GLOBAL ANAEMIA REDUCTION EFFORTS AMONG WOMEN OF REPRODUCTIVE AGE:

IMPACT, ACHIEVEMENT OF TARGETS AND THE WAY FORWARD FOR OPTIMIZING EFFORTS

World Health Organization

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Global anaemia reduction efforts among women of reproductive age: impact, achievement of targets and the way forward for optimizing efforts

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ABBREVIATIONS

AGP	α-1 acid-glycoprotein
ANC	antenatal care
AREA CoP	Accelerated Reduction Effort on Anaemia Community of Practice
CRP	C-reactive protein
DHS	demographic and health surveys
G6PD	glucose-6-phosphate dehydrogenase
IDA	iron-deficiency anaemia
IFAS	iron and folic acid supplements
ITN	insecticide-treated net
MMS	multiple micronutrient supplements
NTBI	non-transferrin-bound iron
RANI	Reduction in Anaemia through Normative Innovations
REACH	Renewed Efforts Against Child Hunger and Undernutrition
SDG	Sustainable Development Goal
SPRING	Strengthening Partnerships, Results and Innovation in Nutrition Globally
SUN	Scaling Up Nutrition movement
SWOT	strengths, weaknesses, opportunities, threats
USAID	United States Agency for International Development
WASH	water, sanitation and hygiene
WHO	World Health Organization

EXECUTIVE SUMMARY

Anaemia is a global public health concern, afflicting adolescent girls, women of reproductive age, pregnant women and children in low- and middle-income countries.[1] Reduction of anaemia is one of the World Health Assembly Global Nutrition Targets for 2025[2] and of the Sustainable Development Goals. Although some progress in reducing anaemia has been achieved, global progress is not on track for reaching the 2025 target accorded by the World Health Assembly of a 50% reduction of anaemia in women of reproductive age.[1]

This review was commissioned by the World Health Organization (WHO) to collate updates and share new resources for those seeking to implement anaemia reduction efforts worldwide. The purpose of the review is to help Member States and their partners in their efforts to understand and make informed decisions on the appropriate nutrition actions needed to prevent and control anaemias. The objective is to summarize and reference key information and resources that can be applied in these anaemia reduction efforts, including (i) the scope of factors associated with anaemia that should be addressed in the process of applying anaemia reduction efforts – both direct and indirect causes or factors found to be directly associated with anaemia; (ii) a compendium of efforts recommended and feedback from those working on anaemia reduction in different countries; and (iii) steps to consider in terms of priority and readiness in the path for anaemia reduction. This review is directed to a wide audience, including, but not limited to policy-makers, economists and technical and programme staff in ministries and organizations involved in the design, implementation and scaling-up of nutrition actions for public health.

In preparing this document, a desk review was conducted and is summarized here to highlight and provide references to research, guidelines, resources and tools that are relevant for anaemia reduction efforts. A "decision tree" is included, to assist countries through the process of identifying next steps in those efforts. In order to obtain feedback from countries at various stages of anaemia reduction efforts, virtual interviews and an online survey were implemented. Key informant interviews were conducted among researchers and government officials in select countries with high or low success in reducing national anaemia rates among women, and these reviews were analysed. A complementary online questionnaire was shared more broadly through the WHO list-serve.

The etiology of anaemia is complex, and successful anaemia reduction efforts must identify the major contributing factors, then develop and implement an evidence-based package of interventions, which usually implies a multisectoral response, in order to achieve effective results. Strategizing involves multiple iterative and feedback loops; intersectoral approaches are also often needed, although they are likely to require changes in the way the health sector has worked in the past, to include open multi-stakeholder engagement and support.

Results from the qualitative interviews/surveys performed for this review show that better results in anaemia reduction were obtained in countries where programmes were premised on a multisectoral approach, with involvement of all sectors working synergistically. In fact, lack of knowledge about specific activities/indicators/programmes or lack of/poor coordination between different programmes made it difficult to track anaemia reduction progress in all the different ministries and departments involved.

Empowerment of women, and sensitization of the general community and of men on gender equity would contribute to better outcomes in anaemia reduction. Leadership and coordination mechanisms for anaemia reduction are required at global, regional and community level.

Research is integral to supporting programmes, and investments need to be made in implementation research to ensure there is sufficient evidence to determine how best to strengthen and maximize the effectiveness of anaemia-related interventions.

The evidence presented in this review clearly reiterates the critical importance of addressing anaemia from multiple perspectives and through multiple coordinated efforts, including multiple government sectors, nongovernmental organizations, United Nations agencies and the private sector – each with specific and complementary roles to accomplish in reducing anaemia.

1 Kassebaum NJ, Jasrasaria R, Naghavi M, Wulf SK, Johns N, Lozano R et al. A systematic analysis of global anemia burden from 1990 to 2010. Blood. 2014;123(5):615–24. doi:10.1182/blood-2013-06-508325.

2 Global Nutrition Targets 2025. Anaemia policy brief. Geneva: World Health Organization; 2014 (WHO/NMH/NHD/14.4; https://www.who.int/nutrition/publications/globaltargets2025_policybrief_anaemia/en/).

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INTRODUCTION

Reduction of anaemia is one of the World Health Assembly Global Nutrition Targets for 2025 *(1)* and of the Sustainable Development Goals (SDGs), along with reduction of stunting, wasting and overweight *(2)*. Although some progress in reducing anaemia has been achieved, global progress is not on track for reaching the 2025 target accorded by the World Health Assembly of a 50% reduction of anaemia in women of reproductive age *(1)*. The purpose of this review is to help Member States and their partners in their efforts to understand and make informed decisions on the appropriate nutrition actions needed to prevent and control anaemias. Evidence related to the success or lack of progress of anaemia-control programmes is presented, in order to provide guidance to decision-makers on how better to tailor their interventions according to the various causes of anaemia. This review is directed to a wide audience, including, but not limited to policy-makers, economists and technical and programme staff in ministries and organizations involved in the design, implementation and scaling-up of nutrition actions for public health. It is intended to contribute to discussions among stakeholders when selecting or prioritizing interventions to be undertaken in their specific context.

The goal is to highlight the potential for combined interventions to optimize anaemia reduction efforts and close the gaps toward achieving the global targets. Information brought together in this review includes research that was not available at the time of setting the anaemia target in 2012, some of which will provide awareness of whether it is achievable for all countries to reduce anaemia by 50% among women of reproductive age (15–49 years) by 2025.

The first part of this review compiles multiple resources developed to assist in anaemia reduction efforts and analyses the causes and consequences of anaemia, as well as interventions needed to address anaemia, considering some frequently underestimated environmental and socioeconomic domains. The following section includes a landscape analysis of available anaemia programmes to help with selection and implementation of the optimal combination of interventions to reduce anaemia.

Finally, a qualitative analysis to identify country-relevant barriers and enablers in anaemia reduction efforts is presented. To obtain detailed feedback, key informants were approached from countries with the most improvements or most difficulties with their efforts to reduce anaemia.

ANAEMIA

DEFINITION

Anaemia is defined as the condition of having a low number of red blood cells or a low amount of haemoglobin *(3)*. Among the known causes of anaemia, iron deficiency is the most common cause. The terms anaemia, iron deficiency and iron-deficiency anaemia (IDA) are too often used interchangeably, masking the need to address the full scope of causes of anaemia. Although iron deficiency leads to decreased haemoglobin and production of red blood cells, which in turn decreases haemoglobin concentrations and haematocrit (used to identify anaemia), there are many other causes of anaemia that do not involve iron. There are multiple determinants of anaemia, and successful anaemia reduction efforts must identify the major contributing factors in order to develop and implement an evidence-based package of interventions that may achieve effective results.

CLASSIFICATION

Clinical

Anaemia is classified as mild, moderate or severe, based on haemoglobin concentrations. The cut-off values for haemoglobin concentration applicable to women of reproductive age recommended by the World Health Organization (WHO) are shown in Table 1. For populations living at altitudes greater than 1000 m above sea level, as well as among smokers, it is recommended to make adjustments to these cut-off values *(4, 5)*.

Table 1. Haemoglobin cut-off values for the detection of anaemia in women of reproductive age, according to physiological status *(5)*

	Cut-off values for haemoglobin concentration (g/L) by population group *(5)*[a]	
Classification	**Non-pregnant women**	**Pregnant women**
No anaemia	≥120	≥110
Mild anaemia	110–119	100–109
Moderate anaemia	80–109	70–99
Severe anaemia	<80	<70

[a] Adjustments to the haemoglobin cut-off values recommended for high altitude and smoking status can be found in reference *(5)*.

Public health

The public health significance of anaemia in a population is identified according to population prevalence, as *(5)*:

- not a public health problem: ≤4.9%;
- mild: 5.0–19.9%;
- moderate: 20.0–39.9%; or
- severe: ≥40.0% of the population affected by the problem.

ANAEMIA SCREENING

WHO recommends using full blood count testing, in settings where this is available, as the method for diagnosing anaemia during pregnancy, and haemoglobinometer reading in settings where full blood count is not available *(5)*. Screening by haemoglobinometer is recommended over use of the haemoglobin colour scale because research suggests that the haemoglobin colour scale is less effective at detecting severe anaemia among pregnant women, and the consequences of missing severe anaemia are more serious than those of missing mild or moderate anaemia *(6)*.

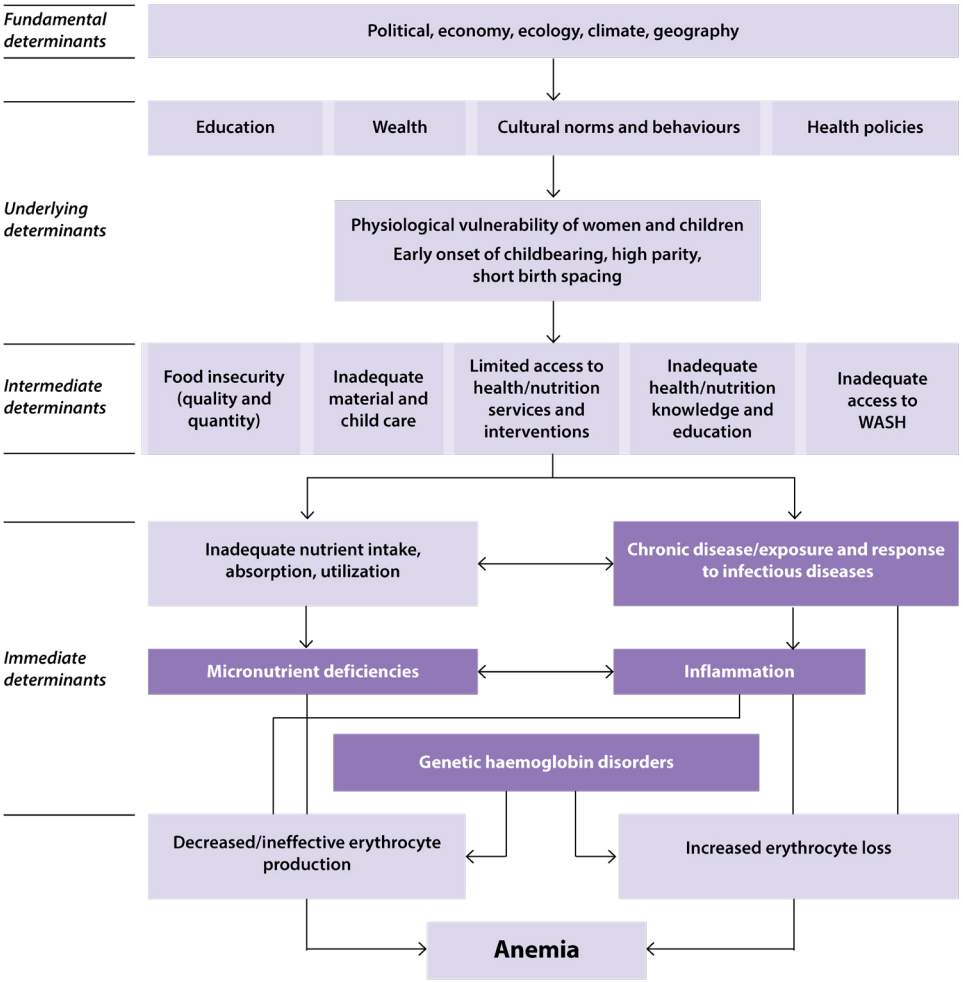
Although it is anticipated that screening would be beneficial to identify and treat anaemia before it becomes severe, there is not yet sufficient evidence to confirm the cost-effectiveness of screening in the general population of vulnerable groups *(7)*. As noted previously, there are multiple causes of anaemia, and screening using haemoglobin does not identify all the potential causes of anaemia; thus, treatment will not necessarily be effective.

CAUSES OF ANAEMIA: A COMPLEX ETIOLOGY

In 2017, WHO described the determinants of anaemia *(8)* as biological (nutrient deficiencies and other forms of malnutrition, growth, physiological state, sex, age and race); related to infection and inflammation (soil-transmitted helminth infections, schistosomiasis, malaria, HIV, tuberculosis, low-grade inflammation); genetic haemoglobin disorders; and social, behavioural and environmental determinants.

A conceptual model, adapted by Chaparro and Suchdev *(9)*, outlines the contribution of intermediate factors and immediate determinants of anaemia, as shown in Fig. 1. Kaussebaum et al. *(13)* identified 17 conditions with cause-specific attribution to anaemia and demonstrated the distribution of these conditions as reported in available large-scale survey data globally. Pasrisha et al. *(10)* further provided suggestions on selected activities and interventions that might be appropriate to address anaemia. Key causes of and contributors to anaemia are addressed in the following sections.

Fig. 1. Conceptual model of anaemia etiology; determinants in boxes with darker purple shading are considered primary contributors to anaemia globally



WASH: water, sanitation and hygiene.

Source: reproduced by permission of the publisher from reference *(9)*; adapted by the authors of reference *(9)* from figure and determinants presented in references *(10–12)*.

NUTRITIONAL AND NON-NUTRITIONAL CAUSES AND CONTRIBUTING FACTORS FOR ANAEMIA

Nutritional causes of anaemia

Nutritional anaemia occurs when regular intake of key micronutrients does not meet the physiological needs of growth, maintenance or losses *(14)*. The most common micronutrient deficiency associated with anaemia is iron deficiency. Other less common micronutrient deficiencies that are known to cause or contribute to anaemia include vitamins A, B_2, B_6, B_9, B_{12}, C, D and E, copper and zinc. While iron is a key component of haemoglobin, these other micronutrients are also required for the formation of haemoglobin or have different roles in iron absorption and immune function that can contribute to the risk of anaemia when deficiencies or malabsorption are present.

Nutritional causes of anaemia

- Iron deficiency
- Other concurrent or separate micronutrient deficiencies, including:
  - vitamins: A, riboflavin (B_2), pyridoxine (B_6), folate (B_9), cobalamin (B_{12}), C, D and E
  - minerals: copper and zinc

Common causes of nutritional anaemia

- Low micronutrient(s) consumption in the regular diet
- Low bioavailability in the diet or high inhibitors of absorption in the diet, resulting in poor absorption
- Increased needs (i.e. during periods of rapid growth like infancy and adolescence, or during pregnancy)
- Increased losses

Iron-deficiency anaemia

Among the known causes of anaemia, the most common cause is iron deficiency. The misconception that iron deficiency is equivalent to anaemia can be understood when considering that biomarkers of anaemia are haemoglobin and red blood cell concentrations and iron deficiency leads to decreased haemoglobin and production of red blood cells. Equating these terms masks the need to also address other potential causes of anaemia. As outlined in Fig. 1, the etiology of anaemia is complex, and successful anaemia reduction efforts must identify the major contributing factors, then develop and implement an evidence-based package of interventions in order to achieve effective results.

Iron deficiency occurs when intake of iron cannot meet the body's demands over a period of time, as with chronic low iron intakes, poor bioavailability of iron sources, or high requirements – such as during periods of increased iron need due to rapid body growth during early childhood, adolescence and pregnancy, or during excess iron loss due to hookworm infection, bleeding disorders or heavy menstrual blood loss.

Causes of and contributors to iron deficiency

- High iron needs: due to high blood, muscle and other tissue accretion during periods of rapid growth (early childhood, adolescence, pregnancy/lactation). High iron needs are difficult to cover even in areas with high dietary diversity, food security and use of animal-source foods
- Low dietary intakes: food insecurity, taboos against consuming iron-rich sources (animal sources of iron, about 40% of which is in the highly bioavailable "heme" form, out of which 25% is absorbed) *(15)*
- Low bioavailability of iron in the diet: plant sources of iron or "non-heme" iron, of which only 2–5% of iron is absorbed *(15)*[a]
- Dietary inhibitors: certain polyphenols, such as those found in tea and coffee *(16)*, and phytates *(17)*, as found in the bran fraction of whole grains
- High loss of iron
- Limited access to nutritional information or to iron-rich food
- Family or community values and preferences leading to poor quality of diet

[a] Consumption of vitamin C and/or heme iron can enhance the absorption of non-heme iron, when consumed in the same meal *(15, 18)*.

Measurement of serum or plasma ferritin is the most specific, non-invasive biochemical test to reflect body iron stores. In the absence of inflammation, the concentration of serum/plasma ferritin is positively correlated with the size of the total body iron stores: a low concentration of serum ferritin reflects depleted iron stores and therefore iron deficiency *(19)*. The serum/plasma ferritin cut-off value for defining depleted iron stores for individuals is <15 µg/L for adults, while a cut-off value of <12 µg/L is used for children under 5 years of age. The serum/plasma ferritin cut-off value during the first trimester of pregnancy is <15 µg/L. A ferritin concentration exceeding 150 µg/L in menstruating women and 200 µg/L in men and non-menstruating women who are otherwise healthy may indicate a risk of iron overload.

IDA is diagnosed when anaemia (low haemoglobin concentration) occurs concurrently with iron deficiency (low ferritin concentration). Thus, iron deficiency can also occur in the absence of anaemia, when ferritin concentrations are low, but haemoglobin concentrations are adequate.

Ferritin is an acute-phase response protein – its blood concentrations rises dramatically during inflammation; as such, ferritin is also considered an indicator of inflammation *(20)*. Thus, measurement of serum ferritin concentration during inflammation can lead to missed diagnoses of iron deficiency due to the increased concentration of ferritin during an acute-phase response to inflammation. In individuals with infection or inflammation, a ferritin concentration <30 µg/L in children and <70 µg/L in adults may be used to indicate iron deficiency *(19)*. Therefore, other markers of inflammation, such as C-reactive protein (CRP) and/or α-1 acid-glycoprotein (AGP) should be measured along with serum ferritin concentrations, to determine whether adjustments must be made to ferritin concentrations in relation to the recommended cut-off value for iron deficiency.

Diagnosis of iron deficiency using serum ferritin requires adjustments for high inflammation

There are several methods to account for the increase in ferritin values caused by inflammation. One method is to raise the cut-off value that defines deficiency, to 30 µg/L or 70 µg/L, depending on the age group *(19)*. Another method is to exclude individuals with elevated concentrations of CRP or AGP from prevalence calculations based on ferritin. Alternatively, arithmetic or regression correction approaches may be used to adjust ferritin concentrations for inflammation and apply the cut-off points recommended for healthy populations. The adjustment that best suits the country reality should be selected and used as long as those conditions prevail.

Recent reviews indicate that the relative portion of anaemia that is due to iron deficiency globally is likely to be less than half *(21–23)*. Petry et al. *(21)* conducted a meta-analysis of nationally representative surveys from 23 countries (including low, medium and high Human Development Index) that collected biomarkers on the prevalence of iron deficiency, IDA and anaemia among women of reproductive age. In these surveys, the proportion of anaemia associated with iron deficiency ranged from 2.9% (Georgia) to 74.7% (Oman), with an overall average of 37.0%.

The proportion of anaemia from iron deficiency (IDA) ranged from 3% to 75% in national level data from 23 countries globally, with an overall average of 37.0% *(20)*. This underscores the need to address more than just iron deficiency with interventions aimed at reducing the prevalence of anaemia.

Other micronutrient deficiencies and general nutritional causes of anaemia

As mentioned, in addition to iron, other micronutrient deficiencies known to cause or contribute to anaemia include vitamins A, B_2, B_6, B_9, B_{12}, C, D and E, zinc and copper, each acting through different mechanisms (see Table 2). Micronutrient surveys that collect biomarkers of multiple micronutrients are the preferred source of data on the status of these micronutrient deficiencies. However, few low- and middle-income countries have conducted comprehensive micronutrient surveys, owing to the high cost of such surveys and the need for highly proficient and specific technical skills among the entire survey team, from enumerators to survey developers, as well as high-quality laboratory facilities and laboratory technicians or a high budget to export samples and conduct analyses at a certified laboratory.

Table 2. Micronutrient deficiencies known to cause or be associated with anaemia, mechanisms of the relationship and risk factors to consider in related anaemia-control programmes

Micronutrient	Primary mechanism/s related to anaemia	Risk factors
Vitamin A	Immune function, mobilization of iron stores *(24)*	Restricted diet (vitamin A is found in animal sources and as pro-vitamin A in a limited variety of fruits and vegetables)
Vitamin B_2 (riboflavin)	Red blood cell production; helps convert tryptophan to niacin, which activates vitamin B_6	Undernutrition, restricted vegan diets (rare in isolation from other deficiencies)
Vitamin B_6 (pyridoxine)	Enzyme cofactor in haemoglobin production	Undernutrition, restricted diets (vitamin B_6 is found in a variety of foods)
Vitamin B_9 (folate)	DNA production, building blocks of red blood cells (deficiency leads to megaloblastic anaemia)	Undernutrition, restricted diets (typical sources: green leafy vegetables, citrus fruit, legumes)
Vitamin B_{12} (cobalamin)	Cofactor in DNA synthesis, including all blood cells	Vegan diets (vitamin B_{12} is not produced by plants; bacteria in foods can produce vitamin B_{12}), deficiency of extrinsic factor in the elderly
Vitamin C	Iron absorption enhancer, potential to help mobilize iron in the body	Low variability in the diet (lacking good sources: citrus fruits, potatoes, bell peppers)
Vitamin D	Iron metabolism, erythropoiesis	Taboos or cultural practices related to wearing all-covering clothes, leading to lack of sun exposure; undernutrition, restricted diets
Vitamin E	Protects the red blood cell membrane from oxidative damage	Premature infants
Copper	Haemoglobin synthesis, component of caeruloplasmin: facilitates iron transport	Undernutrition, excess of zinc supplementation
Zinc	Cofactor of enzymes for iron metabolism, structural component of haemoglobin, immune response	Chronic diarrhoea (intestinal loss), low intake of animal-source foods, high-phytate diet, general undernutrition

Non-nutritional causes of or environmental and socioeconomic contributors to anaemia

Non-nutritional causes of or contributors to anaemia include acute and chronic parasitic infestations or diseases (e.g. malaria, hookworm infestation, schistosomiasis, HIV, Helicobacter pylori infection, tuberculosis, cancer), genetic conditions (thalassaemia, glucose-6-phosphate dehydrogenase [G6PD] deficiency and sickle cell trait), and environmental or support factors (poor sanitation, unsafe drinking water, inadequate personal hygiene, gaps in economic, political, institutional capacity/resources, climatic/environmental conditions) *(8, 10, 11, 25)*. Other factors associated with anaemia, particularly in women, include poverty, obesity, low education level, household wealth, cultural norms, lack of empowerment, rural living, inadequate health care, nutrition knowledge, health policies, limited access to health care, inadequate maternal and child care, and vulnerability of women and children (early onset of childbearing, high parity and short birth spacing).

Non-nutritional causes of or environmental and socioeconomic contributors to anaemia

- Parasites
  - Soil-transmitted helminths and schistosomiasis
  - Malaria
- Infections and inflammation
  - HIV and tuberculosis
  - *Helicobacter pylori*
- Genetic disorders/haemoglobinopathies
  - Sickle cell disease, G6PD deficiency, thalassaemia
- Other factors contributing to anaemia
  - Water, sanitation and hygiene (WASH)
  - Climate change and environmental pollutants
  - Women's empowerment
  - Poverty, education and access to care

Parasites

Soil-transmitted helminths and schistosomiasis

Soil-transmitted helminth infection affects 24% (~1.5 billion) of the global population, mainly in low-and-middle-income settings. Infection with soil-transmitted helminths leads to anaemia, iron deficiency, vitamin A deficiency, malnutrition, diarrhoea and impaired nutrient absorption. The most common soil-transmitted helminth infections are caused by hookworms (*Necator americanus, Ancylostoma duodenale*), roundworm (*Ascaris lumbricoides*), and whipworm (*Trichuris trichura*). Hookworm infection is a leading cause of anaemia *(13),* owing to blood loss that occurs with the damage caused by hookworms feeding on the intestinal mucosa. Roundworms cause intestinal inflammation and poor absorption of nutrients, leading to nutritional deficiencies. Whipworms can impair fat digestion, and cause vitamin malabsorption, appetite suppression, blood loss and related anaemia.

Schistosomiasis is caused by a parasite in water that enters the body by passing through the urinary tract or intestines. Individuals who are infected contaminate fresh water through the parasite's eggs that are excreted through faeces; thus, poor hygiene practices contribute to the cycle of infestation. Eggs that remain in tissues cause immune reactions and damage to the host's organs. About 90% of cases of schistosomiasis occur in Africa. Treatment or control is provided through annual anti-parasite treatment with praziquantel.

Malaria

Malaria causes fever, muscle weakness, haemolysis, respiratory distress, and risk for kidney and liver failure. These risks are greater for the fetus and vulnerable populations of very young or malnourished individuals, pregnant women and older people. The haemolysis caused by malarial parasites is the mechanism by which malaria causes anaemia.

Malaria is one of the world's major public health problems. WHO's *World malaria report 2019 (26)* indicates that malaria is endemic in 31 countries. Targets for malaria reduction are to reduce the incidence of malaria by 40% by 2020, as compared with 2015; although reductions were more rapid between 2010 and 2015, progress has subsequently slowed, such that targeted reductions are not on track *(26)*. *A*ccording to estimates from 2018, 93% of malaria cases occur in Africa.

Malaria case incidence rates are falling, though the decline has slowed since 2014 *(26)*.

Infections and inflammation

HIV and tuberculosis

Anaemia is the most common haematological complication of HIV. Various causes include blood loss, such as with Kaposi sarcoma in the gastrointestinal tract and decreased production or increased destruction of red blood cells *(27)*. HIV infection can disrupt normal haematopoiesis, leading to low levels of blood cell types – red or white blood cells or platelets – resulting in anaemia, neutropenia and/or thrombocytopenia *(28)*. *T*he presence of anaemia with HIV/AIDS is critical, due to the association with decreased survival among those with both anaemia and HIV/AIDS *(27),* and the association with better general quality of life among HIV/AIDS patients who do not have anaemia (*29)*. Comorbidities, including anaemia, are associated with higher mortality among those with HIV *(30)*. Coinfection with tuberculosis and HIV/AIDS has been found to be associated with very severe anaemia, and quality of life scores were higher among those with just HIV/AIDS, without tuberculosis, compared to those with both *(29)*. Coinfection with HIV and malaria is common in endemic areas, and these comorbidities are thought to intensify each other and anaemia resulting from either condition *(31);* haemoglobin concentrations were lower among those with both malaria and HIV compared to just malaria *(31)*.

Helicobacter pylori

Potential mechanisms by which *Helicobacter pylori* infection may cause iron deficiency and/or anaemia include: increase in intragastric pH secondary to a decreased gastric acidity and/or a reduced concentration of ascorbic acid, which affects iron absorption from the diet; chronic bleeding produced by the development of micro-erosions in the gastric mucosa; production of lactoferrins by neutrophils; and capture of iron by the bacteria *(32)*. Other investigators have documented an increase in the synthesis of hepcidin, a central regulator of iron metabolism that blocks iron absorption in the small intestine. The increase in the production of hepcidin in hepatic cells leads to a reduction in absorption of iron and reduced mobilization of iron deposits from the liver and macrophages, causing a reduction of iron available in serum; this will reduce iron availability to the invading bacteria. However, at the same time, this mechanism may lead to the development of iron deficiency and anaemia *(33)*.

Genetic disorders/haemoglobinopathies

The most common inheritable causes of anaemia are haemoglobinopathies, which include variations of thalassaemia and structural haemoglobin variants, such as sickle cell disease. Those affected experience a high risk of anaemia, organ damage, infection and related morbidity and mortality, especially among very young children and pregnant women *(34)*. The risks vary by geographical and other environmental surroundings *(35)*. However, sickle cell disease is also protective against malaria *(36)*. The management of haemoglobinopathies includes screening, vaccination and other preventive measures against infection; iron sequestration to prevent iron overload; management of related cellular damage; and red blood cell transfusions *(36)*. Haemoglobinopathies are found globally *(37),* with the highest prevalence of sickle cell disease in children aged under 5 years found in Africa *(38)*. Screening can be complicated, due to the multiple genetic variants.

Other factors contributing to anaemia

Water, sanitation and hygiene

Universal, affordable and sustainable access to WASH practices of safe water, supply of adequate sanitation, and education on proper hygiene can reduce illness and death and improve health outcomes at the population level. Although reviews have not demonstrated a cause–effect relationship, the association between WASH and anaemia has been identified in different studies. Kothari et al. *(39)* found associations between anaemia and indicators of poor water and sanitation among women of reproductive age, as reported in demographic and health surveys (DHS) from 47 countries. Also using data from DHS from 81 surveys in 45 countries in sub-Saharan Africa, Latin America, Europe, and Asia, Coffey et al. *(40)* found a clear relationship between the prevalence of anaemia among young children and use of open defecation, which was even stronger when controlling for malaria, gross domestic product per capita, or available dietary data.

Climate change and environmental pollutants

Systematic reviews related to climate change have identified selected factors where changes in climate could be linked to anaemia. Myers et al. *(41)* tested edible portions of plants grown at high carbon dioxide levels, as expected

to occur with climate change in this century, and found lower iron and zinc contents of these plants, which would result in lower levels of these micronutrients for those relying on these sources of iron or zinc to prevent anaemia. Using drought as a potential marker of climate change, Belesova et al. *(42)* found a positive association between drought exposure and anaemia among children. Climate change is also postulated to have an impact on the timing of menarche, resulting in earlier or later initiation, which in turn would be associated with various health consequences depending on the direction of the change *(43)*. Although not directly linked to anaemia, blood loss during menstruation is a risk for anaemia, and a short period between menarche and first pregnancy increases the risk of anaemia *(44)*.

Environmental pollutants have been associated with a variety of negative health consequences *(45, 46)*. Anaemia is associated with chronic inflammation *(47)* and inflammation is one mechanism through which it is hypothesized that air pollutants may affect anaemia. Haemoglobin concentrations have been found to be negatively associated with air pollutants such as fine particulate matter ($PM_{2.5}$ or PM_{10}), nitrous oxide, smoke and other ambient pollutants among the elderly *(48),* women *(49),* pregnant women *(50)* and children *(51)*.

Women's empowerment

The studies discussed in this section highlight the relationships of sex or empowerment to general or specific health outcomes, of which anaemia was identified or could be an outcome. Jones et al. *(52)* conducted a systematic review of women's empowerment and children's health outcomes. They found that, in the lowest wealth category, women's empowerment is positively associated with child nutrition, and the specific empowerment-related domains of assets and instrumental agency were associated with anaemia. Mpimbaza et al. *(53)* studied the characteristics of delayed care-seeking for malaria between cases of severe malaria and controls with uncomplicated malarias. As expected, they found that delayed care-seeking was associated with severe malaria. Other associations identified were reduced odds of severe malaria if the child's mother was the first decision-maker, compared to other decision-makers; and employment of the caregiver and having more than three children aged under 5 years were associated with severe malaria. Among factors studied, the mother as the first decision-maker was the only factor that was significantly protective against severe malaria.

Indicators of women's empowerment (decision-making, attitudes toward and experience of violence) from recent DHS data (2011–2017) were found to be significantly associated with indicators of children's nutritional status *(54)*, and similar relationships were found in a review of quantitative studies *(55)*. Systematic reviews of health and empowerment impacts of women's low control or lack of autonomy reported: "Overall, the evidence suggests that women's lower control or autonomy (for example lack of freedom of movement outside the home, lack of authority to access healthcare for sick children) was associated with poorer mental and physical health for women and higher morbidity and mortality for their children, after adjusting for their socioeconomic circumstances" *(56)*. In a protocol for a systematic review, Riddle et al. *(57)* are assessing measures of empowerment in relation to measures of nutritional status, to identify potential indicators of empowerment that are most associated with a woman's or adolescent girl's nutritional status. Dimensions of empowerment under consideration include economic, sociocultural and legal factors.

Poverty, education and access to care

Nagata et al. *(58)* conducted a systematic review of research including qualitative data related to facilitators and barriers to access and adherence to iron supplementation among women of reproductive age, and related the experiences and perceptions of these women and health service providers. The authors categorized their findings into domains and sub-domains, as a means of incorporating these into a useful conceptual framework. The overall domains they considered included: structural drivers, social position, circumstances of daily life, and underlying issues. Wirth et al. *(22)* reviewed survey data to identify factors associated with anaemia, with the following categories identified: in most countries assessed, socioeconomic status was significantly inversely associated with anaemia; in some countries, rural residents had a higher prevalence of anaemia than urban residents; and in selected countries, water and sanitation were associated with anaemia. However, there were variations across countries, indicating the value of local analyses. A study in Brazil demonstrated that family size was positively associated with the prevalence of anaemia among children *(59)*, but no studies have been identified demonstrating associations, or lack thereof, among women.

CONSEQUENCES OF ANAEMIA

The lack of haemoglobin resulting from anaemia limits blood oxygen transport, resulting in reduced physical and mental capacity, along with other health risks. Anaemia risk is increased with the increased iron requirements of rapid tissue accretion during rapid growth in childhood, adolescence and pregnancy. As already discussed, among women of reproductive age, anaemia is due to multiple mechanisms, including both nutritional and non-nutritional causes *(9–11, 13, 21, 22, 60),* with demands increasing during pregnancy. Anaemia during pregnancy can increase the risk of serious consequences for the woman and neonate, such as preterm delivery, miscarriage, stillbirth, prematurity, intrauterine growth retardation, low birth weight and mortality *(61, 62)*. In the general population, anaemia is associated with fatigue, dizziness, reduced work productivity and poor health and development *(63)*. Non-health consequences of anaemia include increased health-care expenditures, decreased income and corresponding consequences for families and communities. Thus, reducing anaemia among women of reproductive age is recognized as an important factor in the improvement of women's health, children's health, school performance, women's work productivity, healthier pregnancy outcomes and intergenerational benefits for good health, economy and community development *(64, 65)*.

Anaemia may have serious health consequences for pregnant women and their offspring, including:

- Preterm delivery
- Miscarriage
- Stillbirth
- Prematurity
- Intrauterine growth retardation
- Low birth weight
- Increased maternal mortality
- Reduced physical and mental capacity in the child, leading to poor school performance

Other non-health consequences of anaemia include:

- Fatigue
- Dizziness
- Reduced work productivity
- Decreased income

INTERVENTIONS

INTERVENTIONS TO ADDRESS NUTRITIONAL CAUSES OF ANAEMIA

Programmes to prevent nutritional anaemia usually focus on the provision of iron, folate, vitamin A, zinc and other micronutrients through different interventions, including supplementation, fortification and improvement of dietary diversity and food security (increased diversity of agricultural production, nutrition education, microfinance, women's empowerment, targeted food distribution), as well as agricultural practices.

Interventions to address nutritional causes of anaemia

- Supplementation
- Food fortification
- Dietary diversity/food security/agriculture

Iron and folic acid supplements (IFAS)

Iron is necessary for replacement of blood loss during menstruation and tissue accretion during pregnancy. Thus, iron-containing supplements, generally with both iron and folic acid, are recommended for all pregnant women *(8, 60)* and for general populations of women of reproductive age *(66, 67)*, particularly where the prevalence of anaemia is high. Systematic reviews have demonstrated that consumption of at least 90 iron-containing supplements during pregnancy can reduce maternal anaemia by up 70% *(68, 69)*, while among women in the general population, consumption of iron supplements can reduce anaemia *(70)* and improve physical performance *(63)*.

Multiple micronutrient supplements (MMS)

In 2020, WHO published a recommendation for use of antenatal MMS that include iron and folic acid, in the context of rigorous research that includes implementation research using high-quality methods appropriate to the specific research questions *(71)*. This updated recommendation on antenatal multiple micronutrient supplements supersedes the corresponding recommendation issued in the original WHO 2016 antenatal care guideline *(6)*.

Although the impact on anaemia alone would not recommend a shift to multiple micronutrient supplementation during pregnancy, those countries also dealing with adverse pregnancy outcomes of preterm birth or infants who are small for gestational age may consider the shift from IFAS to MMS after rigorous research *(72–74)*.

Vitamin A/zinc supplementation

WHO recommends supplementation with zinc during pregnancy only where rigorous research supports its use *(6)*. Although vitamin A deficiency and zinc deficiency are found in association with anaemia and iron deficiency, and vitamin A and zinc have roles in iron metabolism *(75, 76)*, researchers have not found consistent results with supplementation or fortification with vitamin A or zinc on improving iron status or reducing anaemia *(74, 76)*. However, the importance of zinc and vitamin A to iron metabolism warrants more research to understand the role of these micronutrients in diet-related anaemia reduction programmes.

Food fortification

Food fortification is considered to be a low-cost intervention to reduce micronutrient deficiencies in populations where deficiencies are widespread *(15)*, but the impact on anaemia has been mixed. Waller et al. *(77)* systematically reviewed available research and found that studies that were not successful in reducing anaemia had commonalities in the lack of data on environmental factors – such as parasitic infections and micronutrient deficiencies other than those provided through the fortificant – and that changes in taste/organoleptic or other properties may have altered the acceptability and consumption of the fortified food. Systematic reviews to address the effectiveness of programmes for wheat and maize flour fortification on iron status and anaemia have found that few countries complied with the use of the iron compound recommended by WHO and with the recommended concentration of iron. Furthermore, there was a dearth of information related to compliance to fortification standards, coverage

of fortified products, and actual implementation of fortification programmes, making it difficult to derive solid information when evaluating their effects *(78, 79)*. Even with these caveats, the authors found consistent evidence of reduction in the prevalence of low ferritin in women (but not in children); reduction of anaemia prevalence was found only in one third of the subgroups of women and children analysed *(78, 79)*. Barkley et al. reviewed the effectiveness of fortification of wheat flour, alone or in combination with maize flour, with iron, folic acid, vitamin A or vitamin B_{12}, in reducing the prevalence of anaemia. These authors found that each year of flour fortification was associated with a 2.4% decrease in the odds of anaemia prevalence, after adjusting for Human Development Index and malaria (both of which were significantly associated with anaemia). Further, they found that the prevalence of anaemia remained unchanged in countries that never used fortification *(80)*.

Improvement of dietary diversity, food security and agriculture for improved availability

A systematic review of factors associated with anaemia among children in Ethiopia found greater odds of anaemia among children aged less than 2 years with poor dietary diversity and food insecurity *(81)*. Poor diet was associated with anaemia among pregnant women in Ghana *(82)* and dietary diversity score was an independent predictor of haemoglobin concentration *(83)*. In adults with HIV, poor diet quality has been associated with anaemia *(84)*. Regarding food security and agricultural approaches, a programme evaluation document from Helen Keller International reports a positive impact of enhanced home food production on reducing anaemia, night blindness and stunting *(85)*. A landscape analysis tool from SPRING (Strengthening Partnerships, Results and Innovation in Nutrition Globally) summarizes the logical pathway for general agricultural programmes, with related evidence and considerations for potential negative consequences (e.g. increased women's workload) *(86)*. Biofortification of staple crops has been applied as a complement to other agricultural interventions and nutrition programmes, but various factors should be considered to ensure the safety and diversity of plants, soil health and diets *(87)*.

Summary: nutritional causes of anaemia – related programmes and indicators

Survey data provide critical information for policy-makers and programme implementers for decision-making related to the reduction of anaemia. Therefore, some of the following sections include summary tables that present indicators as examples for decision-makers to consider when assessing the state of activities for anaemia-related programmes; some are considered the "gold standard" indicators, which are often more costly, while the supplementary criteria are more commonly available indicators but do not necessarily directly measure the coverage or impact of a programme. Each country will have additional interventions, recipient population groups and other relevant indicators to fit the local context (see Table 3, Table 4 and Table 6). These indicators are separated according to whether they are most directly measuring the desired information, and whether they are secondary indicators – data that are likely to be available should data for the more direct indicator be unavailable or outdated.

The indicators included are selected from WHO and other international guidelines, but there are few indicators directly assessing anaemia prevalence, while – as outlined in this review – there are many possible complementary programmes that support anaemia reduction in one way or another. Thus, with the focus on anaemia reduction, many of the indicators presented here are not included in global guidelines as being appropriate for assessing efforts to reduce anaemia. These indicators are presented as food for thought on how each manager might start to gather as much information as possible that is already likely to be available, and to also consider other aspects that might be useful in assessing anaemia reduction efforts in future surveys and monitoring systems.

Table 3. Nutrition-specific programmes, related population groups and potential indicators to address anaemia

Interventions/ programmes	Population group	Direct programme indicators	Indirect programme indicators
Vitamin A supplementation	PW[a]	Supplement consumption	Supplement distribution Night blindness
MMS	PW, PPW	Any or 90+ MMS during pregnancy	Any, 4+ or 8+ ANC visits
Food or condiment fortification (with vitamin A, iron, zinc, folate, vitamin B_{12}, etc.)	WRA, general population	Dietary intake of fortified product (FACT, FRAT)	Production versus population, HICES[b]
Food security	WRA	Food availability, access, utilization and stability *(90)*	Anthropometry, health, caring and feeding practices Household income and consumption *(91)* Women's empowerment Poverty index tool
Dietary diversity/agriculture diversity	PW, PPW, WRA, general population	Women's dietary diversity score Population receiving food assistance	Agricultural production (FAO food balance sheet) Nutrition counselling

FACT: Fortification Assessment Coverage Toolkit *(88)*; FAO: Food and Agriculture Organization of the United Nations; FRAT: Fortification Rapid Assessment Toolkit *(89);* HICES: Household Income and Consumption Surveys; MMS: multiple micronutrient supplements; PW: pregnant women; PPW: postpartum women; WRA: women of reproductive age (15–49 years).

[a] Vitamin A supplements are recommended in areas where deficiency is a severe public health problem; high-dose supplements should never be provided during the first trimester of pregnancy *(6)*.

[b] Data would have to specify the source of the food (fortified or not) in order to use HICES to estimate consumption.

INTERVENTIONS TO ADDRESS NON-NUTRITIONAL CAUSES OF ANAEMIA

Deworming programmes

In addition to recommendations for improved water and sanitation to reduce transmission of soil-transmitted helminths, WHO also proposes preventive chemotherapy (deworming) in at-risk populations: (i) biannual anti-helminth prophylaxis for all non-pregnant adolescent girls and women of reproductive age living in areas where the baseline prevalence is >50%; and (ii) annual deworming for women of reproductive age living in areas where the baseline prevalence of any soil-transmitted helminth infection is ≥20% *(92)*.

Deworming among adolescent girls and women of reproductive age

A systematic analysis of four randomized controlled trials of mass deworming interventions found reductions in the prevalence of soil-transmitted helminth infection but little or no effect on anaemia and iron deficiency in adolescent girls and women of reproductive age *(93)*. However, Smith and Brooker reviewed the impact on anaemia by the type of antihelminth treatment scheme and found that studies providing albendazole had more effect on anaemia reduction than those with mebendazole treatment *(94)*. This could be because albendazole is found to be more effective against hookworm than mebendazole. This finding indicates that it would be useful to determine the types of soil-transmitted helminth infestations in a population before deciding what treatment to use. Sustainable solutions to preventing soil-transmitted helminth infections will require long-term sanitation measures.

Deworming among pregnant women

In a systematic review among pregnant women, Brooker et al. (95) found a significant association between increasing hookworm intensity and decreasing haemoglobin concentrations. However, another systematic review *(96)* found that one dose of antihelminth in the second trimester of pregnancy had no significant impact on anaemia during the third trimester.

Malaria control programmes

Insecticide-treated nets (ITNs) are the primary tool for malaria vector control *(97)*. ITN use is considered one of the most effective strategies recommended by WHO for preventing malaria infection and its consequences of maternal anaemia, stillbirths and intrauterine growth restriction in malaria-endemic settings *(98, 99)*. Use of ITNs has been found to reduce approximately half of malaria episodes among children aged under 5 years, and 17% of all-cause mortality *(100)*. In general, ITN use has been responsible for a two thirds reduction in the burden of malaria in sub-Saharan Africa.

HIV/tuberculosis programmes

WHO provides guidelines for antiretroviral treatment of HIV *(101)*, and it is important to address the underlying causes of anaemia *(102, 103),* as well as treatment of comorbitidies and infections *(31).* Antiretroviral treatment of HIV/AIDS among children was associated with 60% lower anaemia rates compared to those not yet being treated *(104).*

Programmes that address genetic blood disorders

Owing to the risk of iron overload *(105)* or high concentrations of non-transferrin-bound iron (NTBI), countries with a high prevalence of haemoglobinopathies alongside other causes of anaemia, may question whether universal iron supplementation is warranted, such as during pregnancy *(106)*. One study among women in Cambodia where haemoglobinopathies are common, found that NTBI was not increased among women with anaemia following 12 weeks of daily iron supplementation with a dose of 60 mg/day *(107)*. The proportion of women with high NTBI remained similar after supplementation compared to the group that consumed placebo for 12 weeks. Although this is promising, the authors did not specifically select women with a haemoglobinopathy, so the lack of difference could be the result of lack of sufficient sample size among those with haemoglobinopathies and most at risk of iron overload. Hydroxyurea for treatment of sickle cell anaemia was tested in four countries of sub-Saharan Africa, where authors found positive results with no increase in adverse effects *(108)*.

Water, sanitation and hygiene programmes

The Global Health Observatory data from national populations demonstrate that most countries have exhibited positive, yet slow improvements in the coverage of basic sanitation services between 2000 and 2017. WASH interventions are varied and multiple resources are available from WHO *(109, 110)*.

Delayed cord clamping

Delayed cord clamping reduces the risk of anaemia in the infant, but some may wonder about the impact on the mother. Thus, it is important to note a systematic review showing that delayed cord clamping has no adverse effects on postpartum haemorrhage *(111)*. This review is being updated with recent data, but results are not yet available *(112)*.

Summary of nutrition-sensitive programmes and selected interventions

Table 4 summarizes some of the commonly implemented nutrition-sensitive interventions or programmes that can help to reduce anaemia, the population groups generally involved in these programmes and indicators that may be used to assess the status of the programme. This is intended as an illustrative list to initiate discussions on what to consider among nutrition-sensitive programmes; additional programmes, population groups and indicators are available for all of these categories.

Table 4. Nutrition-sensitive programmes, related population groups and potential indicators to address anaemia

Interventions/ programmes	Population group	Direct or indirect programme indicators
Parasite control	General population	Water treatment, parasite resistance
Deworming	WRA, adolescents[a]	Stool worm egg and species identification Coverage of deworming
ITNs	PW, WRA, general population	Households that own at least 1 ITN Households that own at least 1 ITN/2 people Population with access to an ITN in their household Population that used an ITN the previous night
Parasite prophylaxis or treatment during pregnancy	PW	Coverage of IPT and deworming
HIV/tuberculosis	General population	Prevalence of HIV and tuberculosis; coverage of ART; coverage among affected population *(113)*
Genetic disorders	PW, general population	Prevalence of carriers and newborn screening *(114)*
WASH	Facilities	WASH FIT *(115)*
WASH *(116)*	General population	Safely managed drinking water (SDG 6.1.1) *(117)* Improved latrines Clean play spaces
Genetic disorders	General population, PW	Prevalence of carriers and newborn screening
HIV/ TB	General population	Prevalence of HIV and TB; coverage of ART; coverage among affected population
Delayed cord clamping	PW/infants	Proportion of births with delayed cord clamping

ART: antiretroviral treatment; IPT: intermittent preventive treatment; ITN: insecticide-treated net; PW: pregnant women; SDG: Sustainable Development Goal; WRA: women of reproductive age (15–49 years); WASH: water, sanitation and hygiene; WASH FIT: water and sanitation for health facility improvement tool; HIV: human immunodeficiency virus; TB: tuberculosis.

[a] Adolescent girls (10–19 years).

ENVIRONMENTAL AND SOCIOECONOMIC DOMAINS: ANAEMIA REDUCTION PROGRAMMES AND COORDINATION

A number of environmental and socioeconomic factors should also be considered when assessing the quality and comprehensive nature of anaemia reduction efforts. The following are factors known to be critical to health in general, although data are not always available to directly link them to anaemia.

Environmental and socioeconomic domains to consider in anaemia programmes

- Economic growth
- Women's empowerment
- Poverty alleviation
- Quality of care versus coverage of services – providers, communities and individuals:
  - universal health care, integrated services, provider capacity, behaviour-change activities, community-based programmes
- Governance:
  - strategies, policies, guidelines; financial commitment; coordination (e.g. Scaling Up Nutrition movement (SUN); intersectoral planning and strategizing
- Distressed health and environmental contexts

Economic growth

Alderman and Linnemayr *(118)* demonstrated that although anaemia rates decrease as national income increases, the decrease is modest compared to the economic increase. Overall, they found that anaemia rates declined about one quarter as fast as income increases. The authors also emphasized that economic increases could require decades. However, they found that this was not the case for Africa at the time of the 2009 publication; anaemia reduction in Africa was closer to the same magnitude of change as the change in economic increase. In general, the authors emphasized that politicians must not rely on economic improvements alone to reduce anaemia, particularly as anaemia could be a factor that is dampening economic growth.

Women's empowerment

Resources related to gender and empowerment are available to facilitate understanding, assessing and integrating gender and empowerment interventions into health systems *(119–122)* and the United States Agency for International Development (USAID) has supported multiple country gender analyses that could serve as examples for those seeking to conduct such a review *(122, 123)* in preparation for selecting context-relevant empowerment interventions.

Poverty alleviation

The International Food Policy Research Institute reviewed available research on programmes to alleviate poverty and found mixed results regarding improvements in nutrition, and no evidence for anaemia reduction as a result of these programmes; however, women's sociodemographic and other selected characteristics have been found to be significantly associated with childhood nutritional status *(54)*. A study in the Plurinational State of Bolivia *(124)* found that among women diagnosed with anaemia and provided with a prescription for iron supplements, only 40% sought the supplements. In this study, the supplements were available at cost, so the reluctance could have been partially due to the cost.

Quality of care versus coverage of services, including workforce capacity

Universal health care

Universal health care is considered critical to improving health outcomes, including in low- and middle-income countries *(125)*. Kruk et al. *(126)* evaluated mortality data from low- and middle-income countries to determine whether the mortality rate would differ among causes of death that are amenable to health-care intervention, depending on whether health care was or was not sought. They found that mortality rates were higher among those who sought care than those who did not. Although these findings do not account for the severity or potential comorbidity among those who sought care before death, the authors warned of the central role of quality of care when seeking to improve health-care services and outcomes.

Integrating services

In an attempt to identify key context and capability factors that should be considered before and during health-care expansion to improve frontline services, Topp et al. *(127)* investigated how to tell whether health services are sufficiently functional and devolved for integrated services; whether providers are willing and able to provide integrated services; and whether tools are available and suitable to deliver integrated services. They identified the following categories as critical to consider:

- contextual enablers include: "(1) the organizational framework of frontline services, (2) health care worker preparedness, (3) community and client preparedness, (4) upstream logistics and (5) policy and governance issues"; and
- health system capabilities include: "(1) sufficiently functional frontline health services, (2) sufficiently trained and motivated health care workers, (3) availability of technical tools and equipment suitable to facilitate integrated frontline services and (4) appropriately devolved authority and decision-making processes to enable frontline managers and staff to adapt integration to local circumstances".

These categories also align with the WHO considerations for strategizing national health in the 21st century *(128, 129)*.

Provider capacity

About the time of the shift from Millenium Development Goals (MDGs) to SDGs, multiple reviews highlighted the need to build provider capacity to address the nutritional needs of populations *(130–132)*. Although not specific to anaemia reduction, these reviews demonstrate the value of and gaps in capacity to provide services that reduce nutritional contributors to anaemia. Delisle et al. *(130)* highlight multiple recommendations and areas to consider for strengthening the nutrition workforce in low- and middle-income countries and Shrimpton et al. *(132)* summarize evidence on the value of nutrition in the context of health care.

Although it is important to assess the risks of anaemia relative to coverage of related programmes, landscape analyses must also assess the capacity of local providers to implement the strategies and programme interventions that are developed. As summarized by Fanzo et al. *(131)* and Delisle et al. *(130)*, the nutrition skills and numbers of providers are not yet adequate to cover the needs of well implemented nutrition programmes, and those trained have difficulties finding jobs, due to inadequate recognition and/or funding for trained nutritionists. There are some publications highlighting short- and long-term steps toward improving the quality of nutrition services and the skills and resources required for quality and sustainable public health nutrition *(133, 134)*:

- training or experience specific to nutrition;
- organizational and management support;
- opportunities for professional development;
- engagement with the target community;
- evidence-based practice;
- adequate numbers of competent staff;
- multilevel and multi-disciplinary nature of nutrition;
- build nutrition capacity of health and community workers to expand reach and effectiveness; and
- clear framework for implementation and sustainability.

WHO's *Global strategy on human resources for health: workforce 2030* similarly calls for capacity-building and workforce development *(128)*: "The health workforce will be critical to achieve health and wider development objectives in the next decades". This strategy is broader than a call for training nutritionists or capacity for anaemia reduction, but exemplifies the broader gaps in which anaemia is just one piece.

Behaviour change/knowledge/awareness

Researchers in India demonstrated that proper education and counselling can result in better rates of anaemia reduction than provision of supplements alone *(135)* and the RANI (Reduction in Anaemia through Normative Innovations) project *(136)*, also in India, was established on the premise that a more comprehensive approach to anaemia reduction is required to reach women at multiple levels. When available, the RANI findings should be of interest to those working on anaemia reduction efforts.

Many agencies provide guidance on developing effective behaviour-change messages and interventions *(122, 138–140)*. Key principles highlighted by WHO for effective communications include: accessible, actionable, credible, relevant, timely and understandable *(141)*.

Community-based programmes

The following examples of community-based interventions to improve communication and support *(6)* highlight the need to engage women and their communities in nutrition programming, in order to improve impact. A WHO focused approach to antenatal care (ANC) guidelines from 2002 recommended a focused or goal-orientated approach to ANC to improve the quality of care and increase ANC coverage, particularly in low- and middle-income countries *(140)*. This model was sometimes translated into an indicator of simply reaching at least four ANC visits during pregnancy, without remembering the guidance that each visit includes specific evidence-based interventions for healthy pregnant women (called "goal-oriented") and appropriate referral of high-risk women and those with complications *(6, 140)*.

Downe et al. *(142)* reviewed research to highlight women's values in relation to pregnancy care and found that these included: "maintaining physical and sociocultural normality; maintaining a healthy pregnancy for mother and baby (including preventing and treating risks, illness and death); effective transition to positive labour and birth; and achieving positive motherhood (including maternal self-esteem, competence, autonomy)". Based on these findings, the authors proposed three domains for woman-centered ANC service: (i) "clinical care/therapeutic practices (biomedical interventions and tests, integrated with spiritual and religious practices, where appropriate)"; (ii) "relevant and timely information (physiological, biomedical, as well as behavioural and sociocultural)"; and (iii) "support (social, cultural, emotional and psychological)". The authors suggested that these three domains should receive equal value and weight in ANC services and related research. Further insights are available in the full document.

Governance

> "Governance refers to the exercise of political and administrative authority at all levels to manage a country's affairs. It comprises the mechanisms, processes and institutions, through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences" *(143)*.

The following are examples highlighting multisector initiatives and resources to strengthen and ensure optimal effectiveness of national nutrition activities, of which anaemia reduction is a key component. All of these resources emphasize the value and critical importance of cross-sectoral engagement, support and capacity-building for sustainability and success.

Guidelines for government efforts

The WHO *Comprehensive implementation plan on maternal, infant and young child nutrition (144)* highlights guidelines that support government efforts to improve maternal, infant and young child nutrition activities. The five action areas of the plan include:

1. to create a supportive environment for the implementation of comprehensive food and nutrition policies;
2. to include all required effective health interventions with an impact on nutrition in national nutrition plans;
3. to stimulate development policies and programmes outside the health sector that recognize and include nutrition;
4. to provide sufficient human and financial resources for the implementation of nutrition interventions; and
5. to monitor and evaluate the implementation of policies and programmes.

WHO's *Landscape analysis on countries' readiness to accelerate action in nutrition (145)* complements this plan with templates for assessing a country's situation, need and capacity for nutrition actions.

Strategies, policies and guidelines

Developing effective food and nutrition strategies, policies and programmes

Nine strategic action areas are recommended by WHO for countries as they develop, implement and improve national policies, strategies, programmes and guidelines that integrate nutrition into multiple key sectors *(146)*: (i) mainstream nutrition goals into development policies and programmes; (ii) improve household food and nutrition security; (iii) protect consumers through improved food quality and safety; (iv) prevent and manage infectious diseases; (v) promote breastfeeding; (vi) care for the socioeconomically deprived and nutritionally vulnerable; (vii) prevent and control specific micronutrient deficiencies; (viii) promote appropriate diets and healthy lifestyles; and (ix) assess, analyse and monitor nutrition situations.

The WHO publication *Strategizing national health in the 21st century: a handbook (129)* provides tools for (i) population consultation on needs and expectations; (ii) situation analysis of the health sector; (iii) priority-setting for national health policies, strategies and plans; (iv) strategic planning: transforming priorities into plans; (v) operational planning: transforming plans into actions; (vi) estimating cost implications of a national health policy strategy or plan; (vii) budgeting for health; (viii) monitoring, evaluation and review of national health policies, strategies and plans; (ix) law, regulation and strategizing for health; (x) strategizing for health at subnational level; (xi) intersectoral planning for health and health equity; and (xii) strategizing in distressed health contexts.

National policies for meaningful improvements

Shahid and Bishop *(147)* reviewed national policies that have been implemented to achieve meaningful improvements in nutrition-related risks and challenges related to obesity, but their findings can also be relevant for anaemia reduction efforts (see reference for additional information):

- nutrition crosses multiple sectors, so success requires cross-sectoral actions;
- the following should be included as considerations for use in applying SWOT (strengths, weaknesses, opportunities, threats) analysis when selecting and prioritizing actions: appropriate education for the population in general; labelling regulations for point of purchase; taxation incentives and otherwise (sugar tax, cigarette tax, chocolate tax, alcohol tax); assistance for the supply of food for the needful; set-up and maintenance of nutritional standards; set-up and regulation of quality standards; food marketing standards; collaborative research, development and innovation; and coordination of actions across ministries and agencies, and at local, national, and international levels;
- improvement of food environments to ensure availability and affordability of healthful foods, especially for vulnerable populations;
- health-related food taxes: these taxes are intended to decrease use of the taxed items, while raising funds for government actions; for example, a sugar tax could be applied to reduce sugar intake from foods that are high in sugar, while funds from the taxation could be used in combating diabetes. However, the total raised must also pay the cost of monitoring and implementation of the taxation, so all countries have not observed an increase in available funds. The authors described countries where the taxation reduced intake as desired, but with time the reductions were not maintained. Opposition has also varied across countries, with examples provided by the authors. The typical taxes applied – such as taxes on high-sugar, high-salt or fatty foods – would not directly affect anaemia, although if additional funds became available through taxation, such taxes could be used to fund anaemia reduction efforts;
- the authors highlighted education through schools as a means of improving nutrition choices, and reiterated the need for more comprehensive interventions, including education beyond school to optimize results; and
- in reviewing examples of government community partnerships, the authors added a reminder to address multiple stakeholders in order to achieve behaviour change: researchers, schools, local and national authorities, along with the communities themselves.

Financial commitment

In the World Bank's 2010 book *Scaling up nutrition: what will it cost?*, Horton et al. *(148)* highlight five general categories where financial support is needed across countries with the highest burden of undernutrition; the topics are relevant to anyone who wants to improve nutrition programmes. Topics include: (i) behaviour change; (ii) micronutrients and deworming; (iii) complementary and therapeutic feeding; (iv) capacity development for programme delivery; and (v) monitoring and evaluation and operations research and technical support for programme delivery. Alderman and Horton provided insights into the economics of addressing nutritional anaemia *(149)*, in terms of the cost to benefit of interventions such as:

- the cost of mass fortification, at the time of publication (2007), was probably between $0.10 and $1.00 per person per year, with a benefit-to-cost ratios of 6:1 for adults (physical benefits) and 9:1 for children (including cognitive benefits);
- the cost of iron supplements during pregnancy was estimated as $2–5 per pregnant woman, plus the costs of personnel, and they estimated that in favourable conditions, the economic benefits may exceed costs; and
- the cost of deworming was estimated as ~$0.50 per year and the benefit-to-cost ratio may be comparable to that of fortification.

Coordination – cross-sectoral engagement and commitment

The Scaling Up Nutrition (SUN) movement *(150)* was developed with the growing global recognition that nutrition interventions are some of the most cost-effective in development *(151)*. The SUN initiative is implemented in 61 countries globally, which provides a unique opportunity for multisectoral engagement and collaboration. The primary elements of the SUN framework are:

- start from the principle that what ultimately matters is what happens at the country level. Individual country nutrition strategies and programmes, while drawing on international evidence of good practice, must be "country-owned" and built on the country's specific needs and capacities;
- sharply scale up evidence-based cost-effective interventions to prevent and treat undernutrition, with highest priority to the minus 9 to 24-month window of opportunity where the highest returns from investments occur;
- take a multisectoral approach that includes integrating nutrition in related sectors and using indicators of undernutrition as one of the key measures of overall progress in these sectors; and
- provide substantially scaled up domestic and external assistance for country-owned nutrition programmes and capacity.

The multisectoral approach of the SUN movement builds on REACH (Renewed Efforts Against Child Hunger and Undernutrition). The authors of the 2017 evaluation of REACH activities in Burkina Faso, Haiti, Mali, Myanmar and Senegal provided recommendations for establishing effective multisectoral activities *(152)*.

Intersectoral planning and strategizing

The WHO book on *Strategizing national health in the 21st century (129)* is nicely summarized in a figure that demonstrates that although activities move generally in a stepwise fashion, strategizing also involves multiple iterative and feedback loops. This handbook addresses intersectoral planning, and the WHO website provides a manual for decision-makers on intersectoral food and nutrition policy development (2001) *(153)*. These documents, along with the SUN and REACH approaches and The World Bank multisector resource *(154),* highlight that intersectoral approaches are possible, but require changes in the way the health sector has worked in the past, to include open multi-stakeholder engagement and support.

In addition to the discussion points above, other key factors for effective intersectoral planning and strategizing include:

- engage all stakeholders, both public and private, such as recommended in the decision tree (see Table 7 and Fig. 5) and elsewhere *(155);*
- create a living map of all relevant programmes (see reference *(156)* for an example from Egypt), including overlapping programmes and areas with gaps; this is particularly critical when interventions could potentially lead to excess intakes. For example, pregnant women should receive and consume daily iron supplements, but if multiple stakeholders are providing iron in different forms in the same area, a pregnant woman might receive and consume daily iron from more than one source without being aware she is doing so;
- work together to balance and coordinate interventions and harmonized reporting, including indicators, across stakeholders;
- commit to a coordinating body that is supported at the highest level of ministries and governments;
- engage communities in identifying needs and garnering support, including quality improvement approaches; and
- when strategizing and planning for programmes, there must also be consideration and a plan for how to know when to end a programme. The section on Monitoring and evaluation of anaemia reduction efforts introduces the concept and multiple resources that include use of monitoring to inform decisions about when new programmes are ready for scale-up and whether the programmes needs to be adjusted or terminated.

Health in areas of conflict and political insecurity in fragile environments

Many countries must also consider the impact of localized or national conflict or political insecurity on anaemia and general health, particularly among the most vulnerable children and women. WHO's review of primary health care in efforts to achieve universal health care identified conflict and fragile situations as barriers to universal health coverage *(125)*. Hunger has been considered a weapon of war *(157–159)*. Save the Children estimated that more than half a million children are likely to die in the world's 10 worst conflict areas as a result of hunger *(157)*. Ager et al. *(160)* identified countries classified as "fragile states" as those with the highest infant mortality rates *(7 of 10)* and lowest progress toward reducing maternal mortality (14 of 20); areas of concern included the need for research on responses to health outbreaks, assessing needs and understanding health system weaknesses and coordination across sectors *(157–159, 161)*.

Summary table of environmental and social domain programmes and selected interventions

Table 5 summarizes some of the commonly implemented nutrition-sensitive interventions or programmes that can help to reduce anaemia, the population groups generally involved in these programmes and indicators that may be used to assess the status of the programme. This is intended as an illustrative list to initiate discussions on what to consider among nutrition-sensitive programmes; additional programmes, population groups and indicators are available for all of these categories.

Table 5. Programmes, population groups and potential indicators for environmental and social domains related to anaemia

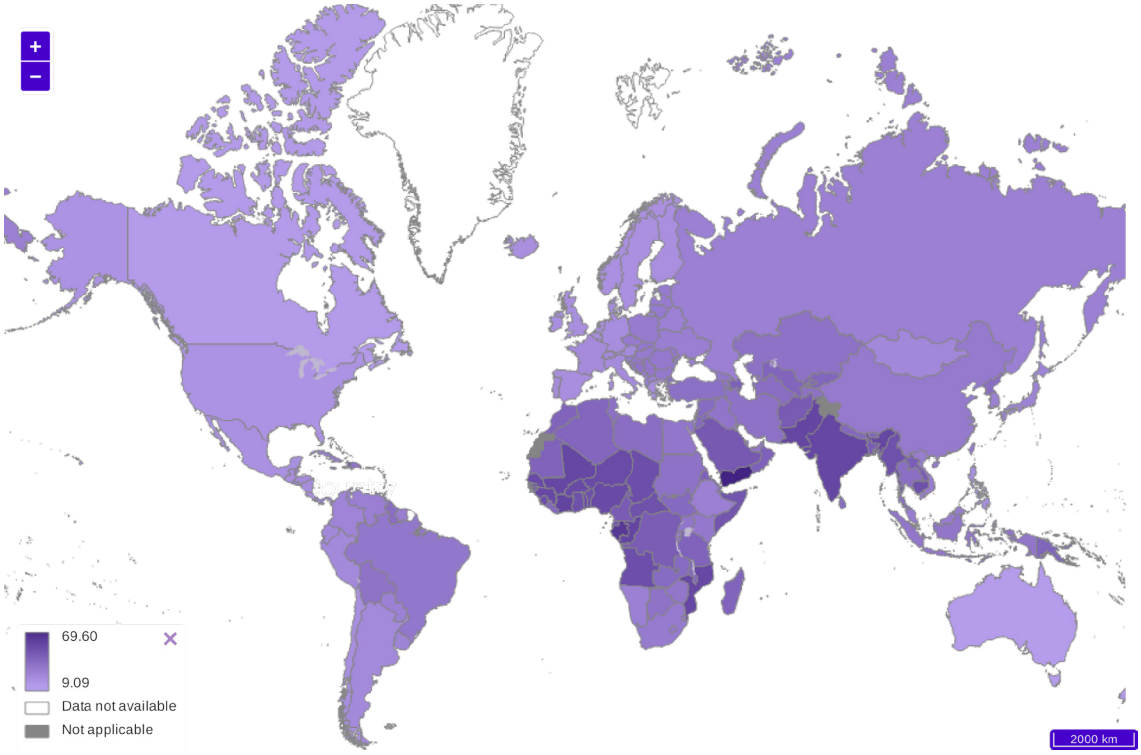
Interventions or status	Population group	Direct or indirect programme indicators
Economic growth	General	Gross national product
Women's empowerment *(54, 86)*	WRA	Women's Empowerment in Agriculture Index *(162)* Women's decision-making Attitudes toward or experience of violence
Poverty alleviation	General	Household socioeconomic status or wealth index Access to social services
Universal health care	General	Distance to care, cost of services
Provider capacity	General	Quality of care, education level of providers, pre- and in-service training opportunities, university programmes
Strategies, policies and programmes	General	Presence of health or multisectoral policies, programmes, strategies related to anaemia reduction or that directly reference anaemia reduction
Financial commitment	General	Budget committed specifically to anaemia reduction efforts
Coordination/SUN	General	Engagement in SUN, REACH or other coordination body
Intersectoral planning and strategizing	General	Presence of functioning intersectoral stakeholder platform

REACH: Renewed Efforts Against Child Hunger and Undernutrition; SUN: Scaling Up Nutrition movement; WRA: women of reproductive age.

GLOBAL PREVALENCE OF ANAEMIA

The Global Health Observatory of WHO provides country-level anaemia estimates from 1990 to 2016 for women of reproductive age (pregnant and non-pregnant) and other population groups *(163)*. These annual data represent estimates based on trajectories modelled using national anaemia survey data collected among pregnant women, non-pregnant women and/or women of reproductive age (163). The Global health Observatory's country estimates of anaemia prevalence for 2016 among women of reproductive age ranged from 9.1% in Australia to 69.6% in Yemen (see Fig. 2).

Fig. 2. 2016 Global map showing the prevalence of anaemia among women of reproductive age using Global Health Observatory estimates *(163)*



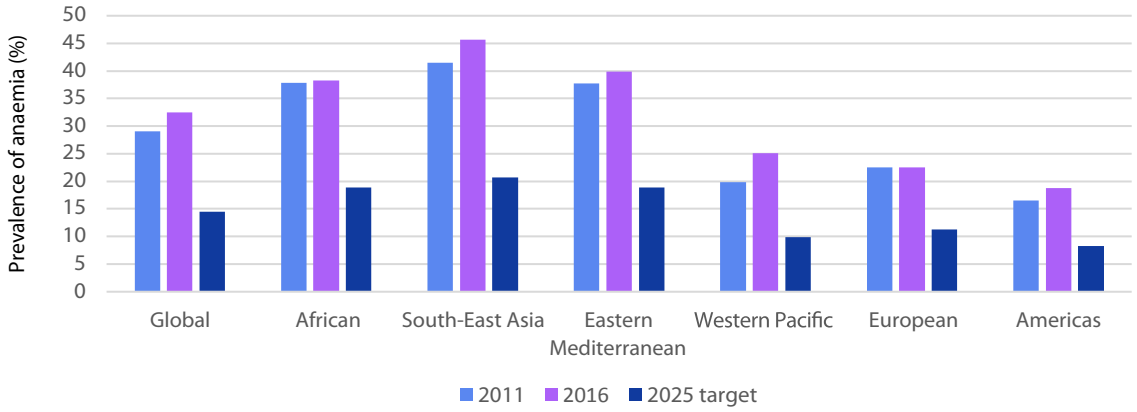
Note: The Global Health Observatory applies statistical modeling techniques ("Bayesian hierarchical mixture model") to derive annual country estimates of the prevalence of anaemia in women of reproductive age using population data.

WORLD HEALTH ASSEMBLY NUTRITION TARGET – ANAEMIA REDUCTION

Anaemia is a global public health concern, afflicting adolescent girls, women of reproductive age, pregnant women and children in low- and middle-income countries *(13)*. In the 2012 World Health Assembly, the WHO Member States endorsed global targets for improving maternal, infant and young child nutrition *(164, 165)*. The second of the six global nutrition target is to achieve a 50% reduction of anaemia among women of reproductive age (15–49 years) by 2025. Reduction of anaemia is important because anaemia afflicts half a billion women of reproductive age worldwide – impairing their health and economic productivity *(1)*.

In 2011, prior to the World Health Assembly setting its 2012 target, WHO estimated the global prevalence of anaemia among all women of reproductive age was 29.4% or 528.7 million *(166)*. By 2016, WHO estimated that 32.8% of women of reproductive age globally had anaemia *(60)*. These estimates are a relative increase of 11.6% in global anaemia prevalence in the first four years of the World Health Assembly target, 2012–2016. Regional estimates and changes during this period are reported in Fig. 3. Assuming a linear trajectory, countries seeking to reduce anaemia by 50% in the 13 years between 2012 to 2025 would need to achieve a relative reduction of 15.4% in the 4 years between 2012 and 2016[1] to stay on track. However, global and regional anaemia estimates showed increases in anaemia prevalence over this period *(163)*.

Fig. 3. Change in anaemia prevalence among non-pregnant women 2011 *(166)* and 2016[2], by WHO region



ARE COUNTRIES ON TRACK?

Considering the World Health Assembly target of 50% reduction in anaemia prevalence by 2025 and a linear expected change per year to reach this goal, a relative change of at least 15.4%[3] reduction by 2016 would be considered "on-track"; a relative change of 0% to 15.4% reduction from baseline would be headed in the "right direction", and anything less than 0% would be "off-track", or an increase in anaemia rates (baseline or 2012 minus 2016 prevalence estimates).

Estimated changes using data from the WHO Global Health Observatory website on anaemia from 2012 to 2016 *(163)* showed a range of changes across countries in anaemia prevalence among women of reproductive age *(5)*, but, overall, the global relative reduction in prevalence of anaemia in women of reproductive age during this period was 8.3%, meaning a fairly large increase in anaemia prevalence. In most countries, the estimated anaemia prevalence among women of reproductive age increased during this period, and even among those countries in which there has been progress toward reducing anaemia, none was on target in 2016 with the estimated reduction of 15.4%[3] for a 50% reduction in anaemia by 2025.

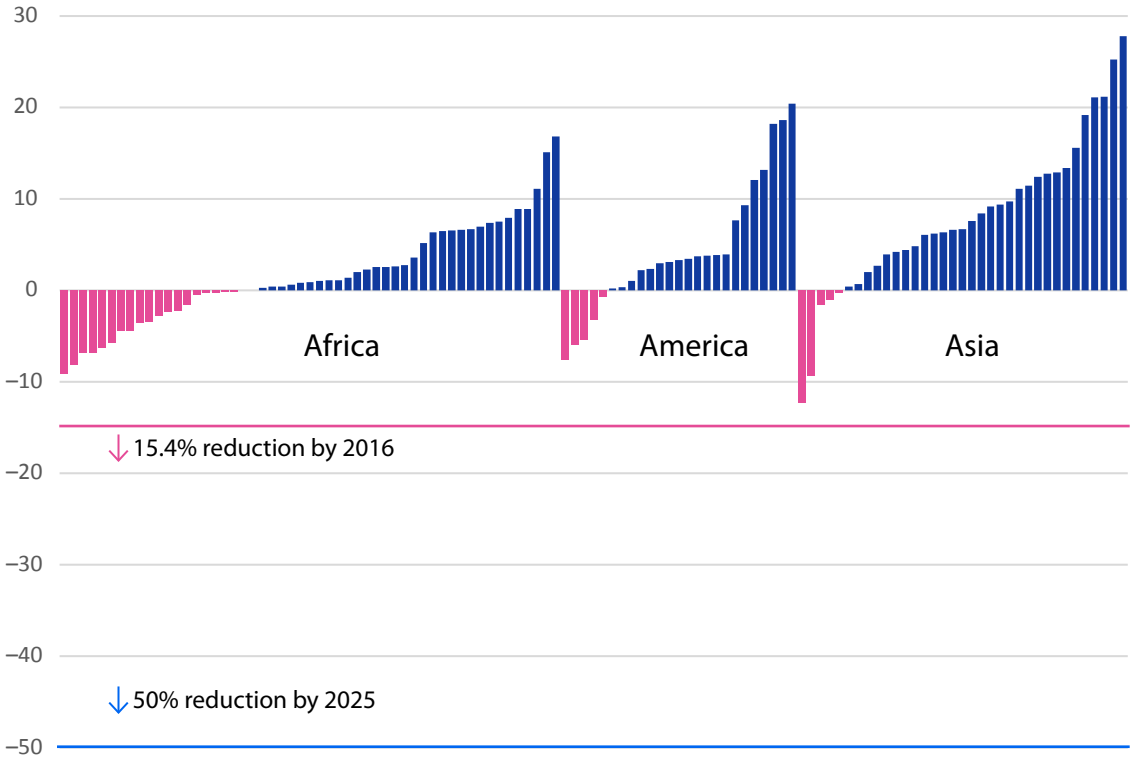
[1] This assumes 13 years between 2012 and 2025 and 4 years between 2012 and 2016 and a linear trajectory, so a 50% decrease divided across 13 years (~3.8% decrease per year), multiplied by 4 years, or: (50%/13 years) × 4 years = 15.4% decrease expected between 2012 and 2016. However, if programmes did not commence immediately, the trajectory would not be expected to be linear.

[2] Global Health Observatory, imputed data for 2016.

[3] Value calculated as the 2016 prevalence in anaemia among women of reproductive age minus the 2012 prevalence, then this change was divided by the baseline, 2012 prevalence, to show both the magnitude and direction of change: ((2016 prevalence – 2012 prevalence)/2012 prevalence) × 100% = % relative change from baseline to 2016 based on Global Health Observatory modelled data.

Fig. 4 depicts the changes in the rates of anaemia among women of reproductive age in all low- and middle-income countries with data from 2012 to 2016 in the Global Health Observatory dataset, the most recent data available since announcement of the 2012 World Health Assembly targets. The Global Health Observatory presents modelled annual estimates of the prevalence of anaemia that are derived based on national level data. This figure presents the progress toward this goal in terms of the percentage change in anaemia that has occurred since 2012 (see calculation in footnote 3 on the previous page) relative to two lines, for the target by 2016 of 15.4% reduction ("–15.4%" in the figure, pink line), and 50% reduction target by 2025 ("–50%" in figure, blue line). Thus, a positive number represents an increase in anaemia prevalence in women of reproductive age, while a negative number represents a decrease in anaemia prevalence. The figure is presented in groupings of countries from the Americas, Africa and all Asia regions combined; specific countries are not labelled.

Fig. 4. Percentage change in anaemia rates among women of reproductive age in low- and middle-income countries 2012–2016, by region



Note: the pink line represents the target trajectory by 2016 of 15.4% reduction; the blue line represents the target by 2025 of 50% reduction.

WHY ARE COUNTRIES NOT ON TRACK?

As clearly outlined throughout the previous sections of this review, the causes of, contributors to and interventions for reducing anaemia are complex *(9–11, 13, 21, 22, 60)*. Decision-makers seeking to reduce anaemia cannot expect to achieve the desired results without first understanding the local context, then intervening through a broad scope of relevant interventions that address this complexity (see resources and recommendations in Governance section). The value of multisectoral approaches is emphasized in multiple publications *(154, 167–169)*.

Nutrition crosses multiple sectors, so success requires cross-sectoral actions

The focus of anaemia reduction efforts must address a broad range of contributors and causes; efforts cannot be limited to addressing the proportion of anaemia that is related to iron deficiency.

The importance of considering more than just iron-related interventions has been highlighted by Wirth et al. *(22)*. Using data from 10 national micronutrient surveys, they showed that as the overall prevalence of anaemia and infection burden increased, the overall proportion of women with anaemia who have iron deficiency (those with

IDA) decreased; this was true even when ferritin concentrations were adjusted for inflammation (see Table 6). Petry et al. *(21)* also found that the proportion of anaemia associated with iron deficiency among women of reproductive age was lower in countries with a very high prevalence of inflammation, which is often found as a component of infection, and where anaemia prevalence was >40% (severe public health concern).

Table 6. Weighted prevalences of iron deficiency anaemia by infection burden among women of reproductive age across 10 low-, medium- and high-income countries, with the proportion of anaemia that is associated with iron deficiency

Infection burden	Weighted prevalence of anaemia in women of reproductive age, %	Proportion of anaemia that is associated with iron deficiency, %
Low	6.9	71.0
Medium	12.4	65.3
High	40.5	35.1

Source: data from Fig. 1 of Wirth et al. *(22)*, described as follows: "Venn diagrams illustrating the weighted prevalences of iron deficiency, anemia, and iron-deficiency anemia and proportions of anemic women with iron deficiency in nonpregnant WRA by category of infection burden: Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia (BRINDA) project. Iron deficiency was defined as an inflammation-adjusted ferritin concentration <15 mg/L. Anemia was defined as a hemoglobin concentration <120 g/L. Iron-deficiency anemia was defined as a hemoglobin concentration <120 g/L and inflammation-adjusted ferritin concentration <15 mg/L. Countries were categorized by infection burden as follows – low: Georgia and the United States of America; moderate: Colombia and Mexico (2006 and 2012); and high: Cameroon, Côte d'Ivoire, Liberia, and Laos".

Although iron deficiency is one component of anaemia, it is only possible to assess the proportion of a population's anaemia that is due to iron deficiency in relatively few countries worldwide. Owing to the high cost and complexity of venous blood collection, treatment, transportation, storage and analyses, few countries have collected data on population ferritin concentrations, which are used to measure the proportion of anaemia that is due to iron deficiency, thus IDA. As described previously, iron deficiency occurs with and without anaemia, and iron deficiency, IDA and anaemia can be due to many different factors.

SELECTING AND IMPLEMENTING THE OPTIMAL COMBINATION OF INTERVENTIONS TO REDUCE ANAEMIA

IRON-DEFICIENCY REDUCTION PROGRAMMES

As summarized in Fig. 1, multiple interventions are needed to address iron deficiency and anaemia among women of reproductive age, including adolescent girls, pregnant women and postpartum women. Common interventions and related population groups among women of reproductive age are summarized in Table 3, Table 4, Table 5 and Table 9. Iron supplementation is recommended in areas where the prevalence of anaemia is high. However, studies have shown that that iron-replete individuals are at risk of adverse effects with iron supplementation, so extra considerations are required *(170)*. When individuals are not iron deficient, provision of iron supplements can lead to excess circulating iron that can then be used by malaria parasites and other infectious agents to increase their virulence. The body's response to the presence of inflammation or infection is to reduce circulating iron and haemoglobin, leading to secondary anaemia. Thus, providing iron to an individual who may be infected and is not iron deficient may pose a health risk, as it will be enhancing the pathogen's virulence. Because of the complexity of laboratory analyses to confirm whether iron deficiency is present, decision-makers and individual providers are often left wondering whether the risk of iron deficiency is higher than the risk of providing iron to individuals with high risk of infection. Owing to these risks, WHO recommends efforts to prevent and manage infections while providing supplemental iron *(171)*.

Those seeking to reduce national rates of anaemia could review the overall steps described in WHO guide: *Strategizing national health in the 21st century: a handbook (129)* and complementary information from WHO's *Nutritional anaemias: tools for effective prevention and control (8)*. Each of these steps highlights overall considerations that are critical to achieving sustainable programme impact. The following sections provide anaemia-specific adaptations for these general steps, along with selected guidance and references to tools. These sections also highlight the programmatic considerations in the form of five domains that are postulated to be important in successful programme implementation *(172, 173)*. Particular consideration of the steps and domains outlined is critical when implementing programmes, monitoring progress and assessing whether programmes are having the desired effects and being implemented as desired.

Considerations recommended by WHO for strategizing national health in the 21st century *(129)*

- Population consultation on needs and expectations
- Situation analysis of the health sector
- Priority-setting for national health policies, strategies and plans: strategic planning – transforming priorities into plans
- Operational planning: transforming plans into action
- Estimating cost implications of a national health policy, strategy or plan
- Budgeting for health: monitoring, evaluation and review of national health policies, strategies and plans
- Law, regulation and strategizing for health at national level
- Strategizing for health at subnational level
- Intersectoral planning for health and health equity
- Strategizing in distressed health contexts

Domains that affect programme implementation *(172, 173)*

- Domain 1: Interventions or "objects of implementation" (type of programme, multisectoral agendas, national or subnational projects by government and nongovernmental organizations, implementation innovations)
- Domain 2: Implementing organization(s) and their providers: frontline workers, supervisors and managers
- Domain 3: Enabling environment/governance – government, funders, civil society, private sector
- Domain 4: Individuals, households and communities
- Domain 5: Implementation processes – initiation, planning, implementation, sustaining

Overall cycle of Assessment, Analysis, Action (AAA)

CONDUCTING A LANDSCAPE ANALYSIS OF AVAILABLE DATA ON ANAEMIA

Landscape analyses help decision-makers identify the combination of probable causes of anaemia, which related interventions are already implemented, and which interventions are likely to be added or improved along the path toward measurable anaemia reduction. One available landscaping tool that is specific to anaemia reduction efforts is the Anaemia Landscape Analysis Tool developed by the USAID-funded SPRING project. This tool includes user guides and Excel-based spreadsheets to guide stakeholders in decision-making. Available tools include three overall categories of questionnaires for gathering pertinent information to assess a country's efforts toward reducing anaemia: (i) prevalence of anaemia and coverage of key anaemia-related programmes, such as those outlined in this document; (ii) programme status related to nutrition, disease control, water and sanitation, reproductive health, agriculture and genetic counselling and management; and (iii) strategy and policy enacted related to anaemia.

Steps in implementing SPRING's Anaemia Landscape Analysis Tool *(174)*

- Step 1: Understand the anaemia situation and its causes:
  - Prevalence questionnaire
  - Year and date of available anaemia prevalence data by population group at national and subnational level
  - Prevalence of other related deficiencies: iron, vitamin A, folate, vitamin B_{12}, zinc
  - Prevalence of genetic blood disorders (sickle cell, thalassemia)
- Step 2: Track interventions to address anaemia:
  - Programme questionnaire
  - Coverage of anaemia-related programmes: prenatal iron, antenatal care visits, intermittent iron for women/adolescent girls, vitamin A or iron for children, exclusive breastfeeding up to 6 months, continued breastfeeding from 6 moths to 2 years, fortified or biofortified food production and consumption, malaria prevention and treatment, deworming for children and women (helminths/ schistosomiasis), safe water and hygiene (drinking water, clean play spaces, etc.), improved sanitation (latrines), reproductive health/ family planning, delayed cord clamping, food security, safe food storage, counselling and management of genetic blood disorders
  - Coverage, quality
- Step 3: Identify anaemia-related strategies or policies in place: Strategy/policy questionnaire
  - Presence of policies (with financial backing) of above related programmes
- Step 4: Put it all together: review outputs
  - Dashboard consolidates the above data to demonstrate potential barriers and bottlenecks

DECISION TREE

Table 7 sets out questions to assist in identifying contributors to anaemia in each country's context. This list reflects the range of steps and domains and other considerations highlighted in this document *(147, 172, 173)*, and provides a global perspective of how a country might apply the various methods and collaborations recommended throughout this document. An example of the stepwise process as it might apply to a country is demonstrated in Table 8.

In Fig. 5, the questions included in the decision tree (Table 7) are organized by general themes of work and information that is required in the stepwise process of designing a multisectoral response to anaemia control programmes. This figure highlights key areas where decisions must be applied.

Table 7. Decision tree: a stepwise approach to designing a multisectoral response to anaemia control programmes

Steps/domains	Theme	Decision question	Yes – Action	No (or uncertain) – Action
Priority-setting for national health policies, strategies and plans Estimating cost implications of a national health policy, strategy or plan Budgeting for health Law, regulation and strategizing for health Strategizing in distressed health contexts Enabling environment and stakeholder dynamics	Policy/ strategy	Q1. Does the country have national cross-sectoral policy/strategy/plan related to anaemia reduction, with aligned project-specific budget lines? (Consider both public and private programmes and initiatives)	Go to Q2	***Scenario 1:*** Develop national and subnational multisectoral plans to address determinants of anaemia ***Scenario 2:*** In preparation for these plans, identify current national and subnational level programmes that address assumed or identified determinants of anaemia Continue to Q2
	Leadership and coordination	Q2. Does the country have a national and subnational leadership and coordination mechanism for nutrition and specifically for anaemia?	Go to Q3	Develop and/or strengthen nutrition leadership and coordination at national and subnational levels
Situation analysis of the health sector Priority-setting for national health policies, strategies and plans Strategic planning: transforming priorities into plans Objects of implementation	Burden of anaemia	Q3. Is the prevalence of anaemia among PW, NPW and WRA >20%?	High priority Go to Q4	Low priority, when possible Go to Q4
	Biochemical determinants of anaemia	Q4. Has the country conducted a national micronutrient[a] or other survey that characterizes the biochemical determinants of anaemia by geography?	Review the prevalence of measured biochemical deficiencies related to anaemia, then Go to Q5	***Scenario 1:*** Plan to conduct a national micronutrient survey ***Scenario 2:*** Due to the high cost and complexity of a national surveys, particularly micronutrient surveys, the country may choose to start with a desk review and multi-stakeholder consultations to characterize determinants of anaemia in their context using alternate indicators *(174)*[b] Continue to Q5
	Nutritional determinants of anaemia	Q5. Has the country conducted a national food consumption survey that characterizes intakes of key nutritional causes of anaemia?	Review the proportion of inadequate intakes, then Go to Q6	***Scenario 1:*** Plan to conduct a national food consumption survey ***Scenario 2:*** Consider alternate indicators of dietary intakes related to anaemia: reported iron-rich, vitamin A-rich foods by young children or WRA; production and distribution of fortified foods and condiments Go to Q6
	Non-nutritional causes of anaemia	Q6. Does the country have prevalence indicators (preferably at subnational level) on the burden of malaria and helminths, access to improved WASH, and coverage of related programmes?	Assess coverage relative to burden, then Go to Q7	***Scenario 1:*** Plan for national and subnational level surveys related to these factors ***Scenario 2:*** Review whatever data are available in-country and from similar surrounding countries, to identify likely country risks Go to Q7
	Genetic causes of anaemia	Q7. Does the country have data on the prevalence of haemoglobinopathies nationally or among subpopulations?	Assess the populations most at risk Go to Q8	***Scenario 1:*** Plan for national and subnational level surveys ***Scenario 2***: Review whatever data are available in-country and from similar surrounding countries, to identify likely country risks Go to Q8

Steps/domains	Theme	Decision question	Yes – Action	No (or uncertain) – Action
Population consultation on needs and expectations Strategizing for health at subnational level Individuals/households/ communities	Needs, resources, capacities, social, cultural, behavioural, economic, political factors	Q8. Do the national and subnational plans, programme implementation plans and/or theories of change include findings from diverse forms of formative research and consultations at multiple levels?	Go to 9	Conduct diverse forms of formative research and consultations at multiple levels, to identify needs, resources, capacities, social, cultural, behavioural, economic, political factors of populations Go to Q9
Intersectoral planning for health and health equity Implementing organizations	Resources and capacity	Q9. Does the country have data on the number of trained nutritionists hired in nutrition-related positions, hired health staff with nutrition training and coverage of in-service nutrition training on select nutrition programmes?	Convert into population numbers per trained nutritionist Go to Q10	***Scenario 1:*** Seek opportunities to obtain these data; review data from NGOs and facility surveys ***Scenario 2:*** Establish a task force to gather this information Go to Q10
	Multi-stakeholder and multisectoral collaborations	Q10. Do the country plans include all sectors and all stakeholders that need to be included?	Go to Q11	Consult with the relevant coordination mechanism at national and subnational levels to identify and include all stakeholders and all sectors Go to Q11
Operational planning: transforming plans into action Monitoring, evaluation and review of national health policies, strategies and plans Implementation processes	Quality of care	Q11. Does the country collect data on the quality of care?	Go to Q12	Review data from NGOs, service availability and readiness assessments, facility data Go to Q12
	Adequacy of objects of implementation targeted multisectoral plans and programmes	Q12. Does the country have targeted national level or subnational level multisectoral programmes[c] to address the determinants of anaemia?	Go to Q13	***Scenario 1:*** Review national and subnational multisectoral plans to address the determinants of anaemia ***Scenario 2:*** In preparation for these plans, identify current national and subnational level programmes that address assumed or identified determinants of anaemia Continue to Q13
	Adequacy of extent of implementation of national and subnational anaemia control programmes	Q13. Are the targeted national level or subnational level multisectoral programmes to address the determinants of anaemia implemented adequately?[d]	Go to Q14	Develop a plan to accelerate implementation of targeted national or subnational level multisectoral anaemia reduction programmes Start with assumptions based on proxy indicators of programme implementation Develop and implement plans to improve programme monitoring data Start with assumptions based on proxy indicators of quality of programme implementation Go to Q14
	Implementation research/bottleneck analysis	Q14a. Is there implementation research on how gaps in programmes can be or have been identified? Q14b. Has a bottleneck analysis in implementing anaemia reduction programmes been conducted?	Go to Q15	Conduct implementation research/ bottleneck analysis With results of analysis, go to Q15

Steps/domains	Theme	Decision question	Yes – Action	No (or uncertain) – Action
	Monitoring and evaluation	Q15. Is there a robust monitoring and evaluation (M&E) system of the anaemia reduction programmes?[e] (Consider both public and private programmes and initiatives)	Go to Q16	Develop a national/subnational M&E system for anaemia reduction programmes Until a M&E system for anaemia reduction is in place, identify available or proxy indicators, and continue to Q16
	Programme improvement	Q16. Does the country have a plan, and related taskforce, to periodically review anaemia reduction programmes (based on M&E system or other available data) and implement improvements?	Go to Q17	Develop a national taskforce to periodically review anaemia reduction programmes based on M&E system results and implement related improvements Concurrently or sequentially, continue to Q17
	Sustained and effective programme	Q17. Does the county have a sustainability plan?	Ensure sustainability	Develop a sustainability plan Return to Q17

M&E: monitoring and evaluation; NGO: nongovernmental organization; NPW: non-pregnant women; PW: pregnant women; WASH: water, sanitation and hygiene; WRA: women of reproductive age (15–49 years).

[a] Examples of nutritional indicators: anaemia versus iron deficiency and iron deficiency anaemia; other micronutrient deficiencies – folate, vitamin A, vitamin B_{12}, vitamin B_6; dietary intake, including intake of fortified foods; food security, hunger index, economic status. Examples of non-nutritional indicators: infection/disease (hookworm, malaria, HIV); inherited disorders (haemoglobinopathies). Complementary indicators: WASH; health-care access; women's empowerment, decision-making, access to household finances; health-care facilities and resource capacity.

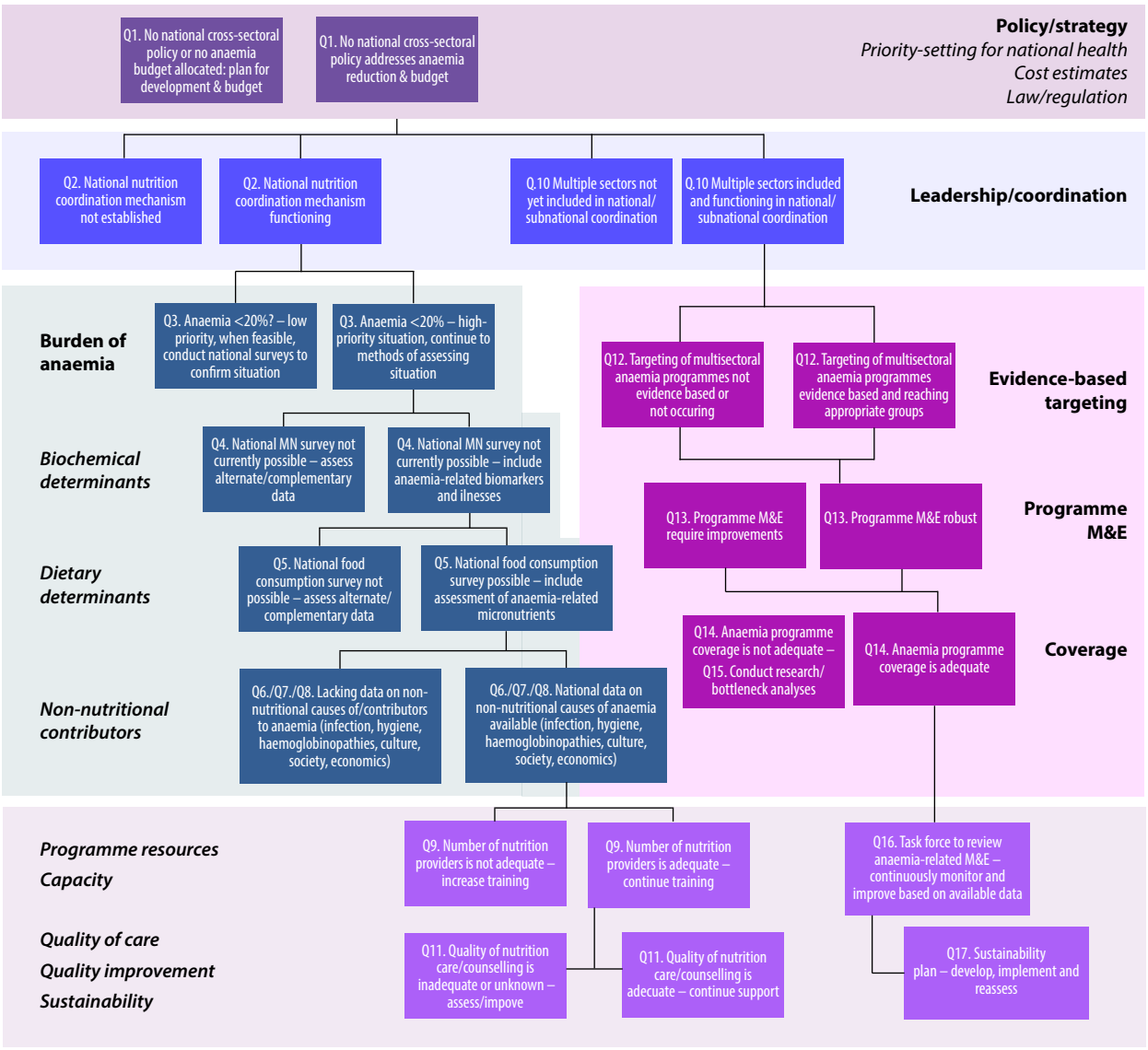
[b] Other potential indicators include food balance sheets (Food and Agriculture Organization of the United Nations) data on iron available in the food supply; survey data on night blindness among women; production data on fortified foods relative to population size; health data on hemoglobinopathies in vulnerable populations; survey data on WASH indicators.

[c] Examples of programmes: supplementation with iron and/or other micronutrients (antenatal iron and folic acid [IFA]) or multiple micronutrients [MMS], postpartum IFA/MMS, intermittent IFA/MMS for adolescents and WRA); fortification with iron and other MNs (wheat flour, oil or condiment fortification, targeted fortified foods through food security efforts); general dietary programmes (nutrition counselling, agriculture support and diversity, food security (access); parasite control, prevention, treatment (deworming, malaria prevention/ screening/treatment, WASH efforts, capacity-building).

[d] Develop a score to determine the adequacy of the extent of implementation of anaemia reduction programmes that includes key components for successful programme implementation.

[e] Refer to guidance for developing a M&E system for national anaemia control programme *(129)*, including implementation research and bottleneck analysis in addition to routine M&E.

Fig. 5. Overview of questions by theme in the decision tree approach



MN: micronutrient.

Anaemia-specific adaptations of the steps and domains that affect programme implementation, country example using decision tree

Table 8 uses the preceding decision tree for a fictitious country, to demonstrate the process a country might follow in deciding next steps toward anaemia reduction efforts.

Table 8. Example: applying the decision tree in a fictitious country with typical data and plans

Decision question	Example country status	Action recommended
Q1. Does the country have a national cross-sectoral policy/strategy/plan related to anaemia reduction, with aligned project-specific budget lines?	The country has a 5-year national nutrition multisectoral plan that includes anaemia Some subregions of the country have contextualized the national nutrition multisectoral plan in regional multisectoral plans that include anaemia	Ensure that all subregions of the country have contextualized the national multisectoral plan that includes anaemia
Q2. Does the country have a national and subnational leadership and coordination mechanism for nutrition and specifically for anaemia?	SUN member country Nutrition is a division within the Ministry of Health at the national and subregional levels	The SUN lead should take advantage of the political commitment generated by SUN to fundraise for scaling up nutrition and specifically anaemia reduction programmes, using effective multisectoral and transdisciplinary approaches Advocate for an anaemia reduction lead at national and subregional levels responsible for coordination of anaemia reduction programmes.
Q3. Is the prevalence of anaemia among PW, NPW and WRA >20%?	Prevalence of anaemia among PW is 50% in 2009 90+ IFAS in pregnancy is 20% ≥4 ANC visits is 40%	Ensure country PW prevalence is valid and current/check Global Health Observatory Review anaemia, IFAS and ANC visits data – critical indicators in the path towards anaemia reduction
Q4. Has the country conducted a national micronutrient[a] or other survey that characterizes the biochemical determinants of anaemia by geography?	National micronutrient survey that included anaemia among different cohorts was conducted in 2009 Malaria indicator survey that measured the incidence of anaemia among PW was conducted in 2015 Country planning to conduct a national micronutrient survey	As planning for a national micronutrient survey is ongoing, the anaemia reduction lead to convene an anaemia reduction stakeholder consultation to assess the data available – use SPRING Anaemia Landscape Analysis Tool *(174)*

Decision question	Example country status	Action recommended
Q5. Has the country conducted a national food consumption survey that characterizes intakes of key nutritional causes of anaemia?	Food consumption survey conducted at subnational levels No national food consumption survey	Plan to conduct a national food consumption survey – consider combining it with national micronutrient survey Planned anaemia reduction stakeholder consultations to include food consumption data, food balance sheets, etc.
Q6. Does the country have prevalence indicators (preferably at subnational level) on the burden of malaria and helminths, access to improved WASH, and coverage of related programmes?	Malaria indicator survey – prevalence of malaria ranges between 10% and 30%	Discuss the possibility of including these indicators in the planned national micronutrient survey Planned anaemia reduction stakeholder consultations to review any available national data on malaria and categorize subregions according to endemicities
Q7. Does the country have data on the prevalence of haemoglobinopathies nationally or among subpopulations?	Subnational data on haemoglobinopathies available in malaria-endemic areas	Subnational data for populations most at risk sufficient – ensure data are current
Q8. Do the national and subnational plans, programme implementation plans and/or theories of change include findings from diverse forms of formative research and consultations at multiple levels?	Subnational formative research	Planned anaemia reduction stakeholder consultations to review subnational formative research for gaps If gaps are identified, plan formative research or consultations at multiple levels
Q9. Does the country have data on the number of trained nutritionists hired in nutrition-related positions, hired health staff with nutrition training and coverage of in-service nutrition training on select nutrition programmes?	No central repository with the data	Obtain data on nutrition workers and convert into population numbers per trained nutritionist
Q10. Do the country plans include all sectors and all stakeholders that need to be included?	Current country plans include nutrition, agriculture and health sectors	Planned anaemia reduction stakeholder consultations should assess whether any other sectors need to be included – private sector
Q11. Does the country collect data on the quality of care?	Country conducts regular service provision assessments and service availability and readiness assessments	Planned anaemia reduction stakeholder consultations to review data from national service provision assessments and service availability and readiness assessments and assess their adequacy

Decision question	Example country status	Action recommended
Q12. Does the country have targeted national level or subnational level multisectoral programmes[b] to address the determinants of anaemia?	The country has a 5-year national nutrition multisectoral plan that includes anaemia Some subregions of the country have contextualized the national nutrition multisectoral plan in regional multisectoral plans that include anaemia	Planned anaemia reduction stakeholders' consultations to review national and subnational multisectoral plans, to ensure determinants of anaemia are adequately addressed
Q13. Are the targeted national level or subnational level multisectoral programmes to address the determinants of anaemia implemented adequately?[c]	Anaemia reduction programmes are implemented in a disjointed manner with no clear coordination at subnational level	Develop a plan to accelerate implementation of targeted national level or subnational level multisectoral anaemia reduction programmes
Q14a. Is there implementation research on how gaps in programmes can be or have been identified? Q14b. Has a bottleneck analysis of implementing anaemia reduction programmes been conducted?	No implementation research	Planned anaemia reduction stakeholder consultations to identify gaps in programmes and plan for implementation research
Q15. Is there a robust monitoring and evaluation (M&E) system of the anaemia reduction programmes?[d]	No M&E system for anaemia reduction programmes	Anaemia reduction lead at national and subregional levels to coordinate the development of M&E system for anaemia reduction programmes
Q16. Does the country have a plan, and related taskforce, to periodically review anaemia reduction programmes (based on M&E system or other available data) and implement improvements?	No taskforce	The anaemia reduction stakeholder consultation group will serve as a taskforce with clear roles and responsibilities
Q17. Does the county have a sustainability plan?	No sustainability plan for anaemia reduction programmes	Anaemia reduction stakeholder consultation group to develop a sustainability plan

ANC: antenatal care; IFAS: iron and folic acid supplements; M&E: monitoring and evaluation; NPW: non-pregnant women; PW: pregnant women; SPRING: Strengthening Partnerships, Results and Innovation in Nutrition Globally; SUN: Scaling Up Nutrition movement; WASH: water, sanitation and hygience; WRA: women of reproductive age (15–49 years).

[a] Examples of nutritional indicators: anaemia versus iron deficiency and iron deficiency anaemia; other micronutrient deficiencies – folate, vitamin A, vitamin B_{12}, vitamin B_6; dietary intake, including intake of fortified foods; food security, hunger index, economic status. Examples of non-nutritional indicators: infection/disease (hookworm, malaria, HIV); inherited disorders (haemoglobinopathies). Complementary indicators: WASH; health-care access; women's empowerment, decision-making, access to household finances; health-care facilities and resource capacity.

[b] Examples of programmes: supplementation with iron and/or other micronutrients (antenatal iron and folic acid [IFA]) or multiple micronutrients [MMS], postpartum IFA/MMS, intermittent IFA/MMS for adolescents and WRA); fortification with iron and other MNs (wheat flour, oil or condiment fortification, targeted fortified foods through food security efforts); general dietary programmes (nutrition counselling, agriculture support and diversity, food security (access); parasite control, prevention, treatment (deworming, malaria prevention/ screening/treatment, WASH efforts, capacity-building).

[c] Develop a score to determine the adequacy of the extent of implementation of anaemia reduction programmes that includes key components for successful programme implementation.

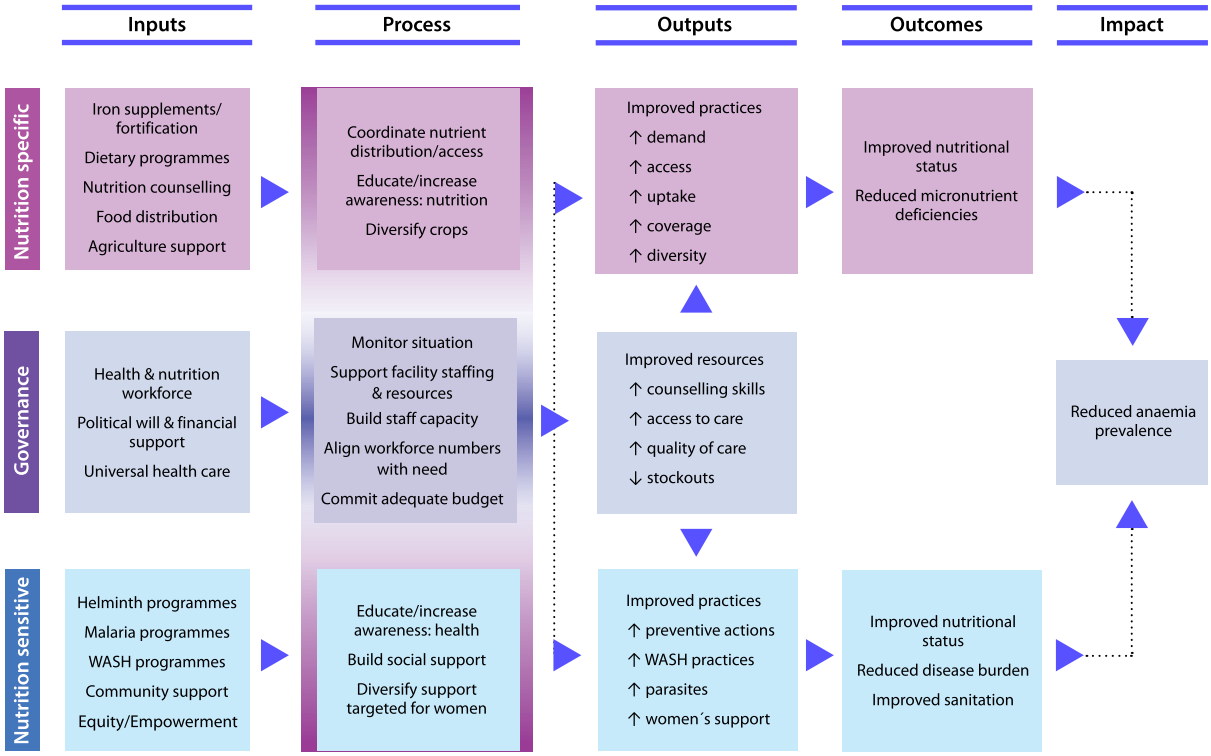
[d] Refer to guidance for developing a M&E system for national anaemia control programme *(129)*, including implementation research and bottleneck analysis in addition to routine M&E.

MONITORING AND EVALUATION OF ANAEMIA REDUCTION EFFORTS

All anaemia reduction efforts must be accompanied by well-designed monitoring plans based on clearly articulated programme logic model or "theory of change" and intervention activities. For example, Fig. 6 highlights a range of anaemia-related inputs discussed in this report and demonstrates how they may fit across a generic theory of change. This model is the foundation for any related monitoring plan.

THEORY OF CHANGE

Fig. 6. Generic anaemia programme theory of change



WASH: water, sanitation and hygiene.

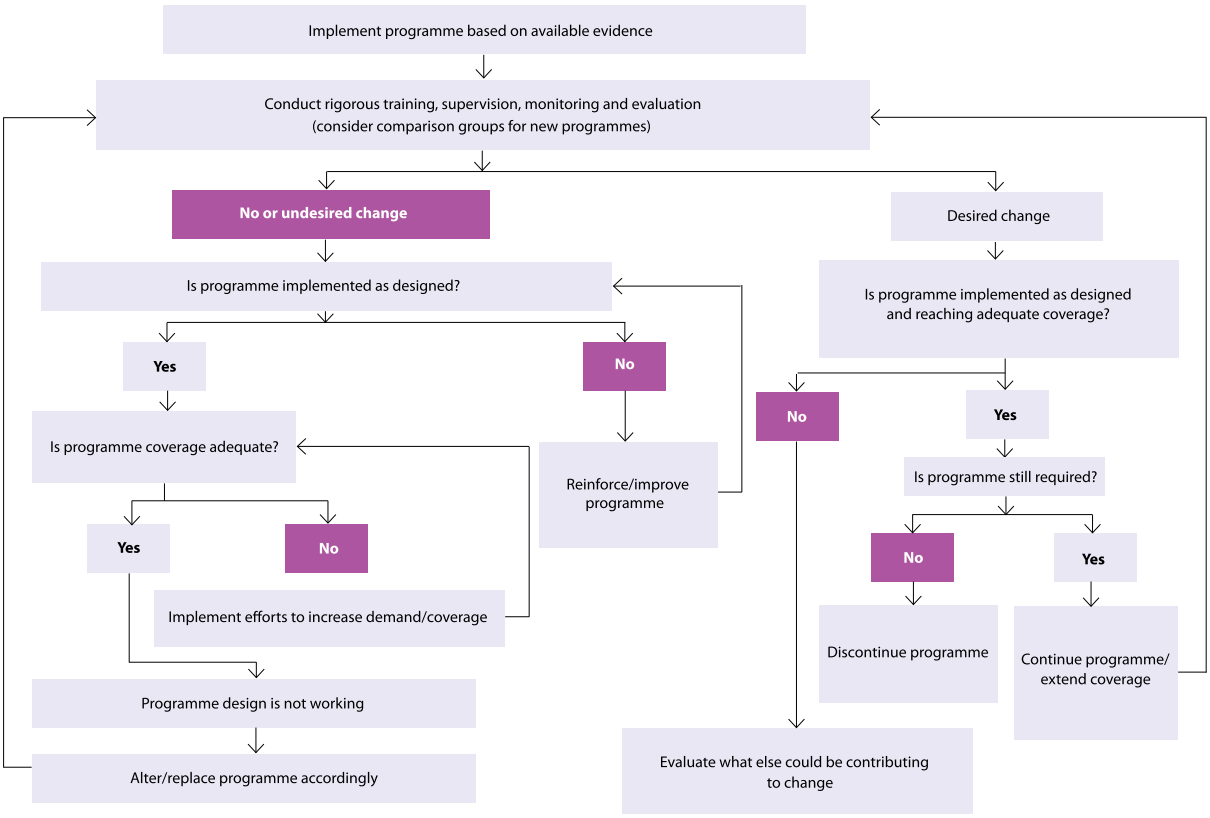
MONITORING ANAEMIA REDUCTION EFFORTS

Each programme or combination of programmes must be evaluated according to best practices of monitoring and evaluation. The primary outcome indicator of interest for anaemia reduction efforts is a decrease in the prevalence of anaemia, as measured by an increase in haemoglobin concentrations among the target population.

Once programmes are established, the following questions, categorized using five domains of implementation *(172, 173),* help to assess whether sufficient time has passed for the expected changes to have occurred and whether the implemented programme aligns with the original programme design. The first questions must be answered prior to deciding whether a programme is ready for evaluation, and later questions are used to assess effectiveness and whether the programme should be continued, replaced, or discontinued – such as following emergency situations or when the population has changed to the extent that the programme is no longer necessary (see Fig. 6). For example, if programme coverage is high, but objectives are not achieved, developers must first ensure the quality of the programme was adequate before deciding whether the programme should be replaced or discontinued.

- *Objects of implementation*: the intervention, behaviour, concept
    - Is the selected intervention evidence based?
    - Is the intervention adapted to local context?
- *Intervention quality and completeness*: is the programme implemented according to design?
    - *Organization/staff:* are providers/implementers adequately trained?
    - *Enabling environment:* do providers receive necessary support (e.g. financial, resources, capacity-building)?
    - *Processes:* are supplies available as required (e.g. stocks, functioning equipment, visual aids)?
    - *Processes:* are providers implementing the programme as designed (e.g. appropriate method of counselling, engaging communities, targeting the correct recipients)?
    - *Enabling environment:* is the intervention receiving adequate support (policy, governance, finances, stakeholder coordination and alignment, public and private sector)?
- *Coverage of and demand for the intervention*: has the programme reached a sufficient proportion of the population to expect to see impact?
    - *Processes:* has the shift in coverage of the programme been adequate to expect a change (e.g. compared to baseline, is the programme now reaching a statistically important larger number of recipients)?
    - *Individuals-communities:* does the target population come for services (e.g. demand creation, participation in group sessions)?
    - *Individuals-communities:* do participants apply the services received (e.g. consume supplements received, return for follow-up visits, change practices)?
- *Efficiency and cost:*
    - *Processes, sustainability:* what is the overall cost relative to the achieved impact?
    - *Processes, sustainability:* what is the expected cost as the programme continues (beyond the initiation costs)?
- *Data use for programme improvement:*
    - *Organization/staff:* are data routinely reviewed to identify problem areas and implement changes?
    - *Organization/staff:* has there been a bottleneck analysis of available data?
    - *Organization/staff:* are data sufficient to assess programme implementation?
    - *Organization/staff:* are data timely?

Fig. 7. Summary of monitoring for impact (adapted from Figure 6 in reference *(175)*).



Key indicators are included in tables from other sections of this review (Table 3, Table 4, Table 5, Table 9). More specific indicators and methods of measurement are outlined in recent guidelines from WHO and online *(175):*

- iron and general nutrition-related indicators *(168);*
- parasite and other infection-related indicators *(168, 177);*
- WASH indicators at household *(177)* and facility *(113)* level; and
- service quality assessment and indicators: service provision assessment (SPA) *(178),* service availability and readiness assessment (SARA) *(179),* service quality *(180–182).*

WHAT TO MONITOR? ANTENATAL IRON SUPPLEMENT EXAMPLE

Table 3, Table 4, Table 5 and Table 9 summarize selected interventions and potential direct or indirect indicators of each programme that may be useful when conducting a landscape analysis of the status of anaemia-related programming. For example, the most common intervention to treat or prevent iron deficiency during pregnancy is daily iron supplementation, with or without other micronutrients. Coverage indicators regularly collected for this intervention include "iron consumption during a recent pregnancy of any or 90+ iron supplements". Prenatal iron is generally distributed through ANC visits to the health facility by pregnant women, so attendance to ANC would provide valuable information about whether women are getting access to iron (access or demand). However, ANC visits could be a bottleneck in antenatal iron distribution. Community-based distribution of iron and folic acid is becoming a feasible approach to improving anaemia rates in low- and middle-income countries and has had moderate success with reaching women early in pregnancy and encouraging them to attend ANC, counselling on health benefits, and compliance with iron and folic acid supplementation *(183).* ANC visits should include support, care, reassurance and information on nutrition during pregnancy and following birth, as well as screening and examinations to assure the health and well-being of mother and baby. Thus, data on the quality of counselling provided during ANC visits would provide an indication of whether the programme is being implemented according to the level of quality that is required to achieve impact. Additional indicators include commencement of ANC

during the first trimester, because this is associated with greater likelihood of consuming at least 90 IFAS during pregnancy (the minimum dose associated with reduced risk of anaemia during pregnancy *(68)*); this indicator could identify another potential bottleneck in iron distribution for pregnant women.

Table 9 presents indicators as examples for decision-makers to consider when assessing the state of activities for anaemia-related programmes for women of reproductive age; some are considered more "gold standard" indicators, which are often more costly, while the supplementary indicators are more commonly available. Each country will have additional interventions, recipient population groups and other relevant indicators to fit the local context. Additional indicators to consider are included in Table 3, Table 4, and Table 5.

Table 9. Iron interventions among women of reproductive age, with selected population groups and indicators

Interventions	Common recipients	Direct intervention-related indicators	Supplementary indicators
Interventions specific to iron-deficiency anaemia	WRA, PW, NPW	Prevalence of low ferritin concentration	Prevalence of haemoglobin concentration below cut-off value for anaemia Quality of health care/nutrition counselling Stock-outs of nutritional supplements
Daily iron containing supplements (IFAS, MMS)	PW, PPW	Coverage of any, 90, 180, 270 supplements during pregnancy	Coverage of any, 4+ or 8+ ANC visits
Intermittent IFAS	WRA, adolescents[a]	Coverage of at least 12 supplements each 6 months	Coverage of female school enrolment[b]
Fortified staple foods and condiments *(77)*	WRA	Biomarkers of nutrient adequacy or deficiency for fortified nutrient Prevalence of adequate dietary intakes	Production per capita[c] Household consumption *(183–185)*
Food insecurity (quality and quantity)	WRA	Prevalence of reported food availability, access, utilization and stability *(90)*	Prevalence of low anthropometry; health, caring and feeding practices Household income and consumption *(186)* Women's empowerment Poverty index
Dietary diversity	PW, PPW, WRA	Women's dietary diversity	Nutrition counselling Children's dietary diversity
Prevention or control of non-nutritional causes of iron deficiency (parasites, infection, etc.)	WRA	See Table 4	

ANC: antenatal care; IFA: iron and folic acid supplements; MMS: multiple micronutrient supplements; NPW: non-pregnant women; PW: pregnant women; PPW: postpartum women; WRA: women of reproductive age (15–49 years).

[a] Adolescents (10–19 years).

[b] In areas where intermittent iron is distributed through schools.

[c] Factors for adjusting per capita found in household income and consumption survey guidelines.

EVALUATION

Implementation sciences encompasses a range of activities in the implementation process. Among these, impact, cost-effectiveness, process and other evaluations complement monitoring of data when evaluating whether interventions are functioning as designed. Multiple guidance and frameworks are available for implementation science, with domains to consider in evaluations *(172, 187–191)*. The box below summarizes one stepwise framework that is available to assist programme monitoring and evaluation officers *(192)*.

United States Centers for Disease Control and Preventipn Framework for Programme Evaluation *(192)*

Steps

- **Step 1: Engage stakeholders** deals with engaging individuals and organizations (with an interest in the programme) in the evaluation process.
- **Step 2: Describe the programme** involves describing the programme or activity to evaluate, by defining the problem, formulating programme goals and objectives, and developing a logic model showing how the programme is supposed to work.
- **Step 3: Focus the evaluation design** determines the type of evaluation to implement, identifies the resources needed to implement the evaluation and develops evaluation questions.
- **Step 4: Gather credible evidence** identifies how to answer the evaluation questions and develop an evaluation plan that will include, among others, indicators, data sources and methods, and the timeline.
- **Step 5: Justify conclusions** is about collecting, analysing and interpreting the evaluation data.
- **Step 6: Ensure use and share lessons learnt** identifies effective methods for sharing and using evaluation results.

Standards

- **Utility** refers to designing an evaluation that meets the needs of the stakeholders.
- **Feasibility** ensures that the evaluation is practical and realistic.
- **Propriety** is concerned about the ethics of the evaluation, such as human rights protection.
- **Accuracy** ensures that the evaluation is producing valid and reliable findings.

"Formative evaluation ensures that a program or program activity is feasible, appropriate, and acceptable before it is fully implemented" *(193)*.

QUALITATIVE ANALYSES

Qualitative research methods were applied to complement this review with country-relevant barriers and enablers in anaemia reduction efforts. To obtain detailed feedback, key informants were approached from countries with the most improvements or most difficulties with anaemia reduction efforts, as demonstrated by the estimated change in anaemia prevalence among women of reproductive age between 2006 and 2016, available through the Global Health Observatory *(163)*. Twelve countries were targeted for the key informant interviews from Africa, the Americas and Asia, for a broad range of contexts, but it was only possible to interview key informants in three of these countries, owing to conflicting priorities and timing. To expand the scope of responses, an online survey was also developed in English, French and Spanish, and shared through the Accelerated Reduction Effort on Anaemia Community of Practice (AREA CoP) to its nearly 1000 members from 78 countries globally.

Online survey responses were received from 10 countries – Bangladesh, Cuba, India, Kenya, Mali, Philippines, Peru, Senegal, Uganda and United Republic of Tanzania; and key informant interviews were conducted in an additional three countries – Chile, Rwanda and Thailand. Respondents for the online survey (n = 22) represented the following sectors and included individuals involved in anaemia reduction activities such as: (i) policy development (n = 4), programme development/high-level programme control or decision-making (n = 4); (ii) programme implementation – training, overall guidance for how a programme is carried out (n = 7); (iii) monitoring and evaluation/survey/health monitoring information system (n = 4); (iv) academic/research related to programme implementation and impact (n = 11); and (v) external technical experts (n = 2). The tool used for the survey (see Appendix 1) was similar to the key informant interview, and covered various topics including causes of anaemia, data-related issues in the country, types of programmes being implemented, challenges that programmes face during implementation, and lessons to learn for future programming, among others.

Analysis of the responses was primarily deductive, searching for information responding to the key objective of potentiating anaemia reduction efforts. The comparison across the different countries established the range and similarities of the respondents' perceptions, experiences and views, as well as the countries' experiences and trajectory in the achievement of anaemia reduction targets. Analysis was completed with a summary using a SWOT approach to highlight the strengths, weaknesses, opportunities and threats experienced by the various countries/respondents interviewed, in order to draw lessons to inform WHO policies and guidelines, as well as future anaemia reduction programmes for different countries with similar settings.

QUALITATIVE INTERVIEW AND SURVEY FINDINGS

Multisectoral approach and involvement of "champions"

In seven countries that recorded a fair increase in anaemia reduction, it was clear that their programmes were premised on a multisectoral approach. The sectors involved included education, finance, agriculture, health and nutrition, and gender affairs, among others. Also, these countries indicated working closely with local and international nongovernmental organizations, United Nations agencies (e.g. United Nations Children's Fund, WHO, World Food Programme, Food and Agriculture Organization of the United Nations), and universities. Additionally, five out of seven of these countries reported working with nutrition champions of such high calibre as prime minister. The involvement of champions at such a high level in society signals a willingness of the political class to support nutrition/anaemia programmes to ensure that the countries achieve their targets. The involvement of high-level nutrition/anaemia champions not only brings awareness of anaemia issues at high level, but helps in resource mobilization, monitoring and evaluation of the programmes, among others.

Among those countries that were lagging behind their anaemia reduction targets, it emerged that while they worked across sectors, the working relationship was not synergetic, and thus impacted negatively on their anaemia reduction efforts. For example, the scholars in Thailand indicated that they had carried out various anaemia surveys and shared their reports with the Ministry of Health. However, policies and guidelines developed by the Ministry of Health were not informed by their data and recommendations. Rather, the Ministry of Health used only data from DHS, which, the scholars felt, was generic and lacked context-specific information that would be key to developing focused and results-oriented interventions.

Private sector involvement was not often mentioned in the context of anaemia reduction efforts in most of the countries, except in a few like Thailand and Philippines (which were both lagging behind in targets for anaemia reduction), where the private sector was actively involved in food fortification efforts. However, the involvement was at a very high level, including mainly multinational companies, and rarely including small business processors. To this end, fortification interventions were seen as beneficial to only the few "rich" households that consume the kinds of products produced by big companies, while the larger population consuming locally produced foods does not benefit from this intervention.

Integration of anaemia activities in existing programmes

It emerged from the interviews and survey that all the countries integrate their anaemia reduction activities in existing programmes, within either the Ministry of Health or related ministries such as the Ministry of Agriculture and Ministry of Education. While this is true for all the countries, there was an indication that the countries lagging behind had less integration compared with those that had better anaemia reduction outcomes. For example, Rwanda's efforts were integrated within the Ministry of Education (for vitamin A supplementation and deworming activities); Ministry of Agriculture for Food Security and Extension Work, including knowledge dissemination on food types, diet diversification, etc.; and also Ministry of Health departments/programmes such as malaria prevention and treatment, nutrition, maternal and child health, among others. However, the key informants from the malaria and maternal and child health programmes were unable to give information on the specifics of the anaemia reduction activities, instead referring the reviewers to the nutrition department for information. There was an indication of departmentalization of their activities (focus on malaria activities and indicators or maternal and child health activities and indicators) and less on other related indicators and activities such as anaemia reduction. As such, they did not adequately track the activities and outcomes related to anaemia, and therefore were unable to give information on the progress made in that regard. There was poor coordination between the activities in all related programmes, and thus it was difficult to track progress in anaemia reduction in all the different ministries and departments.

Programme focus areas

The respondents indicated that their countries targeted different focus areas to improve anaemia reduction. Generally, all the respondents indicated that they had nutrition-related programmes implementing IFAS for pregnant women; intermittent IFAS for women of reproductive age; fortification of food with iron; nutritional counselling, including complementary feeding and maternal nutrition, support to initiate breastfeeding within one hour after birth, exclusively breastfeed to 6 months and continue breastfeeding to 2 years; food security for vulnerable populations; and biofortification/agricultural programmes to increase dietary diversity. Only three countries indicated that they had programmes focusing on weekly IFAS for adolescents.

In addition, there were also parasite/infection-related programmes that were reported to be under implementation. These include ITNs being implemented in malaria-endemic areas, intermittent preventive treatment of malaria for pregnant women, indoor/outdoor insecticide spraying or water treatment, deworming for all children (including children attending school), deworming for pregnant women and active case management for malaria/helminthic infections. Most of these interventions were reported to be carried out at the community level (through the community health strategy) and also in schools (through school health programmes).

WASH programmes were also being implemented in all the countries to complement other anaemia-related interventions. These include use of an improved water source or household treatment, handwashing facilities with water and soap, environmental hygiene and good practices related to sanitary defecation, and food safety. Other programmes that were implemented by half of the countries include family planning to increase birth spacing to at least 2 years, as well as counselling and management of genetic blood disorders (by countries that indicated that genetic disorders contributed to their anaemia cases).

With regard to gender equity/women's empowerment programmes, all the countries had two or three of the following focus areas: women-to-women groups, women's microfinance and women's agriculture. However, only two countries had specific programmes aimed at women's decision-making autonomy regarding nutrition and health care. In Peru, which is one of the countries lagging behind in anaemia reduction targets, the women-centered programmes were focused only around family planning. This suggests that the better performing countries had initiated more than one women-centred programme to promote proper nutrition and anaemia reduction at the household level. Sensitization of the general community and men on gender equity was only implemented in five countries, which were all in the category of better performing countries with regard to anaemia reduction. This

result indicates that most of the country programmes do not view male and other members of the community as partners in gender and equity issues related to nutrition, and specifically anaemia. It also indicates that involvement of these demographic groups in anaemia-related gender and equity activities would contribute to better outcomes in anaemia reduction.

Other challenges of programme implementation experienced by most countries

Poor coordination between stakeholders

The key informants shared that while they worked well with the different stakeholders from different sectors, there was generally poor coordination of the activities and funds, which led to poor reporting, replication of activities, poor focus on the greatest areas of burden, and poor results in anaemia reduction.

Data quality and availability

Most of the countries reported poor access to data for various reasons. The main reason for poor data was lack of funding to collect anaemia-specific data. National and regional budgets did not provide specific funding for anaemia, thus anaemia programmes were dependent on periodic data (such as DHS, national nutrition surveys, national micronutrient surveys) collected at national level. Only three countries indicated that they had other subnational surveys in addition to the national ones. These surveys are done periodically, and respondents were of the view that the surveys did not provide the most current picture of the anaemia situation in specific areas of the country.

DHS data were reported to be inaccurate and insufficient in most countries, since data collection was not adequately implemented at all levels. This was due to many reasons, including poor technical capacity on data collection and nutrition issues, poor staffing at the health facilities and poor coordination of data collection at community level, between Ministry of Health departments, and among other stakeholders such as those in the Ministry of Agriculture and the Ministry of Education.

Data use

Respondents indicated poor use of data to inform policy and programmes. This was attributed to poor data-sharing practices between different sectors and levels, as well as poor quality of data available. One respondent, a university researcher, indicated that there was some disconnect between researchers and policy-makers in their country, to the extent that policy-makers did not seek researchers' input in policy development and programme implementation:

> "I have tried in some cases to contribute, but I feel like our contribution is not fully appreciated. Some things we have suggested for implementation based on the data have not been considered." (key informant)

SUMMARY OF LESSONS FROM RESPONDENT FEEDBACK

Results of feedback from respondents are summarized through a SWOT analysis presented in Table 10, followed by a summary highlight of lessons learnt.

Table 10. SWOT summary, including strengths, weaknesses, opportunities and threats that were reported and/or identified based on all participant responses

SWOT component	Description of SWOT component findings[a]
STRENGTHS	Multisectoral approach to implementation of anaemia reduction programmes in some[a] countries, ensuring that all stakeholders are involved and addressing all aspects of anaemia reduction
	All countries use WHO guidelines (and other resources) to develop country policies and framework for anaemia reduction, and many[a] reported that nutrition departments were leading these efforts. This ensures that local context is considered in country guidelines and policies, as well as in interventions
	Respondents from all countries recognized deficiencies of both iron and other micronutrients as contributors to anaemia
	Most[a] respondents also recognized infection/inflammation as a contributor to anaemia, including the contribution of malaria, helminths and illness related to poor personal and environmental sanitation
	Many[a] respondents identified poor diet as a contributor to anaemia, including poor access and poor knowledge of appropriate choices, traditional cooking methods that destroy nutrients, and food taboos (particularly for women in different life-stages) that limit access to iron-rich foods
	Most[a] countries with respondents had access to national micronutrient survey data, including data on micronutrient deficiencies related to anaemia
	Some[a] respondents, particularly from Africa and Asia, recognized the contributions of genetic disorders
	Most[a] countries reported a range of available programmes to address anaemia
WEAKNESSES	Inconsistent reported use of data at various levels and for various purposes
	Poor data collection and availability
	Few[a] countries reported collecting gender or empowerment data
	Poor financial resources to collect appropriate data and implement anaemia reduction programmes
	Poor technical capacity to implement anaemia reduction programmes
	Poor global reporting on anaemia
	Poor coordination of anaemia reduction programmes
	Policy not being informed by data/evidence
	Few[a] programmes targeting women's empowerment on nutrition issues
	Little involvement of men and the community in equity and gender intervention
	Insufficient community engagement to overcome traditions and taboos
	Some[a] country programmes and data reporting are working in silos, thus anaemia-related results cannot be tracked and attributed accordingly or across sectors
	Some[a] countries are too dependent on best practice approaches of anaemia reduction, ignoring applicability and relevance in local contexts
	Few[a] programmes addressing adolescent iron deficiency

OPPORTUNITIES	Countries to work with existing local research institutions/universities to support data and research on anaemia
	Community-level interventions for all focus areas are essential for improvement in anaemia reduction Such community-level interventions should address the bioavailability of iron through knowledge dissemination to community members
	Implement anaemia reduction interventions using a multisectoral approach to ensure all aspects of anaemia reduction are addressed
	Design anaemia reduction programmes to support high-risk populations such as adolescent girls
	Although bioavailability was identified by some[a] respondents, it appears to be an approach not yet fully considered
	Build capacity of national institutions to enable anaemia reduction
	Build stakeholder engagement opportunities to improve knowledge-sharing and reporting, and reduce duplication of efforts
THREATS	Although participants reported multisectoral engagement in anaemia reduction efforts, none included the finance sector as a participant, and few[a] indicated working closely with women/gender-related sectors or with the private sector
	Inaccurate reporting of anaemia status in many countries, leading to inaccuracy in global status
	Reliance on inaccurate data to set global targets for anaemia reduction
	Fortification programmes were identified by some respondents as only benefiting the rich
	Challenges related to developing and maintaining sanitation and hygiene for the entire population
	General distrust of government routine monitoring data (e.g. DHS) due to inconsistent reporting
	Inadequate capacity of staff and insufficient resources
	Most[a] countries reported that their anaemia reduction efforts were better than just "so-so" and some[a] felt the targets were set too high

DHS: demographic and health surveys; IFAS: iron and folic acid supplements.

[a] Most: 10–13 countries reporting (75% and above); many: 6–9 countries reporting (50–74%); some: 3–5 countries reporting (25–49%); few: 1–2 countries reporting (below 25%).

Qualitative research: general lessons learnt

Multisectoral approach

Involving all sectors in the planning and implementation of anaemia reduction efforts leads to effectively addressing all angles of anaemia, including community, health facilities and policy levels; demand creation (knowledge, advocacy, community strategies); and quality health services (including prevention, screening, diagnosis and treatment). This approach also involves inter-ministerial and inter-departmental cooperation to ensure that all aspects of anaemia are addressed, and that all possible opportunities available in other sectors to improve anaemia reduction are leveraged.

Private sector involvement

Involvement in anaemia reduction efforts should include private sector players at all levels of the programmes, to ensure their involvement in all steps of the process, and that all segments of the population's needs are addressed.

All aspects of anaemia at all levels of implementation

All levels of implementation, including political will, financial resources (policy level), male involvement, community participation, sociocultural aspects (community level), food availability, technical expertise on anaemia (programme level), and individual capacity and knowledge (individual level), need to be synergistically incorporated in anaemia reduction programmes, to ensure that all anaemia needs are addressed effectively.

Data quality and relevance

Data used to inform policy and programmes ought to be accurate, reliable, up to date and relevant to the local context. Data should be collected throughout the implementation of programmes to inform programme adjustment and focus on the key programme components that would lead to improved results. Most programmes in the countries included in this review (especially those countries lagging behind in anaemia reduction) depended on periodic surveys such as the DHS and national micronutrient surveys that were 5–10 years apart. Relevance of these data to local contexts is required to reduce overreliance on data that only highlight globally used indicators, favouring the generation and use of data that are context specific and focused on local anaemia situations, to improve local intervention programmes.

KEY MESSAGES

The following key messages highlight both document research as well as feedback from key informants and participants in the online survey.

- Anaemia is a global public health concern, afflicting adolescent girls, women of reproductive age, pregnant women and children in low- and middle-income countries. It affects half a billion women of reproductive age worldwide, impairing their health and economic productivity.
- In the 2012 World Health Assembly, WHO Member States endorsed global targets for improving maternal, infant and young child nutrition. The second of the six global nutrition target is to achieve a 50% reduction of anaemia among women of reproductive age (15–49 years) by 2025.
- While iron deficiency is the most common cause of nutritional anaemia, iron-deficiency anaemia probably contributes to less than half of the global burden of anaemia, highlighting the need for a comprehensive multisectoral approach. Other less common micronutrient deficiencies that are known to cause or contribute to anaemia include vitamins A, B_2, B_6, B_9, B_{12}, C, D and E, copper and zinc.
- Non-nutritional causes or factors associated with anaemia include, but are not limited to, parasites, infections and inflammation and genetic disorders/haemoglobinopathies, as well as environmental and social factors.
- In the absence of inflammation, the concentration of serum/plasma ferritin is positively correlated with the size of the total body iron stores: a low concentration of serum ferritin reflects depleted iron stores and therefore iron deficiency. However, iron deficiency can also occur in the absence of anaemia, when ferritin concentrations are low, but haemoglobin concentrations are adequate.
- Screening using only haemoglobin does not identify all potential causes of anaemia. Other biomarkers should be included to address all possible causes.
- Although the major global causes and contributors to anaemia are known, programmes to address these issues do not necessarily imply a straightforward, mechanistic response such as improving iron status; instead, programmes must consider all domains and procedures that have a role in individual, community, provider, governmental and environmental capacities.

LOCAL LANDSCAPE AND DATA

- Landscape analyses are critical to identifying the key drivers of anaemia, which anaemia-related programmes are working and which are likely bottlenecks, and opportunities for multisectoral support and engagement.
- Optimal data for decisions are not always available, but existing data can be used to inform decisions, while planning for collection of more specific or comprehensive data.

MULTISECTORAL APPROACHES

- Although there are probably a few key interventions that will have a large impact on anaemia reduction, underlying causes and contributors are likely to dampen the impact of any silo intervention.
- Although activities move generally in a stepwise fashion, strategizing also involves multiple iterative and feedback loops. Intersectoral approaches are often needed but are likely to require changes in the way the health sector has worked in the past, to include open multi-stakeholder engagement and support.
- Results from the qualitative interviews/surveys performed for this review show that seven countries recorded a fair increase in anaemia reduction; in all those cases, it was clear that their programmes were premised on a multisectoral approach. Additionally, five out of seven of these countries reported working with nutrition champions of such high calibre as prime minister. Among those countries that were lagging behind their anaemia reduction targets, it emerged that while they worked across sectors, the working relationship was not synergetic, and thus impacted negatively on their anaemia reduction efforts. Also, lack of knowledge about specific activities/indicators/programmes or lack of/poor coordination between different programmes made it difficult to track the progress of anaemia reduction in all the different ministries and departments involved.

- Sensitization of the general community and of men on gender equity was only implemented in five countries, which were all in the category of better performing countries with regard to anaemia reduction. This result indicates that most of the country programmes do not view male and other members of the community as partners in gender and equity issues related to nutrition, and specifically anaemia. It also indicates that involvement of these demographic groups in anaemia-related gender and equity activities would contribute to better anaemia reduction outcomes.

MULTISECTORAL/MULTILAYER SUPPORT, COORDINATION AND COLLABORATION

- Leadership and coordination mechanisms for anaemia reduction are required at global, regional and community level.
- Research is integral to supporting programmes and investments need to be made in implementation research to ensure there is sufficient evidence to determine how best to strengthen and maximize the effectiveness of anaemia-related interventions.
- Poor coordination between stakeholders, activities and funds leads to poor reporting, replication of activities, poor focus on the greatest areas of burden, and poor results in anaemia reduction.
- Data from the qualitative interviews/surveys exercise show that national and regional budgets did not provide specific funding towards anaemia reduction activities; thus anaemia programmes are dependent on periodic data (such as DHS, national nutrition surveys, national micronutrient surveys) collected at national level. These surveys do not provide the most current picture of the anaemia situation in specific areas of the country. Also, health monitoring information systems data are perceived to be inaccurate and insufficient in most countries, since data collection was not adequately implemented at all levels. Some of the concerns included poor technical capacity on data collection and nutrition issues, poor staffing at the health facilities and poor coordination of data collection at community level, between Ministry of Health departments, and among other stakeholders such as the Ministry of Agriculture and the Ministry of Education.

THE WAY FORWARD

This review has described many gaps in and problems with anaemia reduction efforts, identified and described various components required for successful evidence-informed anaemia reduction programmes, and included recommendations for programme implementers and decision-makers, with links to multiple resources and tools that can be contextualized to each country's situation.

Success in programme implementation requires a mix of activities and interventions, some of which are replicable within and across countries, and some that should be country specific. The optimal portfolio of anaemia reduction interventions is a critical issue and must be developed through careful consideration of data-informed local and global evidence. The resulting portfolio must become an intrinsic part of existing preventive and curative services and must include both nutrition-sensitive and nutrition-specific interventions that are adequately integrated into health and other related systems with multisectoral and multidisciplinary champions and support.

The evidence presented in this review clearly reiterates the critical importance of addressing anaemia from multiple perspectives and through multiple coordinated efforts, including multiple government sectors, nongovernmental organizations, United Nations agencies and the private sector – each with specific and complementary roles to accomplish in reducing anaemia.

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APPENDIX 1: GUIDE FOR KEY INFORMANT INTERVIEWS AND ONLINE SURVEY

KEY INFORMANT INTERVIEW

Anaemia etiology

1. What are the main causes of anaemia in your country?

Probe: among adolescents; among pregnant women; among non-pregnant women; in the general population

Also probe specific causes:

   a. Nutrition-related (iron deficiency and other micronutrient deficiencies)

   b. Non-nutrition-related (infectious diseases such as malaria, intestinal parasites – hookworm, HIV, cancer, tuberculosis

   c. Genetic diseases such as thalassaemia and sickle cell disease; environmental – poor sanitation; blood loss (postpartum haemorrhage, menstruation, accidents, etc); short birth intervals; sociocultural influences

   d. Is there variation in etiology (causes) in different regions of the country? (Same probes as above)

   e. What are the main causes in other countries within your region? (Same probes as above)

2. What is the prevalence of anaemia in your country?

3. Given the prevalence of anaemia in your country, do you feel that this is reflective of the potential causes you have mentioned? Please elaborate.

Data

4. Do you have data related to:

   a. Adolescents?

   b. Non-pregnant women?

   c. Pregnant women?

   d. General population?

5. Do you have data on:

   a. Malaria in relation to anaemia?

   b. Nutrition-related anaemia – iron, and other micronutrients?

   c. Non-nutritional causes of anaemia – infectious diseases, genetic diseases?

6. Describe the type of data collected for each item mentioned above.

Probe: what is the coverage?

Probe: methodology used – what tools are available/used for research – **Probe:** USAID/SPRING, NYAS, WHO, BRINDA, AREA CoP, BOND?

7. How are the data used?

Probe: health facility improvement of services

   a. Community – demand creation and prevention

   b. Policy

   c. Programme, etc.

8. What would you say about the availability/access and quality of the data?
    a. Where are the gaps in the data? Are there efforts to improve data quality? Which efforts are ongoing for data quality improvement? Efforts by whom?
    b. What are the strengths of your current data process?
9. The global target for anaemia reduction is 50%. In your experience doing this work in your country, do you see this target as achievable? Why? Why not?
    a. What would you view as a more achievable target? Why?

Strategies and interventions for anaemia reduction (political/governmental and partnerships)

10. What are the policies, strategies, plans, programmes related to the following; please describe each in detail:

a. Iron interventions

- Iron/folic acid supplements (IFAS) for pregnant women
- Intermittent IFAS for women of reproductive age
- Weekly IFAS for adolescents
- Fortification of foods with iron: wheat flour, corn/maize, rice

b. Dietary interventions

- Nutrition counselling for complementary feeding, maternal nutrition, etc.
- Support to initiate breastfeeding within 1 hour after birth, exclusive breastfeeding to 6 months and continued breastfeeding to 2 years
- Food security
- Biofortification

c. Parasite control or treatment

- Insecticide-treated bednets
- Intermittent preventive treatment (IPTp) of malaria for pregnant women
- Indoor/outdoor insecticide spraying or water treatment
- Deworming for children and pregnant women
- Active case management for malaria/helminthic infections

d. Water, sanitation and hygiene (WASH) – personal and environment

- Use of an improved water source or household treatment
- Handwashing facilities with water and soap
- Environmental hygiene, good practices related to sanitary defecation
- Food safety

e. Other related interventions

- Family planning to increase birth spacing to at least 2 years
- Delayed cord clamping
- Counselling and management of genetic blood disorders
- Women's decision-making autonomy regarding nutrition and health care

Operational/implementation issues

11. What has been your experience in bringing programmes to sufficient scale to address anaemia issues?

Probe: political will, financial resources, sociocultural issues; adaptability to local circumstances

12. If not mentioned (question 8), please identify the gaps in implementation and context that have affected your anaemia reduction implementation.
13. If not mentioned (question 8), have you applied a multisectoral approach to address the multicausal nature of anaemia? Describe how this was done.
14. How has your experience been with integrating your anaemia-reduction activities into existing programmes? What are the challenges? What are the positive aspects?
15. What is the biggest lesson you have learnt from your implementation programme(s)? What would you say has worked well in your programme(s)? Why? What has not worked well? Why?
16. Given the prevalence of anaemia in your country, do you feel that the current coverage of interventions is sufficient to address the issues? Please elaborate.
17. What are your recommendations going forward?
    a. Based on your experience implementing anaemia programmes, what are your recommendations for future programmes or countries with similar circumstances to yours?
    b. Based on your knowledge and understanding of anaemia, what are the best strategies required to achieve the set targets? (It does not matter whether the strategies are currently being implemented or not.)

AREA CoP: Accelerated Reduction Effort on Anaemia Community of Practice; BOND: Biomarkers of Nutrition for Development; BRINDA: Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia; NYAS: New York Academy of Sciences; SPRING: Strengthening Partnerships, Results and Innovation in Nutrition Globally; USAID: United States Agency for International Development; WHO: World Health Organization.

ONLINE SURVEY

Introduction

Thank you for participating in this survey. This survey is part of a review being implemented by Nutrition International under the direction of World Health Organization (WHO). It will take about 15–30 minutes to complete, depending on whether you have time to provide additional detail.

We are asking for the country where you work and your general responsibilities, to assist us in our interpretation of the findings. When the report is complete, the link will be shared through the WHO list-serve. Feel free to share this survey with others whom you think would be able to provide useful information for this review.

1. In what country are you currently working?
2. What is your role in that country related to anaemia? *(select the primary descriptor)*
    a. Policy development or overall decision-making
    b. Financial control/budgetary allotment
    c. Programme development/high-level programme control or decision-making
    d. Programme implementation – training, overall guidance for how a programme is carried out
    e. Monitoring and evaluation/survey/health monitoring information system (HMIS) – data collection, analyses and feedback to programmes
    f. Academic/research related to programme implementation and impact

Anaemia etiology

3. What are the main causes of anaemia among women of reproductive age in your country? *(select all that apply)*
    a. Iron deficiency
    b. Other micronutrient deficiencies (*specify below*)
    c. Infection/disease related, such as malaria, hookworm (*specify below*)
    d. Genetic disorders, such as thalassaemia, sickle cell disease (*specify below*)
    e. Environmental/sanitation
    f. Growth related (short birth intervals, rapid growth in childhood and adolescence, pregnancy)
    g. Sociocultural influences, such as taboos, inequity (*specify below*)
4. What is the prevalence of anaemia among women of reproductive age in your country?
    a. >40%
    b. 20–39%
    c. 5–19%
    d. <5%
    e. Don't know/don't remember
5. In your country, who is engaged in anaemia reduction efforts? Select all that are actively engaged (such as programme implementation, financial support, capacity-building – not just attending related meetings) *(select all that apply)*
    a. Health Minister/Office of Health Ministry
    b. Other national level health officials
    c. Subnational health officials
    d. At least one other Ministry (Education, Agriculture, Women, Finance, other)
    e. At least four other Ministries
    f. National or international nongovernmental organizations
    g. United Nations organizations (e.g. UNICEF, WHO, FAO, WFP, other)
    h. Universities
    i. Other, *specify*:

Data

6. What is/are the source(s) of anaemia data in your country? *(select all that apply)*
    a. Demographic and health surveys (DHS) or similar national scale surveys (MICS, PMA2020, other)
    b. National nutrition surveys
    c. National micronutrient surveys
    d. Smaller scale surveys
7. If a micronutrient survey has been completed in your country in the past 5–10 years, which biomarkers and which population groups were included? *(select all that apply)*
    a. No micronutrient survey completed

Biomarkers

b. General anaemia (haemoglobin)

c. Iron (e.g. ferritin/transferrin/other)

d. Vitamin A (e.g. RBP, other)

e. Vitamin B_{12}

f. Folate

g. Iodine (urinary iodine, other)

Population groups

h. Children

i. Non-pregnant women

j. Pregnant women

k. Women of reproductive age

l. Adolescents

m. Men

8. Select from the following those for which you have data from either national or high-risk populations: *(select all that apply)*

   a. Malaria incidence or prevalence

   b. Coverage of malaria prevention interventions

   c. General anaemia prevalence

   d. Iron-deficiency anaemia prevalence

   e. Prevalence or any information on other nutritional causes of anaemia

   f. Infectious diseases that could be contributors to anaemia

   g. Genetic disorders that could be contributors to anaemia

9. Is your country using anaemia-related guidelines or methodology from any of the following groups or initiatives or platforms? *(select all that apply)*

   a. None to my knowledge

   b. WHO

   c. USAID/SPRING (United States Agency for International Development/Strengthening Partnerships, Results and Innovation in Nutrition Globally)

   d. NYAS (New York Academy of Sciences)

   e. BRINDA (Biomarkers Reflecting Inflammation and Nutrition Determinants of Anemia)

   f. AREA CoP (Accelerated Reduction Effort on Anaemia Community of Practice)

   g. BOND (Biomarkers of Nutrition for Development)

   h. Other, *specify*:

10. How are anaemia data used by you or others in your country? *(select all that apply)*
    a. Global reporting
    b. Policy development (what strategy/plan to propose…)
    c. Budget decisions (where to spend available budget)
    d. Programme development (what interventions might be required)
    e. Identification of high-risk target groups (by age or sex, rural versus urban, high versus low income, other)
    f. Identification of platforms for anaemia reduction (such as community versus facility versus schools)
    g. To my knowledge, anaemia data are not used
11. What are the most critical gaps/weaknesses of anaemia-related data in your country? *(select all that apply)*
    a. Low-quality data/unreliable indicators
    b. Not nationally representative
    c. Missing population groups
    d. Lack of disaggregated data (region or population group)
    e. Missing all potential causes of anaemia
    f. Data not used/misunderstood
    g. Lack of political will to use data
    h. Lack of resources to implement programmes based on data
    i. Other, *specify*:
12. The global target for anaemia reduction is 50%. In your experience in your country, how are you doing on the path toward achieving this target? *(select all that apply)*
    a. We know what is causing anaemia
    b. We know how to address it
    c. We have enough budget
    d. Appropriate programmes are being developed
    e. Appropriate programmes are already implemented
    f. We are not sure of all causes of anaemia
    g. We do not yet know how to address it
    h. We do not have enough budget allocated or do not know how much budget to allocate
    i. Appropriate programmes have not yet been developed
    j. Appropriate programmes are not yet being implemented
    k. Other reasons: *specify*

Strategies and interventions for anaemia reduction (political/governmental and partnerships)

13. In your country, how have anaemia-reduction activities been implemented?
    a. Stand-alone programmes
    b. Integrated into existing programmes?
14. Which of the following programmes are being implemented nationally or subnationally in your country:

a. Iron interventions

- Iron/folic acid supplements (IFAS) for pregnant women
- Intermittent IFAS for women of reproductive age
- Weekly IFAS for adolescents
- Fortification of foods with iron: wheat flour, corn/maize, rice

b. Dietary interventions

- Nutrition counselling for complementary feeding, maternal nutrition, etc.
- Support to initiate breastfeeding within 1 hour after birth, exclusive breastfeeding to 6 months and continued breastfeeding to 2 years
- Food security
- Biofortification

c. Parasite control or treatment

- Insecticide-treated bednets
- Intermittent preventive treatment (IPTp) of malaria for pregnant women
- Indoor/outdoor insecticide spraying or water treatment
- Deworming for children and pregnant women
- Active case management for malaria/helminthic infections

d. Water, sanitation and hygiene (WASH) – personal and environment

- Use of an improved water source or household treatment
- Handwashing facilities with water and soap
- Environmental hygiene, good practices related to sanitary defecation
- Food safety

e. Other related interventions

- Family planning to increase birth spacing to at least 2 years
- Delayed cord clamping
- Counselling and management of genetic blood disorders
- Women's decision-making autonomy regarding nutrition and health care

Operational/ implementation issues

15. What has been your experience in bringing programmes to sufficient scale to address anaemia issues? (*select all that apply)*

    a. Political interest is low

    b. Political interest is high

    c. Financial or other programme resources are low

    d. Financial or other programme resources are appropriately committed

    e. Household resources are low

    f. Household resources are improving

    g. Available foods are lacking (agriculture production, imports, fortification…)

    h. Available foods are improving (agriculture production, imports, fortification…)

    i. Technical expertise to design and implement programmes is low

    j. Technical expertise to design and implement programmes is high

    k. Sociocultural barriers, such as gender and other inequities

    l. Beneficiary situation: lack of individual will/knowledge/education/capacity

    m. Improvements in sociocultural support – reducing gender and other inequities

    n. Beneficiary situation: increasing will/knowledge/education/capacity

    o. Other

16. Please take a minute to share some of your general experience that is not captured above; for example: What is the biggest lesson you have learnt from your implementation programme(s)? What would you say has worked well in your programme(s)? Why? What has not worked well? Why? What would you recommend to others? What support is most lacking?

FAO: Food and Agriculture Organization of the United Nations; MICS: multiple indicator cluster surveys; PMA: Performance Monitoring and Accountability 2020; RBP: retinol-binding protein; UNICEF: United Nations Children's Fund; WFP: World Food Programme; WHO: World Health Organization.