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Cost-Effectiveness and Feasibility of Anemia Management in Pregnant Women: A Systematic Review

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ABSTRACT
Anemia among expectant mothers is a major health issue worldwide, especially in developing countries, where prevalence reaches 37%. Various interventions, such as micronutrient supplementation and intravenous iron administration, have been widely implemented. However, limited systematic reviews have comprehensively evaluated both the cost-effectiveness and feasibility of such interventions in low- and middle-income countries (LMICs). This study aims to systematically evaluate recent evidence on the feasibility and cost-effectiveness of anemia management interventions for pregnant women in developing countries. The review followed the 2020 PRISMA guidelines and was registered in PROSPERO (CRD420251089753). Article searches were conducted across five primary databases (CINAHL, CENTRAL, PubMed, Wiley, and Taylor & Francis) for publications between 2015 and 2025. Study selection was performed independently by six authors. Seven studies meeting the inclusion criteria were analyzed narratively. The findings indicated that interventions such as Multiple Micronutrient Supplementation (MMS) and Intravenous Iron Sucrose (IVIS) were highly cost-effective, demonstrating Incremental Cost-Effectiveness Ratios (ICERs) substantially lower than the willingness-to-pay threshold (USD 653–1,792 per DALY) in developing nations, including Indonesia. Feasibility of implementation was influenced by healthcare system capacity, logistical resources, educational initiatives, and sociocultural contexts. Overall, MMS and IVIS interventions demonstrated superior efficiency and effectiveness compared to conventional therapies, though their success relies on system readiness and contextual adaptation. This review fills a critical evidence gap by jointly assessing cost-effectiveness and real-world feasibility, providing a strong foundation for designing sustainable, evidence-based strategies to manage anemia in resource-limited settings.

INTRODUCTION

In the year 2023, it is estimated that around 260,000 women died as a result of issues connected to pregnancy and giving birth, almost 92% of these maternal fatalities happen in low- and lower-middle-income nations.[1] The WHO states that anemia is a global health issue causing maternal deaths, affecting about 37% of pregnant women in low and lower-middle-income countries (LMICs). Africa and Southeast Asia bear the highest burden of anemia, with around 106 million females and 103 million kids impacted in Africa, and approximately 244 million females and 83 million kids in Southeast Asia.[2]

In Indonesia, anemia affects approximately 27.7% of pregnant women.[3] Anemia is a medical condition defined by a decrease in the level of red blood cells or hemoglobin levels, or a decline in the capacity of red blood cells to carry oxygen.[4] Anemia is prevalent in poorer nations, raising the likelihood of low birth weight, premature delivery, as well as maternal and infant deaths. Additionally, maternal anemia poses a barrier to reaching the Sustainable Development Goals (SDGs) For 2030, especially in the effort to lower the rates of mortality among mothers and children.[5,6]

Various interventions have been implemented in developing nations to lessen the occurrence of anemia among expectant mothers. The Indonesian government has adopted a national policy of providing Multiple Micronutrient Supplementation (MMS) since 2024, in accordance with the 2020 WHO recommendations. MMS includes several important micronutrients that help in avoiding anemia and issues during pregnancy.[7] Additionally, the administration of iron-folate tablets (IFTs) for a minimum of 90 tablets during pregnancy is a key strategy in reducing the incidence of anemia caused by iron deficiency. Other efforts include providing supplementary food for mothers who may experience chronic energy deficiency and ensuring that at least four antenatal care appointments are held during pregnancy for early detection of anemia and complications.[8–10]

Healthcare workers, particularly midwives, play a crucial role in education, screening for anemia risk, and monitoring compliance with iron supplement intake.[11] However, the effecttiveness of interventions is often hindered by low educational levels, economic constraints, and unequal access to healthcare services.[12] Support from family and community is critical to the success of interventions, particularly in improving pregnant women's compliance with treatment.[13]

Considering the high prevalence of anemia among pregnant women and the constrained resources in developing countries, a comprehensive evaluation of the cost-effectiveness and practicality of various anemia management strategies is necessary. This evaluation is crucial to ensure that the interventions implemented are not only effective but also efficient and can be widely adopted to lower the rates of anemia among expectant mothers.[14] Previous studies and reviews have generally focused on clinical outcomes, such as comparing oral versus intravenous iron or IFA versus MMS, but have not examined both economic and implementation dimensions together.

Although several systematic reviews have explored anemia management during pregnancy, to date, none have comprehensively assessed both the cost-effectiveness and feasibility of such interventions in low- and middle-income nations so far. Addressing this important gap is essential to strengthen evidence-based maternal health policy and guide the efficient allocation of limited resources. Therefore, the novelty of this study lies in its dual analytical framework systematically reviewing both cost-effectiveness and feasibility of anemia management interventions for pregnant women in developing countries. By addressing this research gap, the study provides comprehensive insights that can guide policymakers and healthcare providers toward efficient, equitable, and contextually appropriate strategies to reduce the burden of maternal anemia.

MATERIAL AND METHOD

This study employed a systematic review approach to collect and assess evidence regarding the feasibility and cost-effectiveness of interventions for managing anemia among pregnant women in developing countries. This review followed the 2020 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, and the protocol was of-ficially registered in PROSPERO on July 11, 2025, under the registration ID CRD420251089753.

The population examined in this review consisted of pregnant women from low-and middle-

income countries (LMICs) who received interventions for anemia management, including Multiple Micronutrient Supplementation (MMS), Iron Folic Acid (IFA), Intravenous Iron Sucrose (IVIS), and Oral Iron (OI). Articles were included if they were original, open-access, full-text in English and published between 2015 and 2025, discussing the cost-effectiveness and feasibility of anemia prevention and management among pregnant women in developing countries, as classified by the World Bank. Studies that focused on pregnant women or published in non-English were excluded from the review.

This study included five databases: CINAHL, CENTRAL, PubMed, Wiley Online Library, and Taylor & Francis, all of which were published between 2015-2025. The search was conducted systematically, expanded using Boolean operators and truncation. Additionally, the reference lists of the included articles were manually checked to identify any relevant studies that were not captured in the initial database search.

The literature search strategy in this study was comprehensively designed using the main keywords "pregnant women," "anemia," "anemia management," "economic evaluation," and "developing countries" (Appendix 1). The retrieved articles were imported into Mendeley to identify duplicates. The article selection process was conducted using Rayyan Software, where six authors independently selected articles. If there are differences of opinion in the selection of articles, they will be discussed until an agreement is reached.

Data extraction was performed using a predetermined format that included study characteristics, population, type of intervention, outcomes, cost-effectiveness data, and feasibility aspects. Extraction was performed independently by six authors to ensure data accuracy. Effect measures included ICER, cost savings, outcomes, and ease of implementation. Reporting bias was assessed by evaluating the consistency between study results and the original research objectives. Additionally, a literature search was conducted to reduce the risk of publication bias.

Synthesis Methods

The synthesis was conducted narratively and thematically, taking into account the type of intervention and study outcomes. A meta-analysis was not conducted because of substantial heterogeneity in study designs, populations, and economic evaluation measures. Study results were summarized in tables and descriptive narratives, enabling comparisons of cost-effectiveness and implementation feasibility across interventions. Prior to synthesis, economic information was standardized to US dollars (USD) based on the official exchange rate at the time of the study. If cost information was incomplete or only available descriptively, results were presented qualitatively to maintain consistency in the analysis. The summary table presents the study location, type of intervention, clinical outcomes, economic effectiveness values (ICER, DALY, QALY), and implementation aspects. The certainty of the evidence was evaluated considering study design quality, result consistency, and applicability to the context of developing countries. Interventions with high-quality studies and comprehensive reporting were assessed as having moderate to high certainty.

Ethical Considerations

As this work was a systematic review utilizing previously published data, ethical approval from an institutional review board was not required. No new data collection involving human subjects was undertaken. All studies included in the review had received ethical approval as stated in their respective original publications.

RESULTS

Study Selection

Based on a search of 5 databases (CINAHL, CENTRAL, PubMed, Wiley Online Library, and Taylor & Francis), 2,312 articles were found. After checking for duplicates using Mendeley, 316 articles were excluded, leaving 1,996 articles for selection based on title and abstract. From this stage, 1,976 articles were excluded as irrelevant, leaving 20 articles for full-text review. The manual search process resulted in the identification of four additional papers that proceeded to full-text evaluation, resulting in 24 articles being reviewed in total. From the review results, 15 articles were excluded because the population was not appropriate (n=5), the study was not conducted in a developing country (n=1), and the results were not relevant to the criteria (n=11). In total, seven studies fulfilled the inclusion criteria and were incorporated into this systematic review. The article selection

flowchart follows the PRISMA 2020 format and is shown in Figure 1.

Study Characteristics

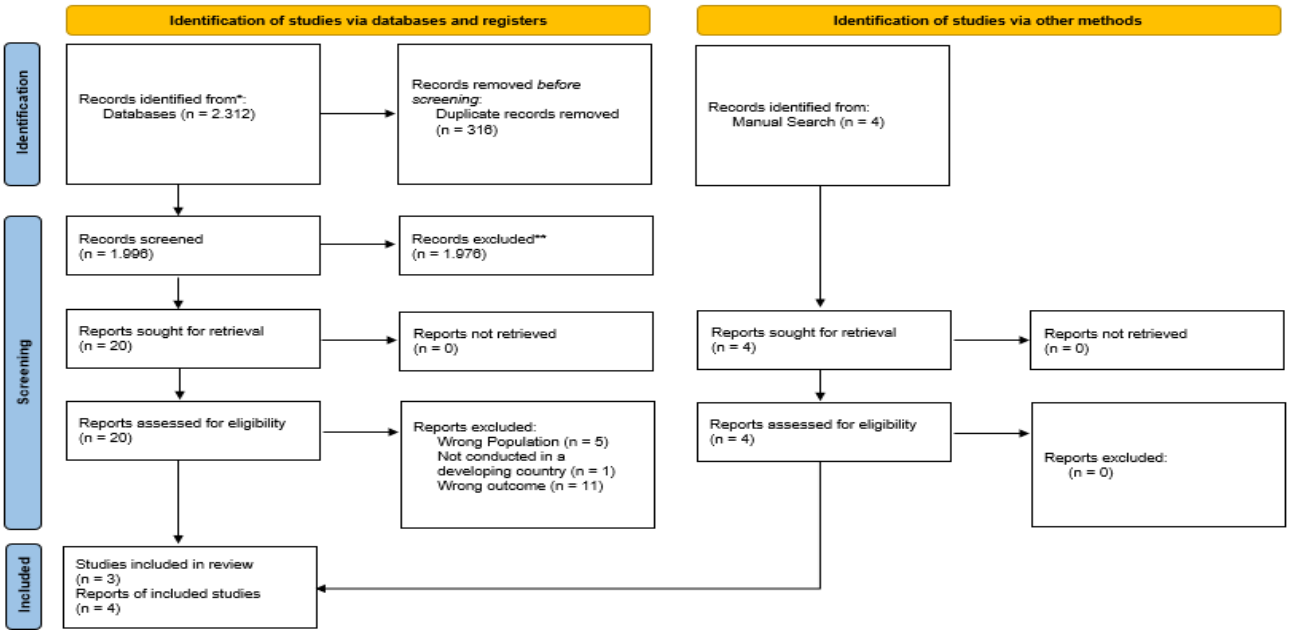
Seven studies were found to meet the inclusion criteria (Appendix 2), covering interventions for the management of anemia in pregnancy through iron supplementation alone, in combination, or through intervention model and policy implementation approaches (A1–A7). All studies were of high quality, as assessed the Joanna Briggs Institute (JBI) guidelines. The studies were published between 2015 and 2024, with the earliest cost estimate in 2016 (A1) and the latest in 2023 (A7); four other studies did not explicitly mention the year of the cost estimate (A2, A3, A4, A6).

Studies were conducted in developing countries, including India, Indonesia, Pakistan, Ethiopia, Bangladesh, and Malawi, all of which are classified as low and middle-income countries (LMICs). Most were conducted at primary care level (A1, A3, A5, A6, A7) or community-based settings (A4), with one study at secondary referral facilities (A2). Study designs varied: two employed decision tree-based economic modeling to calculate ICER per DALY/QALY (A1, A5), while others used prospective case-control (A2), quantitative and qualitative cross-sectional (A3, A4), quasi-experimental (A6), and qualitative designs (A7).

There are differences in the analytical perspectives used, including the perspectives of service providers (A1, A2, A6, A7), the community (A4, A5), and individuals or patients (A3). The evaluation timeframe also varies, ranging from a short-term six-week period (A2) to a lifetime estimate (A1), depending on key indicators such as maternal anemia status, infant health conditions, and maternal mortality rates.

Risk and Reporting of Bias in Studies

The seven included studies were evaluated for potential bias using the Joanna Briggs Institute (JBI) critical appraisal tool, which was adapted according to the specific characteristics of each study design. The economic evaluation studies (A1, A5) demonstrated adequate methodological quality, although some studies did not provide comprehensive cost details. The case-control study (A2) was deemed acceptable, although it did not report confounding factors. The cross-sectional studies (A3, A4) and quasi-experimental study (A6) showed relatively low risk of bias, supported by the application of multivariate analysis however, in study A6, randomization methods were not applied. Meanwhile, the qualitative study (A7) had good methodological quality, but did not include a description of the researcher's reflections during the data analysis process.



Source: PRISMA 2020 Flow Diagram (Page et al., 2021)

Figure 1. PRISMA Flowchart

Overall, the study methodology is good with moderate certainty of evidence, however there are limitations in reporting cost perspectives, duration of effects (time horizon), ethical information, and potential for selective reporting due to the absence of a research protocol.

Results of Syntheses

Multiple Micronutrient Supplementation MTwo studies reported that MMS demonstrated greater cost-effectiveness compared to IronFolic Acid (IFA), with Incremental Cost-Effectiveness Ratio (ICER) values ranging from USD 3.62 to 41.54 per DALY. These values remain well below the willingness to pay (WTP) thresholds established in the respective coun-tries.[15,16] In Indonesia, an additional cost of ap-proximately USD 1 per pregnancy still results in a highly efficient ICER (USD 16.96 per DALY).[17] A 30 mg dose of MMS is equivalent to 60 mg of IFA in maintaining hemoglobin levels and is more effective when combined with IFA.[18,19] MMS is also associated with reductions in anemia, low birth weight, and prematurity.[19]

IV Iron Sucrose (IVIS) vs Oral Iron (OI)

The results of two Indian studies demonstrated that Intravenous Iron Sucrose (IVIS) was more beneficial clinically and economically than Oral Iron (OI) in addressing moderate to severe anemia among pregnant women. The first study demonstrated that IVIS significantly improved hemoglobin, ferritin, and transferrin saturation levels, with a higher mean hemoglobin concentration after 12 weeks of treatment (11.35 ± 0.93 g/dL vs. 10.75 ± 0.95 g/dL), and was associated with fewer gastrointestinal side effects compared to oral ferrous fumarate. The incremental cost-effectiveness ratio (ICER) was very low, at USD 9.84 per QALY (0.49% of GDP per capita), making it highly cost-effective.[20–23]

The second study, an economic analysis of the FeSPAW trial, showed that IVIS, despite having higher average costs (INR 7,677.7 vs INR 6,693.6), resulted in more safe deliveries, with an ICER of INR 31,951 (USD 445.2) per additional safe delivery. Probabilistic analysis indicated that this intervention has a 67% probability of being cost-effective at the 0.5 GNI per capita threshold in India.[24]

Overall, IVIS demonstrated superior clinical efficacy and cost-effectiveness compared to Oral Iron (OI) and is a rational choice for broader adoption in primary care, provided that logistical support systems and strengthened healthcare capacity are in place to support its successful implementation.

Table 1. Summary of Cost-Effectiveness Analyses on Anaemia Management Strategies During Pregnancy

ID	Name & Year	Comparator	Intervention	ICER per X	Threshold CET Indonesia (USD)	Economic Interpretation	Conclusion
A1[15]	Kashi *et al.*, (2019)	Iron and Folic Acid (IFA)	Multiple Micronutrient (MMS)	41.54 USD/DALY (Pakistan)	653-1.792	Very cost-effective (62.6%)	MMS is more cost-effective than IFA (ICER is lower than the WTP threshold)
				31.62 USD/DALY (India)	653-1.792	Very cost-effective (76.8%)	
				21.26 USD/DALY (Bangladesh)	653-1.792	Very cost-effective (82.6%)	
A6[20]	Saha *et al.*, (2024)	Oral Iron (OI)	IV Iron Sucrose (IVIS)	9,84 USD/QALY	653-1.792	Very cost-effective	IVIS is more effective; it is feasible to implement with system support.

Source: Kashi et al., 2019; Saha et al., 2024

Cost-Effectiveness Estimates and Threshold Comparison in the Indonesian Context

MMS and IVIS interventions showed strong economic evaluation results. A summary of the ICER results for both interventions is presented in Table 2.

The cost-effectiveness threshold (CET) analysis for Indonesia, based on simulations from the Umbrales Tool, indicates that all ICER values in studies A15 (MMS vs. IFA) and A20 (IVIS vs. OI) are well below the range of USD 653–1,792 per DALY/QALY, which represents the national WTP threshold. Specifically, the ICER for MMS in Pakistan, India, and Bangladesh was USD 41.54, USD 31.62, and USD 21.26, respectively, indicating a high probability of cost-effective (probability of cost-effectiveness >60%). Similarly, the IVIS intervention yields an ICER of only USD 9.84 per QALY, indicating a dominant position (more effective and cheaper than the oral standard). These findings reinforce the conclusion that both interventions have high potential for national scale adoption, including in Indonesia, given their cost-effectiveness in the context of resource limited countries.

Feasibility Intervention Anemia

Five studies show that the success of iron deficiency anemia intervention implementation is greatly influenced by the readiness of the health care system, sociocultural factors, and logistical support. A study in India found that intravenous (IV) iron sucrose is effective when administered in primary care facilities, while a combination with vitamin B12 is more appropriate for referral facilities due to resource limitations.[26] These findings are consistent with other reports stating that cost factors, implementation complexity, and the readiness of the healthcare system influence the success of IV iron implementation. In the contexts of India and Malawi, insufficient supply of IV iron and differing perceptions among healthcare providers about its safety and clinical effectiveness versus oral therapy were identified as major barriers.[27]

Two studies in Ethiopia emphasize the importance of education and compliance among pregnant women regarding IFA supplementation, although access, acceptability, and sociocultural norms remain barriers.[28,29] Good knowledge, additional information, and ≥4 ANC visits improve compliance, while side effects and forgetfulness are the main barriers.[27] In Indonesia, the collaborative management model shows potential for success if accompanied by training, though it is still hindered by funding and intersectoral coordination.[30] This aligns with findings stating that interprofessional education (IPE) improves collaboration effect-tiveness and clinical outcomes.[31]

Studies in Malawi support the co-design approach for IV iron as a clinically and operationally feasible intervention, although its success depends on training and mitigation of cultural and logistical barriers.[32] Studies in Nigeria add that perceptions of effectiveness, training, availability of information, and cost subsidies are key factors for success, as well as the importance of building trust between health workers and pregnant women to overcome cultural resistance and misconceptions.[33]

The findings show that interventions such as MMS, IFA, and IVIS are generally cost-effective and feasible for reducing maternal anemia in LMICs. However, their effectiveness and feasibility vary by health system capacity, supply reliability, and adherence. Improving anemia management in LMICs therefore requires not only cost-effective choices but also sustainable implementation supported by strong health systems and policy integration. These results highlight the need to prioritize scalable, low cost, and high-impact interventions to optimize resources and advance maternal and child health goals under the SDGs.

DISCUSSION

Main Finding

This systematic review analyzes two studies that evaluate cost-effectiveness and five studies that evaluate the feasibility of various interventions to address anemia in pregnancy, particularly pregnancy-related iron deficiency anemia. All studies were conducted in low and middle-income countries (LMICs), such as India, Ethiopia, Indonesia, and several African countries.

This review is the first to systematically combine evidence on both cost-effectiveness and feasibility of anemia interventions in pregnancy within LMIC settings, offering a novel integrated perspective that has not been explored in previous reviews.

Tabel 2. Feasibility Findings from Studies Related to Iron Deficiency Anemia

ID	Name & Year	Comparator	Intervention	Components of Feasibility Analyzed	Main Findings	Limitations
A2[26]	Shakya *et al.,* (2023)	IV Iron Sucrose only	IV Iron Sucrose + IM Vit B12	Availability of medicines, access to health services	In large-scale implementation, IV Iron Sucrose is suitable for use in primary facilities, while combination therapy is better suited for referral facilities.	Lack of knowledge; culture of oral iron use; need for trained staff and special infusion rooms; limited stock; costs and logistics of repeated administration.
A3[28]	Getachew *et al.,* (2018)	Non-compliance vs. compliance with IFA consumption	Regular IFA tablets	Adherence, access to service systems, social and cultural factors	Feasible if there is increased education, ≥4 ANC visits, and counseling to improve effectiveness.	Low knowledge; uneven education; low compliance despite available access; social and cultural factors not adequately addressed
A4[29]	Wana EW (2020)	IFA users vs. non-users	Regular IFA tablets	Availability, adherence, and acceptance	Low feasibility from the user's perspective, but logistically feasible (supplements available).	Acceptability and accessibility are still limited, especially for mothers who start ANC late or irregularly, low utilization, low awareness
A6[30]	Widyawati *et al.,* (2015)	Regular services	New management model with collaborative teams	Training of health workers and availability of medicines	Feasible if supported by training.	Not yet analyzed from a cost perspective; requires specialized training and cross-sectoral involvement; insurance coverage does not yet support additional ANC visits.
A7[32]	Mamani *et al.,* (2024)	Conventional approach	Co-design model for IV iron	Patient involvement, staff support, logistics & coordination	Feasible clinically and operationally if training and logistics are available	High acceptability but hindered by local culture, logistical and cost barriers.

Source: Getachew et al., 2018; Mamani-Mategula et al., 2024; Shakya N & Rajput, 2023; Wana, 2020; Widyawati et al., 2015

Comparison to Existing Evidence

To date, systematic evidence on the cost-effectiveness and feasibility of implementing anemia interventions during pregnancy LMICs remains scarce. Previous reviews have discussed the potential of interventions such as MMS and Intravenous Iron therapy, however, few have comprehensively examined both cost-effectiveness and feasibility aspects. This review shows that MMS is clinically and economically superior to standard IFA supplementation. The consistency of these findings is supported by several reports linking MMS use with reduced incidence of anemia, LBW, and preterm birth.[18,19,34] In Indonesia, the cost-effectiveness of MMS has been confirmed, with a consistently low incremental cost-effectiveness ratio (ICER) despite an increase in cost per pregnancy.[17]

The findings from the threshold analysis indicate that the ICER values for both MMS and IVIS are significantly lower than Indonesia's cost-effectiveness threshold of USD 653–1,792 per DALY/QALY. Therefore, these interventions can be categorized as highly cost-effective and consistent with recommendations for efficient interventions in middle income countries. These results provide strong economic justification for including MMS and IVIS in national strategic

interventions, particularly in integrated antenatal care schemes that take into account the limitations of the health system's resources.

Economic effectiveness does not always guarantee successful implementation in the field. Studies on the feasibility of anemia interventions highlight various challenges, including constraints in the health system, social norms, and infrastructure limitations. The success of intravenous (IV) iron therapy is significantly influenced by the readiness of healthcare facilities, the training of medical personnel, and the availability of supporting logistics.[27] Perceptions of effecttiveness and availability of information have been shown to influence the acceptance of therapy in Nigeria.[35]

In Ethiopia, low compliance with IFA is attributed to a lack of knowledge, concerns about side effects, and cultural influences.[28,29] The importance of additional information and the frequency of antenatal care (ANC) visits in improving compliance among pregnant women is reinforced by the results of a meta-analysis.[36] From a systemic perspective, interprofessional education (IPE) plays a role in improving collaboration among health workers, provided that formal training and financial support are available.[29,31] A study in Malawi confirms that successful implementation also depends on community participation through a co-design approach.[32]

Policy Implication

This review supports a number of recent WHO clinical guidelines by presenting consistent evidence of cost-effectiveness. This review highlights several interventions with promising economic value as alternatives to current conventional practices. Even though the Nutritional Interventions Update: MMS during Pregnancy has not confirmed MMS as the typical alternative to IFA, the findings from two studies discussed in this review indicate that MMS is more economical, particularly in regions where anemia is widespread and where nutrition access is restricted.[37]

While the WHO has not provided specific guidance on iron administration pathways during pregnancy, The results of this analysis suggest that intravenous iron treatment is frequently more economical than taking iron supplements by mouth, particularly due to faster hemoglobin response and minimal side effects. Nonetheless, how well this approach works is largely influenced by how prepared the healthcare system is, the availability of resources, and the adequacy of professional capacity.

This analysis uncovers major deficiencies in the information related to the economic efficiency of methods for addressing anemia in expectant mothers in low- and middle-income nations. Even though different treatments like iron pills, IV iron treatment, and MMS are suggested in clinical guidelines, thorough and context-driven cost assessments in practical healthcare environments in low- and middle-income countries are still scarce. The absence of such data has the potential to hinder evidence-based policy decision-making and reduce efficiency in the allocation of limited health resources. Therefore, systematic efforts are needed to strengthen cost-effectiveness evidence through contextually designed economic evaluation studies to support the development of sustainable, equitable, and efficient policies for addressing pregnancy-related anemia in antenatal care.

Given that the ICERs for MMS and IVIS are well below the national WTP threshold, these interventions qualify as highly cost-effective solutions from an economic perspective. Therefore, national health policies should begin considering the integration of MMS and IVIS into routine pregnancy interventions as an optimal strategy for improving budget efficiency and maternal health outcomes, particularly in areas with high anemia rates and limited access to healthcare services.

Strenght and Limitations

This systematic review has several strengths. It is relevant for application in Indonesia and other LMICs because it focuses on developing countries, thereby providing applicable findings related to the cost-effectiveness and feasibility of pregnancy anemia management. It also provides a comprehensive overview that can guide evidence-based policymaking. However, it's important to highlight a few limits. The included studies varied in methodology, population, and outcome measurement, which prevented quantitative synthesis or meta-analysis. The search was limited to five English-language databases due to access constraints, which may have left out important research published in different languages or local publications.

Furthermore, the limited amount of qualifying studies indicates the need for further primary research to strengthen the evidence base for both cost-effectiveness and feasibility of anemia interventions in pregnancy within LMICs.

CONCLUSION AND RECOMMENDATION

This systematic review indicates that interventions such as Multiple Micronutrient Supplementation (MMS) and Intravenous Iron (IV) administration are more cost-effective than conventional approaches and align with current clinical guidelines. However, the healthcare system's preparedness is crucial to the practical implementation of these interventions, inter-professional support, and socio-cultural factors.

Evidence related to feasibility shows that the main obstacles are limited resources, the need for health worker training, and access to information for end users. The lack of high-quality economic evaluation studies, particularly in vulnerable populations, underscores the need for further research and evidence-based policies to ensure the effectiveness, efficiency, and sustainability of interventions in low- and middle-income countries, including Indonesia. Practical Implication for Antenatal Care Program in Indonesia.

To optimize the impact of the research findings, integrating Multiple Micronutrient Supplements (MMS) and intravenous iron therapy into Indonesia's antenatal care programs requires a multi-faceted strategy. The foundational step involves policy integration, which entails updating national guidelines to recommend these interventions as standard therapies, supported by a sustainable financing mechanism through the National Health Insurance/*Jaminan Kesehatan Nasional (JKN)* scheme or regional budgets/*Anggaran Pendapatan dan Belanja Daerah (APBD)*.

At the implementation level, the capacity of the healthcare system needs to be enhanced through comprehensive training for medical staff on intravenous iron administration and counseling methods, alongside strengthening the logistics distribution to prevent stockouts of MMS and intravenous iron at primary healthcare facilities. Community acceptance is also a crucial factor that can be achieved by developing culturally relevant educational materials and empowering *Posyandu* cadres as agents of change at the community level.

Prior to nationwide scaling, the final step involves a limited implementation through pilot programs and operational research in selected districts to assess feasibility, effectiveness, and other contextual factors to ensure a successful expansion.

For future research, Randomized Controlled Trials (RCTs) are needed to directly compare the effectiveness of various key interventions, long-term cost-effectiveness analyses tailored to the local context, and implementation studies exploring intervention acceptance, health system readiness, and satisfaction from both service recipients and healthcare providers.

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AUTHOR CONTRIBUTIONS

DW contributed to conceptualization, procedure formulation, literature search, screening, data extraction, and initial manuscript writing. IY contributed to the literature search strategy, critical appraisal of included studies, and interpretation of results. NF was responsible for the methodological framework, risk of bias assessment, and contributed to manuscript writing and revision. SM contributed to data synthesis, thematic analysis, and the preparation of tables and figures. M assisted in the full-text review, data validation, and ensuring consistency in the final manuscript. FH contributed to supervision, providing guidance throughout the review process, and providing important revisions to the scientific substance. The final version of the manuscript has been reviewed and approved by all authors. DW = Della Winanti; IY = Isra Yanti; NF = Nurul Fitriyah; SM = Sirajul Munira; M = Mufdlillah; FH = Firdaus Hafidz.

CONFLICTS OF INTEREST

The authors state that they possess no conflicting interests related to the writing of this study. No financial sponsors influenced the conceptualization, data processing, manuscript preparation, or the decision to publish the findings.

AVAILABILITY OF DATE AND MATERIALS

Data supporting the conclusions of this research can be accessed via the external link included in the appendix.

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