food Programme and the United Nations Children's Fund* 2007.