

Exploring the Anemia Ecology: PART II

Application of the Ecological Approach to Assess and Address Anemia—Experiences from the Field

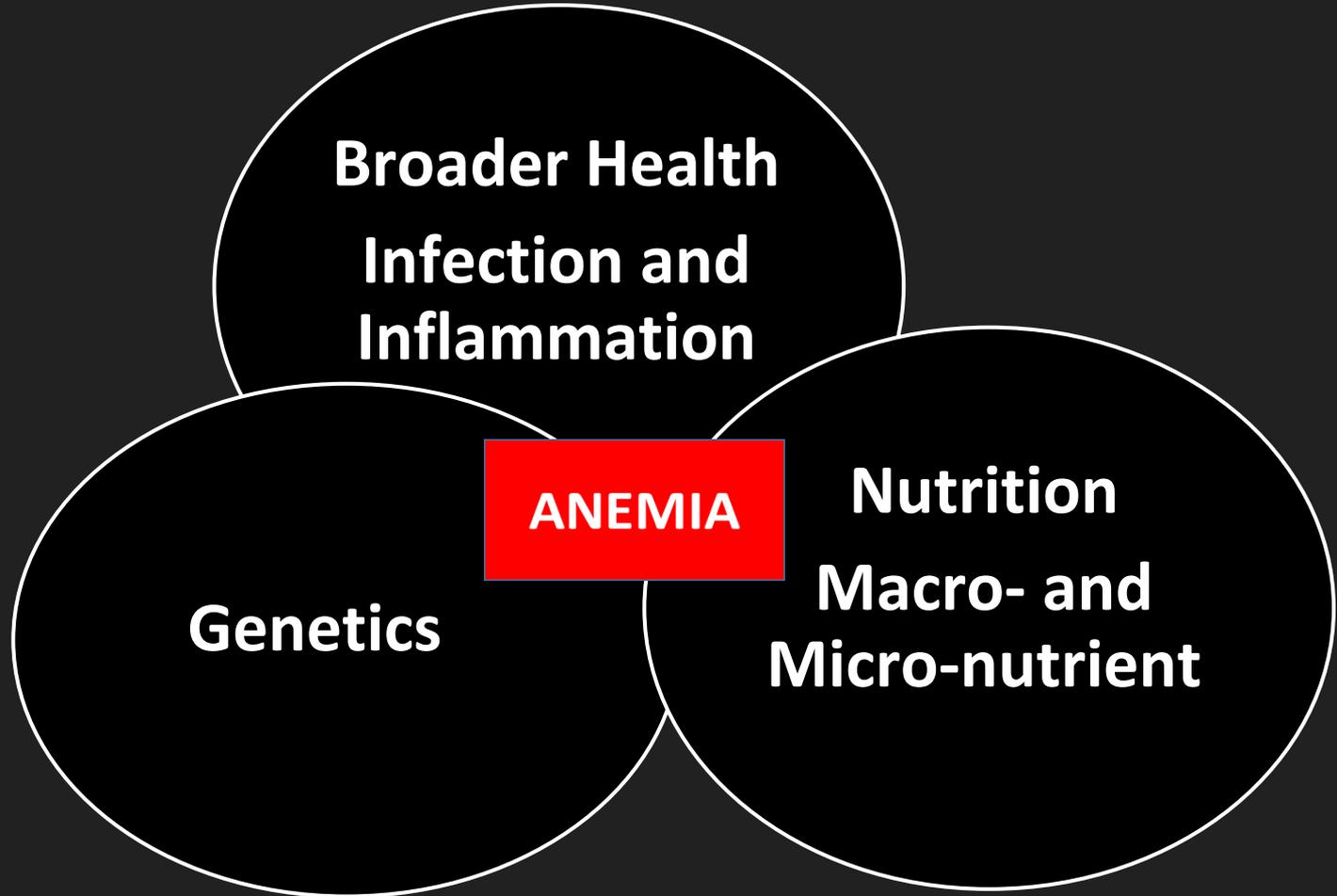
A webinar on behalf of the U.S. Global Nutrition Coordination Plan
Ecology of Parent, Infant, and Child (EPIC) Nutrition Subgroup

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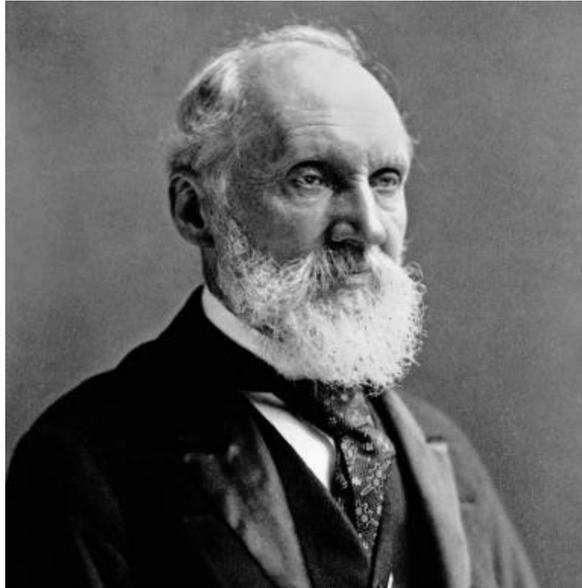


Overlapping Conditions of Anemia Ecology



“If you cannot measure it, you cannot improve it”

-Lord Kelvin



Objectives of assessment group

1. Review how to **assess anemia** based on low hemoglobin
2. Review assessment of **anemia etiology** in different settings
3. Propose a **framework** to systematically approach measurement of anemia ecology in surveys
4. Discuss **research gaps and priorities** related to anemia assessment

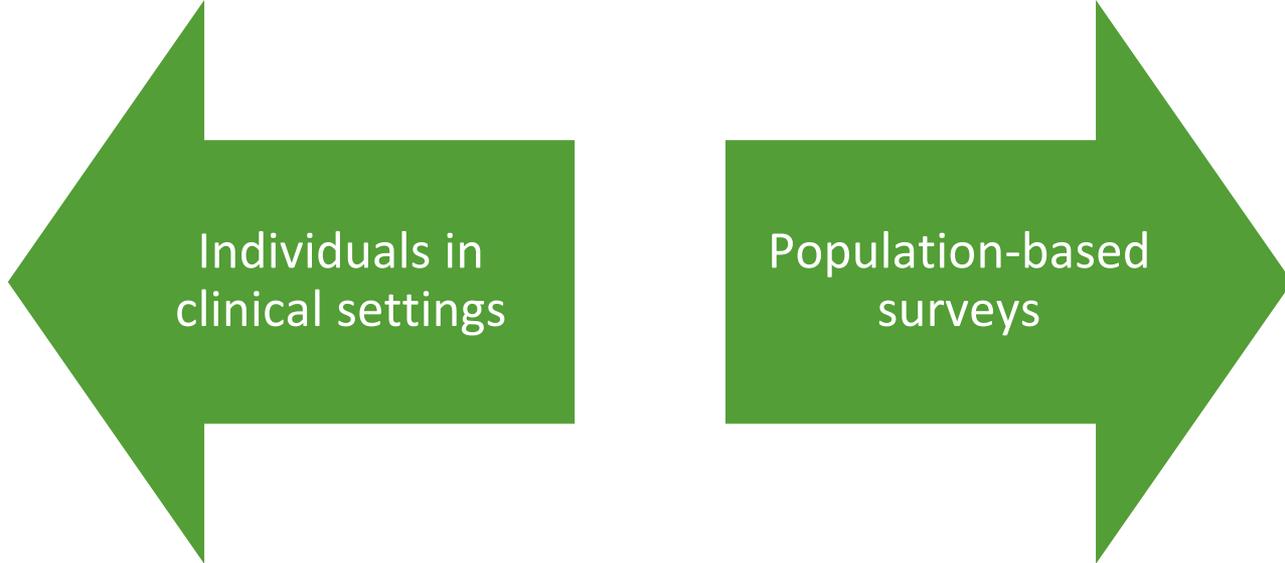
Common causes of anemia

Non-nutritional causes of anemia				Nutrient-specific causes of anemia ⁺	
Blood loss	Increased hemolysis	Deficient erythropoiesis		Microcytic	Macrocytic
		<i>Microcytic</i>	<i>Normocytic</i>	<ul style="list-style-type: none"> Iron deficiency Vitamin A deficiency Riboflavin deficiency 	<ul style="list-style-type: none"> Folate deficiency Vitamin B12 deficiency
<ul style="list-style-type: none"> Heavy menstrual bleeding Postpartum hemorrhage Gastrointestinal blood loss (hookworm infection, ulcers, schistosomiasis) Urinary blood loss 	<ul style="list-style-type: none"> Infection (malaria) Hemoglobin disorders (sickle cell disease, thalassemias) Enzymopathies (G6PD deficiency) Immune-mediated Intravascular RBC destruction Hypersplenism 	<ul style="list-style-type: none"> Anemia of inflammation (chronic disease) Thalassemias 	<ul style="list-style-type: none"> Anemia of inflammation (chronic disease) Renal failure Bone marrow failure (aplastic anemia, leukemia) 		

⁺ Not all potential causes of anemia are listed. Insufficient dietary intake, impaired absorption or increased losses all influence nutrition-specific causes of anemia

Anemia itself is not a disease

Application of an Ecological Approach to Assess and Address Anemia



Population-Based Assessment of Anemia: Considerations

1. Existing data sources
2. Biomarkers and characteristics to include
 - nutrition, health status, genetics, infection, inflammation
3. Underlying disease status
4. Measurement of structural and social determinants
 - economic stability; education access and quality; racism, discrimination, and violence; language and literacy skills; food security; and climate change
5. Financial resources
6. Technical capacity



Resource: The Micronutrient Survey Manual & Toolkit, produced by CDC, UNICEF, Nutrition International and WHO

<https://mnsurvey.nutritionintl.org>



Welcome to the Micronutrient Survey Manual & Toolkit

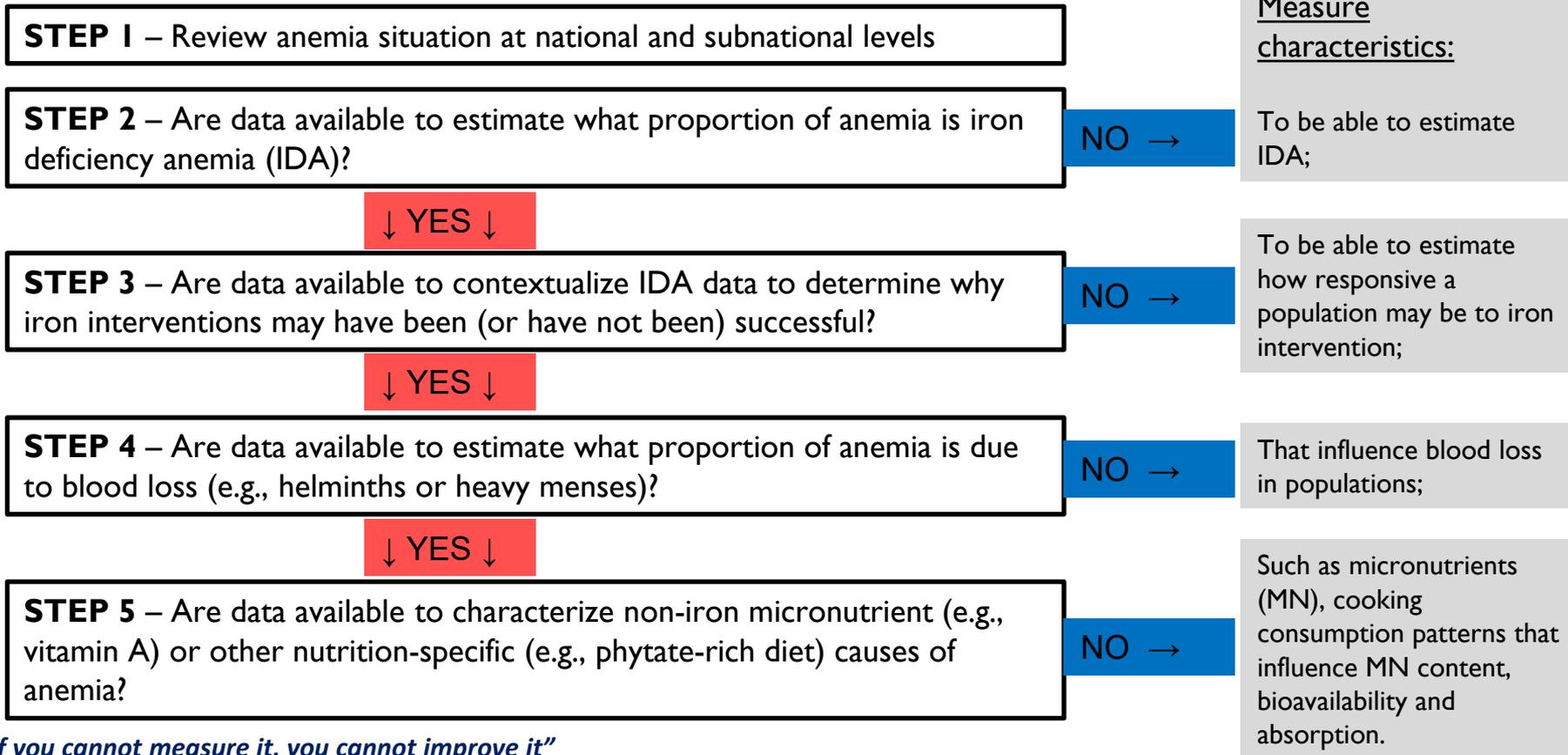
≡ EXPLORE OUR CONTENT

<https://mnsurvey.nutritionintl.org>

The Micronutrient Survey Manual & Toolkit is a collaboration of:



Framework to inform measurement of *anemia ecology* in surveys



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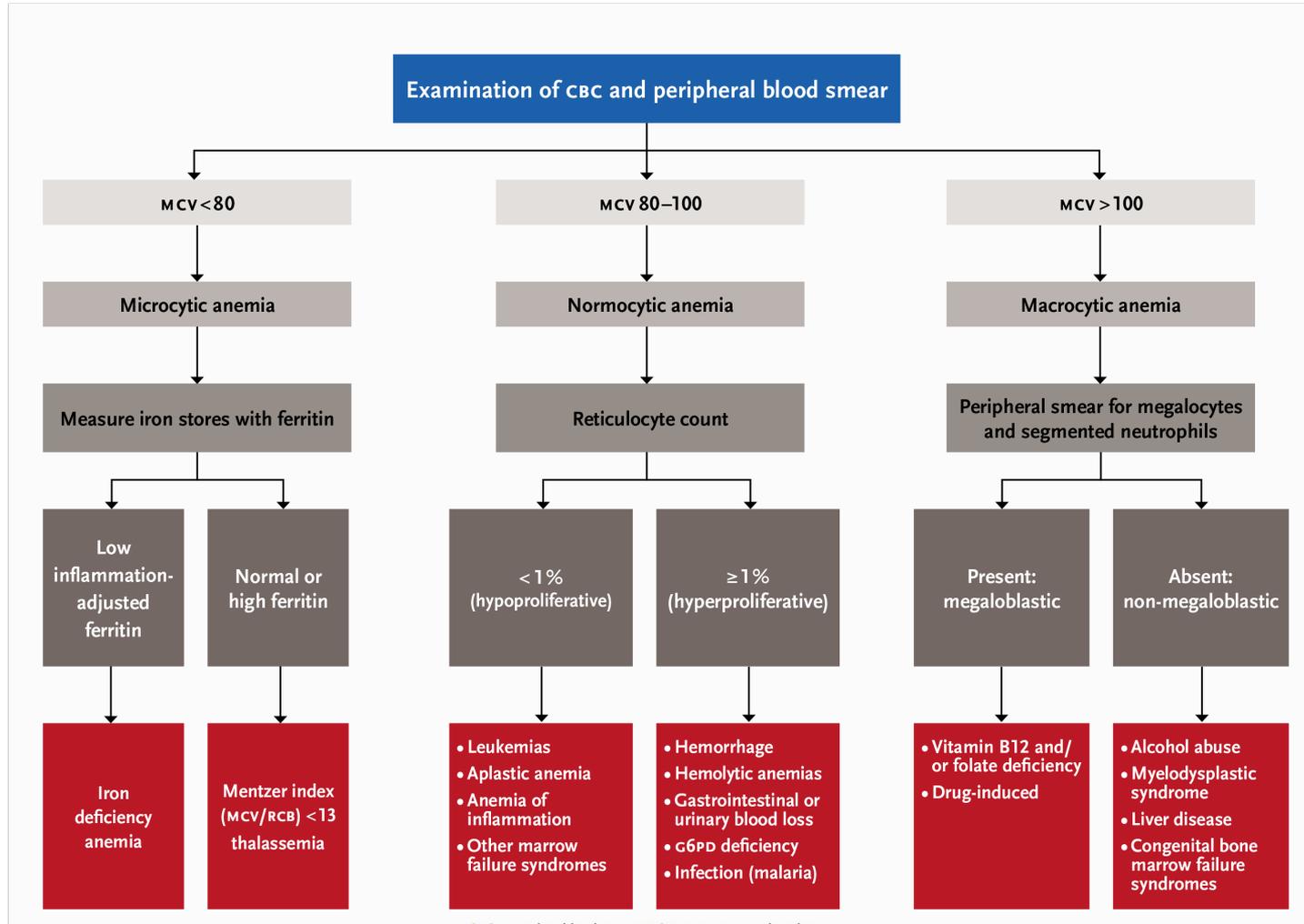
Additional Notes on the Framework

- Consider context – e.g., contribution of ground water iron
- WHO recommends assessing ferritin and inflammatory proteins (C-reactive protein, alpha-1-acid glycoprotein) for iron deficiency
- Iron program data (coverage); Infectious disease burden (parasitic – malaria, bacterial, viral); Inherited blood disorders; Environmental causes of inflammation (unimproved water or sanitation); Chronic diseases (kidney disease)
- Prevalence of uterine fibroids, heavy menses, hormonal contraception use
- Dietary pattern information (phytate-rich diet) alongside discussions with survey partners on other biomarkers (vitamin A, vitamin B12, folate)

Clinical Assessment of Anemia: Considerations

1. Frequency of measurement
 - multiple visits;
 - tests possible for additional workup
2. Based on RBC indices
 - shape, size, Hb content
3. Process of elimination and differential diagnosis

Clinical assessment of anemia in individuals



CBC—complete blood count; MCV—mean corpuscle volume;

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Utilizing Survey Data to Inform Programmatic Decision Making

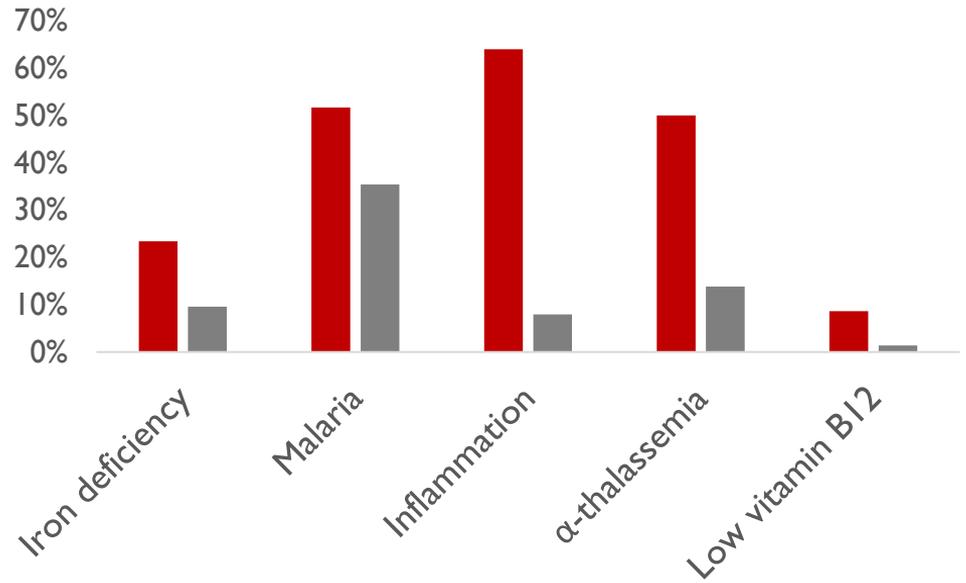
1. Malawi national survey data – public; measured inherited blood disorders, infectious diseases, and multiple micronutrients
2. Our process:
 - a) Evaluate prevalence estimates
 - b) Univariate associations b/n risk factors & anemia
 - c) Multivariable models predicting likely causes of anemia – control for overlap & interrelation between conditions
 - d) Metrics: Maximum Expected Effect; Adjusted Prevalence Ratios; Attributable Fractions to assess contributions

Utilizing Survey Data to Inform Programmatic Decision Making⁺: Explanation of Metrics

1. Maximum expected effect (an overestimate of effect):
Prevalence of anemia and the condition (e.g., iron deficiency) /
Prevalence of anemia
2. Adjusted Prevalence Ratios (aPR): (for each risk factor)
Prevalence among exposed/Prevalence among unexposed, with
adjustments for other factors
3. Attributable fraction: (for each risk factor): [*Proportion exposed*
** (aPR - 1) / (1 + proportion exposed*(aPR - 1)*]

⁺ Limitation of survey data: missing temporal (before/after) component

Maximum Estimated Effect (red) versus Attributable Fraction using adjusted prevalence ratios (gray) to estimate attribution of characteristics to address anemia in children in Malawi, 2015-16



Risk Factor (Prevalence)	Anemia Prevalence, Exposed	Anemia Prevalence, Unexposed	Prevalence Ratio	Adjusted Prevalence Ratio
Iron deficiency (16.9%)	40.2	26.9	1.5	1.6
Malaria (26.2%)	57.4	19.1	3.0	3.1
Inflammation (53.0%)	35.2	22.3	1.6	1.2
Alpha-thalassemia (42.7%)	34.1	25.4	1.3	1.4
Low vitamin B ₁₂ (5.3%)	47.0	28.1	1.7	1.3

Important Considerations and Research Needs for an Ecologic Approach to Assess and Address Anemia

- Assess all relevant causes of anemia in surveys, surveillance or program monitoring (e.g., infections, inflammation, blood loss, inherited blood disorders, micronutrient deficiencies)
 - Cost and logistical implications of broad-based anemia etiology assessment versus stepwise diagnostic algorithm
- Apply analytical methods to measure the relative contributions of multiple anemia causes in the population to inform anemia interventions
 - Statistical approaches (population attributable risk) to assess anemia etiologies using cross-sectional data
- Best practices for assessing social and structural determinants of anemia

Take Home Messages

- Anemia is itself not a disease, but a condition diverse and overlapping causes.
- Broadening the focus from predominantly iron to a better understanding of nutritional and non-nutritional anemia determinants would inform clinical care and anemia control programs.
- Adopting a practical, systematic approach to anemia assessment is essential to address data gaps and make progress on reducing the global burden of anemia.

